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Psychological and Physical Functioning Difficulties Associated with Complex Activity Limitations among U.S. Adults

Mitchell Loeb, MS* and Bruce S. Jonas, ScM PhD

Centers for Disease Control and Prevention, National Center for Health Statistics

Abstract

Background—There is limited research that assesses psychological functioning categorically as a predictor of complex activity limitations either alone or in conjunction with physical functioning.

Objectives—This paper assesses the impact of psychological and/or physical functioning difficulties as predictors of complex activity limitations among U.S. adults, using data from a national survey.

Methods—Data come from the 2006–2010 National Health Interview Survey among U.S. adults 18 or older (n=124,337). We developed a combined physical/psychological exposure variable with six categories: 1) no/low psychological distress (LPD) and absence of physical functioning difficulties, 2) moderate psychological distress (MPD) only, 3) serious psychological distress (SPD) only, 4) physical functioning difficulty only, 5) MPD and physical functioning difficulties, and 6) SPD and physical functioning difficulties. Selected complex activity limitations include daily living, social and work limitations.

Results—Compared to adults with LPD and absence of physical functioning difficulties, the results demonstrated a clear and significant gradient of increasing risk of complex activity limitations beginning with MPD only, SPD only, physical functioning difficulty only, both MPD and physical functioning difficulties, and SPD and physical functioning difficulties.

Conclusions—The data suggest a stronger risk of complex activity limitations when increasing psychological functioning difficulties coexist with physical functioning difficulties, leading to potential interference with a person's ability to accomplish major life activities measured in this study. The sizeable contribution of psychological distress to the prevalence of basic actions difficulty implies that the mental health component of functional limitations is important in the overall assessment of health and well-being.

*Corresponding author: 3311 Toledo Road, Hyattsville, MD, 20782, MLOEB@CDC.GOV.

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Disclaimer:

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Keywords

psychological functioning; physical functioning; basic actions difficulty; complex activity limitations; NHIS; K-6

Background

Disability is currently understood [1, 2, 3, 4, 5], as a complex phenomenon that embraces a bio-psycho-social paradigm and adopts a multidimensional, functional approach. The complexity of disability precludes operationalization by a single survey measure with dichotomous response options. In order to best capture its inherent complexity, disability is best represented by examining its component parts.

Disability can be understood on multiple levels, from manifestation within a person, i.e. individual capacities (basic actions difficulties) to performance in their environment (complex activity limitations). This paper focuses on two core constructs of the disability phenomenon: basic actions and complex activities; and two components within basic actions – physical and psychological functioning. Basic actions refer to specific acts of physical and mental functioning and include sensory, movement, psychological, intellectual and cognitive functioning. Complex activities represent a more complicated level of functioning and incorporate organized and multiple tasks. Traditionally, difficulties experienced performing basic actions and/or limitations in carrying out complex activities place a person in the category *disabled* [6, 7]. However, we operate under the premise that the process starts with the person's own capacities (basic actions difficulties) and then moves to performance in activities (complex activity limitations). It is clear that there is some overlap between these two constructs and moderate co-linearity would be expected. Therefore we treat basic actions difficulties as a predictor variable and complex activity limitations as an outcome variable. Within basic actions, we will address the interaction of these two components: physical and psychological functioning difficulties. In the analyses presented here, physical functioning includes indicators of sensory (seeing and hearing), movement (mobility) and cognition (remembering) difficulty that meet current criteria [2, 6, 8] and have been used extensively. Psychological functioning is operationalized using Kessler's K-6 scale [9] of psychological distress.

Research has demonstrated the associations between certain physical functioning difficulties and complex activity limitations [10]; and associations between dichotomous measures of mood disorders and complex activity limitations [11, 12, 13]. General population-based surveys [14, 15, 16] and surveys of the adult population specifically [17, 18] have assessed the co-morbidity of mood disorders and physical functioning. In an earlier paper [19] we examined the joint association between mood disorders (Major Depressive Episode, Dysthymia and Bipolar I–II disorders), physical functioning and complex activity limitations using data from Third National Health and Nutrition Examination Survey (NHANES III 1991–1994). Due to sample restrictions in those data, the paper focused on a population of young adults (17–39 years of age). There is, however, also an association between psychological and physical functioning in older age groups [20]. In order to adequately

investigate physical functioning and/or psychological functioning as predictors of complex activity limitations, it is important to address the issue of their comorbidity.

Lacking among established research is a determination of the magnitude of the association of complex activity limitations with basic actions difficulties, particularly those with psychological functioning difficulties or with co-morbid psychological and physical functioning difficulties. These associations may have important ramifications because of the potential impact of these difficulties among an aging population that is increasingly prone to chronic conditions and limitations in functional ability. This paper analyzes the impact of selected basic actions difficulties on the risk of complex activity limitations among U.S. adults, using data over several years from a national survey.

Methods

Data source and study population

Data from the 2006–2010 National Health Interview Survey (NHIS) were used for analysis [21–25]. Due to a change in the hearing question in the 2007 NHIS (the addition of a response category), data reported from 2006 are not strictly comparable with data from more recent years. This will not be immediately apparent in the combined results presented here. The impact on the results is minimal; and pertains more specifically to analyses of trend over time. For more information see: Health, United States, 2010 [26, Appendix 2, page 499]. The NHIS is a cross-sectional household survey of the civilian, non-institutionalized population of the United States, conducted annually by the National Center for Health Statistics (NCHS). Data are collected in person from a sample based on a multistage probability design. The basic module of the NHIS is a core questionnaire that consists of three main components: the Family Core, the Sample Adult Core, and the Sample Child Core. The Family Core collects information for all family members based on responses from a family respondent. The Sample Adult Core collects information from one randomly selected adult aged 18 or over in each surveyed family. Data for this analysis are from the Family Core, the Sample Adult Core, and, for poverty data, the Imputed Incomes files. For the study period (2006 through 2010) 124,337 sample adults participated in the NHIS – and while all analyses are subject to non-response on certain variables, the non-response for the elements in the analyses presented here was minimal (less than or equal to 1.0%). The average final response rate for sample adults over the five study years was 65.2%. Interviews are completed in-person. Specific weights have been established for use of multiple waves. More information on the sample design and survey characteristics of the NHIS is available at: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm

Basic Actions Difficulties: Exposure groups

Kessler's K-6 trichotomized is used as an indicator of psychological functioning [9, 27]; and as indicators of physical functioning, difficulties with mobility, vision, hearing and cognition were operationalized. Details and definitions of these indicators are available in Ancillary Online-Only Material.

By cross-classifying the indicators of psychological functioning (trichotomy) and physical functioning (dichotomy), we created one combined exposure variable with six categories defining persons with selected basic actions difficulties: 1) no/low psychological distress (LPD) and absence of physical functioning difficulties (referent group), 2) moderate psychological distress (MPD) only, 3) serious psychological distress (SPD) only, 4) physical functioning difficulty only, 5) both MPD and physical functioning difficulties, and 6) SPD and physical functioning difficulties [19, 28]. Additional details are available in Ancillary Online-Only Material.

Complex Activity Limitations: Outcome measures

Complex activity limitations are defined through the presence of daily living, social and/or work limitations. Daily living limitations include activities of daily living (ADL) [29] and instrumental activities of daily living (IADL) [30].

The presence of social limitation is determined on the basis of three NHIS questions that cover difficulties going out, difficulties participating in social, at home or leisure activities.

Inability to work (work limitation) is operationalized in NHIS as either a respondent-defined limitation in the kind or amount of work or as a complete inability to work.

Four outcome measures are assessed in this paper: daily living, social or work limitations occurring alone, and one or more of the above defining “any complex activity limitation”. Details of the questions used in determining complex activity limitations are found in the Ancillary Online-Only Material.

Socio-Demographic Characteristics

Selected socio-demographic characteristics in this study fall into the following categories: age (18–44 years, 45–64 years, 65 years and older), sex, race-ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and Other), education (less than high school, high school, some college, college graduate), marital status (married, widowed, separated/divorced, never married), health insurance status at the time of interview (insured, uninsured), and poverty income ratio (below 100%, 100 – < 125%, 125 – < 200%, 200 – < 400%, 400% or above). These categories are used in the descriptive table (Table 2). In order to minimize the effects of smaller sample sizes in certain categories on the logistic regression analyses (Table 4), the following categories have been combined: for race-ethnicity – non-Hispanic Asian and Other are combined as Other; for marital status – widowed and separated/divorced are combined as widowed/separated/divorced; and for poverty income ratio – 100 to < 125% and 125 to < 200% are combined as 100 to < 200%.

Statistical Methods

Data for this study were drawn from the NHIS (2006 – 2010) and included the non-institutionalized civilian U.S. adult population 18 years of age and over. All estimates and associated standard errors were generated using SAS [31] and SUDAAN [32], software packages designed to account for the complex sample design of the NHIS sample. All estimates were calculated using the sample adult record weight and are representative of the

U.S. non-institutionalized population of adults aged 18 years of age and over. Estimates having a coefficient of variation (CV) >30%, were considered statistically unreliable and will be so indicated. The χ^2 test of independence was used in bivariate analyses, with minimum significant p-value at <.05. Multiple logistic regression analyses were used to estimate the odds of complex activity limitations by the six category basic actions difficulties scheme, controlling for sex, age, race/ethnicity, marital status, education, poverty, and insurance status. The odds ratio (OR) with 95% confidence intervals (CIs) served to indicate a significant association; 95% CIs that exclude the value 1.0 are considered statistically significant.

Results

Disability is an umbrella term that encompasses two constructs: 1) individuals' capacities and 2) performance in activities (a function of person-context interactions). We define context-free individuals' capacities as basic actions difficulties, and performance in activities as complex activity limitations. These two constructs are moderately correlated as can be seen below in Table 1.

The Pearson correlation coefficient (2-tailed) is 0.547. This table shows the cross-tabulation of basic actions difficulties by complex activity limitations. Both measures are operationalized as dichotomous variables. Looking at basic actions difficulties by any complex activity limitation, we see that for those 38,700 respondents with basic actions difficulties, 18,184 (43.7%) have any complex activity limitation. For those 84,399 respondents without basic actions difficulties, 2,497 (2.8%) have any complex activity limitation. Theoretically this implies that these two constructs are correlated but not synonymous. Due to a combination of: the absence/presence and extent of basic actions difficulties, degree of accommodation in the persons' environment, personal resolve, among other factors, a person with basic actions difficulties may or may not have complex activity limitations. It is relevant to point out that even among those without basic actions difficulties, a small percentage have complex activity limitation. Therefore there is moderate co-linearity between basic actions difficulties and complex activity limitations. As previously discussed, based on the premise that the person's own capacities (basic actions difficulties) may or may not lead to performance in activity challenges (complex activity limitations), we therefore operationalize basic actions difficulties as our independent exposure variable and complex activity limitations as the outcome variable.

As mentioned above, psychological functioning was assessed based on a K-6 trichotomy. Those with serious psychological distress (SPD) scored highest and represented 3.1% of the population. The group previously identified as without SPD, represented about 96.9% of the population and was sub-divided into those with no/low psychological distress LPD (88.5%), and those with *moderate psychological distress* MPD (8.4%).

The proportions of persons in each of the six exposure groups appear in Table 2 (row 1). Overall, almost two thirds (63.0%) of adults had no psychological or physical functioning difficulties. (Rates among those with and without physical functioning difficulty regardless of comorbid psychological functioning difficulty were 28.6% and 71.4% respectively (not

shown)). About a fifth (18.4%) had physical functioning difficulties only, 7.6% reported MPD, less than one percent reported having SPD (0.8%), while almost eight percent (7.9%) reported having both MPD and physical functioning difficulties and a little over two percent (2.3%) reported having both SPD and physical functioning difficulties. Furthermore, among the adults with physical functioning difficulties, 35.7% also had comorbid psychological functioning difficulty (27.5% MPD and 8.2% SPD); and among adults with psychological functioning difficulty, 54.8% also had physical functioning difficulties (not shown).

Table 2 also presents the six exposure groups defined above by selected socio-demographic characteristics. Women compared to men more often reported psychological functioning difficulties only (MPD: 7.9% vs. 7.3%; SPD: 0.8% vs. 0.7%), physical functioning difficulties only (20.0% vs. 16.6%) and co-morbidity of psychological and physical functioning difficulties (MPD: 9.4% vs. 6.2%; SPD: 2.8% vs. 1.8%). The presence of psychological difficulties alone (either MPD or SPD) declined with age; however prevalence of physical functioning difficulties alone or in combination with psychological functioning difficulties increased with age. The prevalence of psychological functioning difficulties and physical functioning difficulties had an inverse association with income and education and was higher among the uninsured. The highest proportions of MPD and physical functioning difficulties occurred among widowed, separated, or divorced persons; those with less than high school education; and among those with a poverty income ratio below 125% (all between 12% and 15%). The highest proportions of SPD and physical functioning difficulties occurred among widowed persons; those with less than high school education; and among those with a poverty income ratio below 125% (all between 4% and 7%).

The prevalence rates for limitations in complex activities are: daily living 4.5%, social 7.5%, work 12.2%, and overall 14.9% (Table 3). The prevalence of complex activity limitations by basic actions difficulty exposure groups also appears in Table 3. Regardless of the type of complex activity limitation, a consistent gradient in prevalence manifested among the six exposure groups. The prevalence of complex activity limitations was highest among those with SPD and comorbid physical functioning difficulty followed in descending order by those with MPD and comorbid physical functioning difficulty, physical functioning difficulty alone, SPD alone, MPD alone and no psychological or physical functioning difficulty.

The adjusted odds ratios derived from logistic regression analyses for basic actions difficulty exposure groups (all compared to the reference group of no basic actions difficulties) and other co-variables as predictors of the four complex activity limitations outcome groups (daily living, social, work and any complex activity limitation) are presented in Table 4. Adjusted odds ratios for the basic actions difficulty exposure groups demonstrated a clear and significant gradient of increasing risk of complex activity limitations, regardless of type (daily living, social, work or any complex activity limitation), beginning with psychological functioning difficulties (MPD or SPD) only and followed by those with physical functioning difficulty only and then the combinations of psychological and physical functioning difficulty. The results for any complex activity limitation will serve as an example. Odds ratios [with 95% CI] were: 2.6 [2.4–3.0], 9.7 [7.6–12.5], 12.7 [11.8–13.5], 30.3 [28.1–32.7], 92.7 [81.6–105.2] for MPD only, SPD only, physical functioning difficulties only, physical

functioning difficulties plus MPD, and physical functioning difficulties plus SPD respectively. Gradients consistent with those demonstrated in the bivariate prevalence analyses above (see Table 3) continue to appear in the multivariate logistic regression analyses; with odds ratios for each of the basic actions difficulty exposure groups significantly higher than the reference group after controlling for all other confounders in the model. Varying patterns of association were observed among the other co-variables analyzed. There was no consistent pattern for sex. Those in the younger age group (18–44) had consistently lower odds ratios compared to 45–64 year olds for each of the outcome groups; while those 65 years of age and older were generally higher as compared to those 45–64 years old (noteworthy was the relatively high odds ratio of 2.10 observed for daily living limitation). For race/ethnicity, odds ratios for non-Hispanic Blacks were generally non-significant compared to non-Hispanic Whites; the odds ratios for Hispanics were generally lower compared to non-Hispanic Whites; the findings for “Other” was mixed. For each of the four outcome groups analyzed, there was a consistent trend seen with odds ratios increasing with decreasing levels of education attained. The same trend was also observed with respect to the poverty income ratio: odds ratios trending higher with lower poverty income ratios.

Supplemental Analyses

We also undertook a series of alternative models that could exploit the utility of a large dataset like the NHIS and further validate the work presented in the paper. These are fully described in the Ancillary Online-Only Material.

Discussion

An earlier paper by Jonas and Loeb [19] found that the percentage of young adults (age 17–39) in NHANES III (1991–1994) who reported complex activity limitations was lowest among those who reported no basic actions difficulties. This was followed, in order, by those with mood disorder alone, physical functioning difficulties alone, and finally highest among those with the co-occurrence of mood disorder and physical functioning difficulties. The current investigation confirms and expands this finding in several aspects. Specifically, this investigation uses recent survey data (2006–2010) from a larger sample (approximately 124,000 sample adults) of a different major health survey (NHIS). In addition, all aged adults (18+ years) are analyzed. Outcome measures include any complex activity limitation and its three components (daily living, social and work limitations) all of which are analyzed. Finally, psychological functioning is examined as an ordinal level variable (operationalized as a trichotomy) allowing for a combined physical/psychological exposure variable with six categories. This six category scheme allows for extended assessment of potential risk gradients between levels of physical and psychological functioning as predictors of complex activity limitations. This is particularly revealing regarding intermediate levels of psychological functioning difficulty only or in conjunction with physical difficulty. Such intermediate levels of psychological functioning difficulty are often referred to as subsyndromal.

Subsyndromal depression (SSD) is traditionally defined in patients as having had some of the characteristics of a clinically relevant depressive condition without meeting criteria for a full-blown unipolar major depressive disorder (MDD). Evidence indicates that SSD is common [28]. SSD has been associated with loss of productivity [33–38], absenteeism and presenteeism (referring to persons at work, but distracted) [39] and societal and economic burden [40–42]. Further, during the long term course of illness, research indicates that patients with unipolar MDD spent three times as many weeks with SSD symptoms compared to MDD symptoms [43]. Thus unipolar depression is expressed symptomatically along a dimensional continuum of depressive symptom severity in which depressive subtypes (e.g. MDD, SSD) are phases of illness intensity that fluctuate in the same patient over time.

With respect to functional impairment, SSD had elevated rates in some studies [44–46] while others do not confirm the association [47, 48]. However, these studies have been conducted in clinical and other select populations. In the current study, the percentage of adults who reported complex activity limitations was lowest among those who reported no basic actions difficulties (no psychological or physical functioning difficulty) followed, in increasing order, by those with MPD only, SPD only, physical functioning difficulties alone, and finally those with the co-occurrence of MPD then SPD and physical functioning difficulties. Results from the multivariate models indicated that similar gradient patterns were observed in all complex activity limitation outcome measures assessed: daily living, social or work limitation or any complex activity limitation. With few exceptions (the odds ratio of 4.1 among those in the lowest poverty income ratio group under the work limitation outcome) the effect size of the odds ratios for the basic actions difficulty exposure groups were substantially higher than any other odds ratios for the set of covariates included in the multivariate models. Overall, effect sizes for the basic actions difficulty exposure groups ranged from 1.2 to 216.2; and even for the exposure group *MPD only*, effect sizes ranged from 1.2 to 4.5, exceeding the odds ratios for most other co-variable categories. This is indicative of the relative importance of psychological and physical functioning (controlling for other socio-demographic background variables) as predictors of limitations in complex activities.

Our investigation confirms that psychological functioning difficulty either alone or in conjunction with physical functioning difficulties demonstrated a consistent risk gradient with respect to any complex activity limitation and each of its three components. With respect to our exposure variable, even starting with MPD alone as compared to the reference group of no difficulty, the odds ratio effect size is substantial. Moving through the exposure variable to SPD and physical functioning difficulty the effect sizes increase dramatically. Therefore, the exposure variable gradient defined here is strongly associated with the outcome variables defining complex activity limitations. Furthermore, the risk of SPD alone is in a similar order of magnitude as physical functioning difficulty alone, a finding that we believe is relatively new.

A series of supplemental models were conducted to further investigate the associations of basic actions difficulties on complex activity limitations. Basic actions difficulties were disaggregated into movement, sensory and cognitive elements, each of these were

significantly associated with complex activity limitations and for severe and moderate mobility a risk gradient was observed. When crossed with psychological functioning each of these elements confirmed significant associations and risk gradients with SPD, MPD and LPD. Disaggregating daily living limitations revealed similar risk gradients with the exception that for IADL MPD alone was non-significant and for ADL both MPD and SPD alone was non-significant. By trichotomizing physical functioning difficulties, a risk gradient was observed for increasing levels of physical functioning difficulties (no/mild, moderate, severe) and for increasing levels of psychological functioning difficulties (LPD, MPD, SPD). It is notable that there is some overlap in the effect sizes. For example, moderate physical functioning difficulty and SPD (OR=33.1) is higher than severe physical functioning difficulty and LPD (OR=26.7). Similarly no/mild physical functioning difficulty and SPD (OR=8.9) is higher than moderate physical functioning difficulty and LPD (OR=5.0). This verifies the interactive nature of these two components of basic actions difficulties. Additionally it shows the relative importance of increasing levels psychological functioning difficulties on complex activity limitations when modelled with finer definitions of physical functioning difficulties. In summary, these supplemental models confirmed the trends established in our main analyses.

Strengths of this study include the NHIS data (2006–2010) which provide a wide range of standardized, well-measured variables for a large, nationally representative non-institutionalized population base. The use of all waves (2006 through 2010) was necessary due to the combination exposure variable (difficulties in physical and psychological functioning), the extensive list of covariates, the use of three specific outcome categories for complex activity limitations in addition to the fourth (any complex activity limitations). All of these analytical components needed to be considered to ensure estimate stability and reasonable standard errors (i.e. reasonable relative standard errors) particularly when conducting multiple logistic regression analyses (see Table 4, ORs and CIs).

In addition, the focus of this research was on all adults 18 years of age and older. Both of these represent improvements over our earlier study that focused on young adults in the NHANES III (1991–1994). Results from this study both confirm and expand upon our earlier findings. An additional strength of this study is the availability of a set of physical functioning indicators (seeing, hearing and movement) that meets current criteria and that has been used extensively [2, 8]. The use of the K-6 trichotomy in the determination of psychological functioning difficulty is, as we have argued above, an improvement over the K-6 dichotomy. However, the K-6 is but one of several measures of psychological functioning difficulty. Since research remains unclear on the potential impact of psychological difficulties on complex activity limitations, we believe the inclusion of the K-6 trichotomy as an indicator of psychological distress and a component of basic actions difficulty to be an asset.

The association between difficulties in basic physical and psychological functioning and complex activity limitations has not been well established. Furthermore, the use of moderate psychological distress in analytic studies is rare. In addition, we have included, in supplemental models, a variety of modeling alternatives to our exposure variable. One of these is gradations for physical functioning difficulties.

These two constructs, basic actions difficulty and complex activity limitations, are moderately correlated as can be seen in Table 1. The large odd's ratios are a result of designing an exposure variable (combining physical and psychological functioning difficulties) that shows a large risk gradient for complex activity limitations. This can be seen descriptively in Table 3 comparing prevalence (e.g. for any complex activity limitations – no/low psychological distress (LPD) and absence of physical functioning difficulties =2.3% vs. SDP and physical functioning difficulties=78.0%). The large ORs are a result of comparing each of the five exposure categories (MPD only, SPD only, physical functioning difficulties only, MDP and physical functioning difficulties, SDP and physical functioning difficulties) to the reference group of no/low psychological distress (LPD) and absence of physical functioning difficulties.

A limitation of this study is that the basic actions difficulty domains operationalized here (seeing, hearing, upper/lower body mobility, and psychological functioning difficulties), are neither comprehensive nor exhaustive. Though not captured here, aspects of upper body functioning, communication and learning may also form one aspect of basic action domains. Table 3 shows, for example, that among those with no recorded basic actions difficulties 2.3% have some form of complex activity limitation. This may be an indication of the existence of basic actions difficulties that are not being measured using the methodology we propose. Similarly, more complex activity domains exist than are analyzed in this report. One's ability to interact with others in different social situations and one's degree or level of participation in society (through education for example) may be another aspect of complex activities domains. Accepting that the selected basic actions and complex activity domains delineated here were not exhaustive, we believe, that they are still among the major indicators of psychological and physical functioning difficulties and limitations experienced by the adult population. Replication of results in other populations using other domains will await further research.

Furthermore, specific basic actions difficulties are not mutually exclusive; for example a person with hearing difficulties may also have communication difficulties; or a person with seeing difficulties may also experience mobility difficulties. This added dimension underlines the importance of future research in examining co-morbidities or the co-occurrence of specific difficulties in basic actions in assessing their impact on limitations in complex activities. Similarly selected indicators of complex activity limitations, daily living, social and work limitations are not mutually exclusive. Rather than exploring these aforementioned co-occurrences of basic actions difficulties and complex activity limitations, we have chosen, in this report, to analyze the broader categorizations and, focus more specifically, on the co-occurrences of extended psychological and physical functioning difficulties in order to fill a particular gap in the literature. Using this approach, we were able to provide stable statistical estimation with respect to the basic actions difficulties six category scheme.

Another potential limitation of this study is that the estimates of physical functioning difficulties (with the exception of seeing) are assessed without accommodation. (See Indicators of Physical Functioning, page 6 above.) This was chosen based on the wording of questions in the NHIS. Estimates of physical functioning difficulties (in this case mobility

and hearing) without accommodation may be higher than concurrent estimates with accommodation. Investigating these limitations with accommodation would be a topic for future research.

Despite the constraints and challenges outlined above, the findings in this paper offer several conclusions and potential implications. First, over one-third of adults have basic actions difficulty (36% have psychological and/or physical functioning difficulties). Second, among adults with basic actions difficulty, 37.4% have psychological difficulties (MPD-26.8% or SPD-10.6%). Third, 14.9% of adults have a complex activity limitation (4.5% daily living limitation, 7.5% social limitation, and 12.2% work limitation). Finally, the risk of complex activity limitations is elevated for those with MPD only, SPD only, physical functioning difficulties only and even greater for those with both psychological (MPD, SPD) and physical functioning difficulties. The sizeable contribution of psychological distress to the prevalence of basic actions difficulty implies that the mental health component of functional limitations is important in the overall assessment of health and well-being. This implication seems further substantiated in light of the larger risks of complex activity limitations associated with the co-occurrence of psychological and physical functioning difficulty. A possible area for future research could explore coordinated efforts to reduce physical and psychological functioning difficulties and therefore potentially facilitate the accomplishment of complex activities. We believe that the results of this study support the bio-psycho-social approach to disability measurement that is currently being proposed [1, 2, 3, 49].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Basic Actions Difficulty (Dichotomous) by Any Complex Activity Limitation (Dichotomous): National Health Interview Survey (NHIS) - (2006–2010)

Basic Actions Difficulty		Any Complex Activity Limitation		
		No	Yes	Total
Yes	n	20516	18184	38700
	weighted Row %	56.3	43.7	100
No	n	81902	2497	84399
	weighted Row %	97.2	2.8	100
Total		102418	20681	123099

Pearson Correlation Coefficient: 0.55; $p < 0.001$

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Table 2
 Basic Actions Difficulty Exposure Groups by Socio-Demographic Characteristics: National Health Interview Survey (NHIS) - (2006–2010)

	Basic Actions Difficulty Exposure Groups																			
	No/LPD ¹ OR physical functioning difficulties			MPD ² only			SPD ³ only			Physical functioning difficulties only			MPD and Physical functioning difficulties			SDP and Physical functioning difficulties				
	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	p-value	
Distribution of Exposure Groups	63.0	0.2	7.6	0.1	0.8	0.0	18.4	0.2	7.9	0.1	2.3	0.1	0.1	0.1	2.3	0.1	0.1	0.1		
Sex																				
Male	67.3	0.3	7.3	0.2	0.7	0.0	16.6	0.2	6.2	0.1	1.8	0.1	0.1	0.1	1.8	0.1	0.1	0.1	<0.001	
Female	59.1	0.3	7.9	0.1	0.8	0.0	20.0	0.2	9.4	0.2	2.8	0.1	0.2	0.2	2.8	0.1	0.1	0.1		
Age																				
18–44	72.6	0.3	11.0	0.2	1.1	0.1	8.3	0.2	5.2	0.1	1.7	0.1	0.1	0.1	1.7	0.1	0.1	0.1	<0.001	
45–64	59.8	0.4	5.4	0.1	0.5	0.1	21.1	0.2	9.8	0.2	3.4	0.1	0.2	0.2	3.4	0.1	0.1	0.1		
65+	41.1	0.4	2.1	0.1	0.2	0.0	42.9	0.4	11.7	0.3	2.1	0.1	0.3	0.3	2.1	0.1	0.1	0.1		
Race-Ethnicity																				
Non-Hispanic white	61.3	0.3	7.3	0.1	0.7	0.0	20.1	0.2	8.2	0.2	2.4	0.1	0.2	0.2	2.4	0.1	0.1	0.1	<0.001	
Non-Hispanic black	61.7	0.5	8.5	0.3	1.0	0.1	17.7	0.4	8.4	0.3	2.7	0.2	0.3	0.3	2.7	0.2	0.2	0.2		
Hispanic	69.1	0.4	8.5	0.2	1.0	0.1	12.6	0.3	6.6	0.2	2.2	0.1	0.2	0.2	2.2	0.1	0.1	0.1		
Non-Hispanic Asian	77.3	0.8	7.2	0.4	0.6	0.2	10.5	0.5	3.4	0.4	0.9	0.2	0.4	0.4	0.9	0.2	0.2	0.2		
Other	68.2	1.0	7.5	0.5	0.6	0.1	14.3	0.9	7.2	0.5	2.1	0.3	0.5	0.5	2.1	0.3	0.3	0.3		
Marital Status																				
Married	65.9	0.3	6.6	0.1	0.6	0.0	18.1	0.2	7.0	0.1	1.9	0.1	0.1	0.1	1.9	0.1	0.1	0.1	<0.001	
Widowed	52.7	0.5	7.8	0.2	1.2	0.1	21.3	0.4	12.3	0.3	4.7	0.2	0.3	0.3	4.7	0.2	0.2	0.2		
Divorced or Separated	33.7	0.6	3.6	0.2	0.4	0.1	44.0	0.6	14.7	0.4	3.5	0.2	0.4	0.4	3.5	0.2	0.2	0.2		
Never married	68.6	0.4	11.9	0.3	1.2	0.1	10.3	0.2	5.9	0.2	2.1	0.1	0.2	0.2	2.1	0.1	0.1	0.1		
Education																				
Less than High School	51.0	0.6	7.5	0.3	1.0	0.1	23.1	0.4	12.5	0.3	4.9	0.2	0.3	0.3	4.9	0.2	0.2	0.2	<0.001	
High School graduates	59.3	0.4	7.6	0.2	0.9	0.1	20.1	0.3	9.3	0.2	2.8	0.1	0.2	0.2	2.8	0.1	0.1	0.1		
Some college	63.0	0.3	8.8	0.2	0.8	0.1	17.7	0.3	7.6	0.2	2.1	0.1	0.2	0.2	2.1	0.1	0.1	0.1		
College graduate	73.9	0.4	6.5	0.2	0.4	0.0	14.5	0.3	4.0	0.2	0.7	0.0	0.2	0.2	0.7	0.0	0.0	0.0		
Poverty income ratio																				

Basic Actions Difficulty Exposure Groups

	No/LPD ¹ OR physical functioning difficulties		MPD ² only		SPD ³ only		Physical functioning difficulties only		MPD and Physical functioning difficulties		SDP and Physical functioning difficulties		p-value
	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]	
Below 100%	50.2	0.6	10.4	0.3	1.7	0.1	18.2	0.4	13.2	0.3	6.2	0.2	<0.001
100%-less than 125%	51.3	0.8	8.5	0.5	1.3	0.2	21.3	0.6	13.0	0.5	4.6	0.3	
125%-less than 200%	54.6	0.5	8.7	0.3	1.0	0.1	21.6	0.4	10.8	0.3	3.3	0.2	
200%-less than 400%	62.7	0.4	7.5	0.2	0.7	0.1	19.5	0.3	7.8	0.2	1.8	0.1	
400% or above	71.9	0.3	6.3	0.2	0.4	0.0	16.0	0.2	4.5	0.1	0.8	0.1	
Insurance													
Insured	62.7	0.3	6.8	0.1	0.6	0.0	19.8	0.2	7.9	0.1	2.2	0.1	<0.001
Uninsured	64.7	0.4	11.5	0.3	1.6	0.1	11.3	0.3	7.9	0.2	3.0	0.1	

[†] Standard error

¹ No/low psychological distress

² Moderate psychological distress

³ Serious psychological distress

Table 3
Complex Activity Limitations by Basic Actions Difficulty Exposure Groups: National Health Interview Survey (NHIS) - (2006–2010)

	Daily living Limitation		Social Limitation		Work Limitation		Any Complex Activity Limitation	
	%	SE [†]	%	SE [†]	%	SE [†]	%	SE [†]
Distribution of Complex Activity Outcome Measures	4.5	0.1	7.5	0.1	12.2	0.2	14.9	0.2
No/LPD ¹ OR physical functioning difficulties	0.3	0.0	0.2	0.0	2.1	0.1	2.3	0.1
MPD ² only	0.7	0.1	1.9	0.2	5.3	0.3	6.9	0.3
SPD ³ only	1.6	0.4	11.4	1.4	15.3	1.7	22.3	1.9
Physical functioning difficulties only	10.9	0.3	16.5	0.3	28.0	0.4	35.2	0.4
MPD and Physical functioning difficulties	17.9	0.5	33.5	0.6	44.5	0.6	54.4	0.6
SDP and Physical functioning difficulties	30.2	1.1	57.0	1.1	66.1	1.0	78.0	0.9
p-value	<0.001		<0.001		<0.001		<0.001	

[†] Standard error

¹ No/low psychological distress

² Moderate psychological distress

³ Serious psychological distress

Table 4 Odds ratios (95% CI) for Logistic Regression analyses of Complex Activity Limitations by Basic Actions Difficulty Exposure Groups controlling for Socio-Demographic Characteristics: National Health Interview Survey (NHIS) - (2006–2010)

	Complex Activity Limitations							
	Daily living Limitation		Social Limitation		Work Limitation		Any Complex Activity Limitation	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
No/LPD ¹ or physical functioning difficulties ^a		referent		referent		referent		referent
MPD ² only	1.2	0.9–1.7	4.5	3.5–5.8	2.2	1.9–2.5	2.6	2.4–3.0
SPD ³ only	2.6	1.6–4.5	28.5	21.1–38.5	6.5	5.0–8.6	9.7	7.6–12.5
Physical functioning difficulties only	11.5	10.1–13.1	29.9	25.6–34.8	10.6	9.8–11.4	12.7	11.8–13.5
MPD and Physical functioning difficulties	23.5	20.6–26.7	80.2	68.7–93.6	22.4	20.8–24.2	30.3	28.1–32.7
SPD and Physical functioning difficulties	51.1	43.3–60.3	216.2	181.5–257.6	53.8	47.8–60.5	92.7	81.6–105.2
Sex								
Male ^a		referent		referent		referent		referent
Female	1.1	1.0–1.2	1.1	1.0–1.2	0.7	0.7–0.7	0.8	0.7–0.8
Age								
18–44	0.6	0.5–0.6	0.6	0.6–0.7	0.4	0.4–0.4	0.4	0.4–0.5
45–64 ^a		referent		referent		referent		referent
65+	2.2	2.1–2.4	1.3	1.2–1.4	0.9	0.8–1.0	1.3	1.2–1.4
Race-Ethnicity								
Non-Hispanic white ^a		referent		referent		referent		referent
Non-Hispanic black	1.2	1.1–1.3	1.0	0.9–1.1	1.0	0.9–1.1	1.0	1.0–1.1
Hispanic	0.9	0.8–1.0	0.8	0.7–0.9	0.6	0.5–0.6	0.6	0.6–0.7
Other	0.9	0.7–1.1	1.0	0.8–1.1	0.7	0.6–0.8	0.8	0.7–0.9
Marital Status								
Married ^a		referent		referent		referent		referent
Widowed/Separated/Divorced	2.0	1.8–2.1	1.2	1.1–1.3	1.6	1.5–1.7	1.5	1.4–1.6
Never married	2.6	2.3–2.9	1.1	1.0–1.2	1.7	1.6–1.8	1.6	1.5–1.7
Education								

	Complex Activity Limitations											
	Daily living Limitation		Social Limitation		Work Limitation		Any Complex Activity Limitation					
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Less than High School	1.2	1.1-1.4	1.4	1.3-1.6	1.6	1.5-1.8	1.7	1.6-1.9	1.7	1.6-1.9	1.7	1.6-1.9
High School	1.1	1.0-1.3	1.2	1.1-1.3	1.4	1.3-1.5	1.4	1.3-1.5	1.4	1.3-1.5	1.4	1.3-1.5
Some college	1.0	0.8-1.1	1.1	1.0-1.2	1.2	1.1-1.3	1.2	1.1-1.3	1.2	1.1-1.3	1.2	1.1-1.3
College Graduate ^a	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
Poverty income ratio												
Below 100%	2.3	2.0-2.6	2.2	2.0-2.5	4.1	3.7-4.5	3.8	3.4-4.2	3.8	3.4-4.2	3.8	3.4-4.2
100%-less than 200%	1.9	1.7-2.1	1.9	1.8-2.1	2.7	2.5-3.0	2.5	2.3-2.8	2.5	2.3-2.8	2.5	2.3-2.8
200%-less than 400%	1.2	1.1-1.4	1.5	1.3-1.6	1.7	1.6-1.8	1.6	1.5-1.8	1.6	1.5-1.8	1.6	1.5-1.8
400% or above ^a	Referent	Referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
Insurance												
Insured ^a	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
Uninsured	0.3	0.3-0.4	0.6	0.5-0.6	0.5	0.4-0.5	0.5	0.5-0.6	0.5	0.4-0.5	0.5	0.5-0.6
Model Statistics	F ^b (df)	p-value	F ^b (df)	p-value	F ^b (df)	p-value	F ^b (df)	p-value	F ^b (df)	p-value	F ^b (df)	p-value
	338.5 (20)	<0.001	351.7 (20)	<0.001	667.3 (20)	<0.001	833.9 (20)	<0.001	833.9 (20)	<0.001	833.9 (20)	<0.001

¹No/low psychological distress

²Moderate psychological distress

³Serious psychological distress

^aReference group for statistical analyses

^bWald F test