**Indicators of Psychological Functioning**

Psychological functioning is measured using the K-6 serious psychological distress scale [9]. The K-6 asked respondents to consider the one month in the past 12 months when they were at their worst emotionally and to self-report how frequently they experienced the following six symptoms: felt nervous, hopeless, restless or fidgety, worthless, depressed, and felt that everything was an effort [9]. Each of the 6 questions that make up the K-6 has 5 response categories: (0) none of the time, (1) a little of the time, (2) some of the time, (3) most of the time, (4) all of the time. The K-6 has traditionally been analyzed as a dichotomy with scores (summation over the 6 items) of 13+ defined as *serious psychological distress* (SPD) and scores of 0-12 as without *serious psychological distress*. However the K-6 scale represents a continuous distribution of psychological distress ranging from none (0) to very severe (24). We have chosen to trichotomize the K-6. In addition to the traditional, more severe group (SPD), we define a group as *no or low psychological distress* (LPD) with scores between 0 and 4 inclusive and an intermediate group as *moderate psychological distress* (MPD) with scores between 5 and 12 inclusive. The rationale for constructing this trichotomy is that there exists a sub-group of individuals with subsyndromal levels of psychological distress distinct from those with either serious psychological distress (SPD) or low levels of psychological distress (LPD). This intermediate group, i.e., those with *moderate psychological distress* (MPD), is defined as those who scored 5-12 on the K-6 scale. The utility of an intermediate group that operationalizes moderate psychological distress has been previously validated [27]. The upper group scoring 13 through 24 (SPD) remains the same as traditionally defined using the K-6 dichotomy. In this paper, the assessment of psychological functioning from the K-6 is based on a psychological symptoms checklist that measures general psychological distress. It is not synonymous with meeting criteria for a specific mood disorder (e.g. major depressive episode) which is based on a psychiatric interview schedule. [19] Throughout this paper the terminology *psychological functioning* is used as the operationalization of *psychological distress* as defined using the K-6.

**Indicators of Physical Functioning**

 Participants’ responses to a series of questions about difficulty performing a series of basic physical actions identified whether they had any of the selected sensory, movement and/or cognition difficulties. We classified respondents as having a movement limitation if, when they are by themselves and without the use of aids, they reported that they have difficulty walking for a quarter of a mile, walking up 10 steps, standing or remaining on their feet for about 2 hours, sitting for 2 hours, stooping/crouching/kneeling, reaching over their head, using fingers to grasp or handle small objects, or lifting/carrying something as heavy as 10 pounds. Response options are: *not at all difficult, only a little difficult, somewhat difficult, very difficult,* and *cannot do at all*. Those who responded *somewhat, very* or *cannot do at all* were considered as having a movement limitation. If respondents reported blindness or trouble seeing even when wearing corrective lenses we classified them as having a visual limitation. Similarly, we classified respondents as having a hearing limitation if they reported deafness or a lot of trouble hearing without a hearing aid. If a respondent reported being limited in any way because of difficulty remembering or because they experience periods of confusion they were classified with a cognition limitation. Self-reported limitations performing one or more of the eight motor actions listed above, or the classification as having a visual or hearing limitation, or a cognition limitation indicated the presence of a Physical Functioning Difficulty (dichotomous variable).

**Basic Actions Difficulties: Exposure groups**

Having no/low psychological distress (LPD) and absence of physical functioning difficulties implies lesser risk than the five remaining categories and is therefore the referent group. Regarding the order in which we present these categories, we postulate that they represent a risk gradient with complex activity limitations. The rationale for this gradient is as follows. From available research [28] it is clear that MPD alone represents a lesser level of psychological distress than SPD alone and therefore a lesser risk for complex activity limitations. Our decision to place SPD alone lower on the risk gradient scale than physical functioning difficulty alone is based on prior research [19]. In that paper, the assessment of psychological functioning was restricted to the absence or presence of mood disorders based on a psychiatric interview schedule, and results indicated that those with mood disorders alone were at lesser risk than those with physical functioning difficulty alone. Further, the combination of psychological and physical difficulties was associated with the highest risk of complex activity limitations. Additional logistic regression analyses included an overall model including physical functioning, psychological functioning and interaction of physical and psychological functioning all of which were significantly associated with complex activity limitations.

**Complex Activity Limitations: Outcome measures**

**Daily living limitations** include activities of daily living (ADL) [29] and instrumental activities of daily living (IADL) [30]. As operationalized in this paper, ADLs and IADLs represent different levels of activities that are more complex than basic actions. Though ADLs are sometimes referred to as ‘basic’, each of the basic actions defined in the preceding section represents a single action or task, whereas the ADLs defined in the question operationalized for this paper requires a certain amount of coordinated action in order to complete successfully:

*Because of a physical, mental, or emotional problem, [do you/does anyone in the family] need the help of other persons with PERSONAL CARE NEEDS, such as eating, bathing, dressing, or getting around inside this home?*

Similarly, the IADLs are defined according to the following question:

*Because of a physical, mental, or emotional problem, do [you/any of these family members] need the help of other persons in handling ROUTINE NEEDS, such as everyday household chores, doing necessary business, shopping, or getting around for other purposes?*

These routine IADL needs are also complex in nature and the coordination of several basic actions (movement, sensory and cognitive function) is required for their successful completion.

An affirmative, *Yes*, response to either ADLs or IADLs was indicative of a daily living limitation.

The presence of **social limitation** is determined on the basis of three NHIS questions:

‘‘By yourself, and without using any special equipment, how difficult is it for you to

* Go out to things like shopping, movies, or sporting events?
* Participate in social activities such as visiting friends, attending clubs and meetings, going to parties?
* Do things to relax at home or for leisure (reading, watching TV, sewing, listening to music)?’’

Response options were: *not at all difficult, a little difficult, only somewhat difficult, very difficult,* or *can’t do at all*. A social limitation was recorded for those who responded *somewhat difficult, very difficult,* or *cannot do at all* for any of the three questions.

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. Two questions are used to identify this status:

* ‘‘Does a physical, mental, or emotional problem NOW keep {you/anyone in the family (age 18+)} from working at a job or business?’’

If not yes:

* ‘‘{Are/any of these family members} limited in the kind OR amount of work {you/they} can do because of a physical, mental or emotional problem?’’

A positive, *Yes*, answer on either question was indicative of a work limitation.

**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. Unless otherwise specified, in all cases the alternative models make use of the outcome variable “Any Complex Activity Limitation” and adjust for all co-variates previously described. Descriptions and analyses of these supplemental models follow.

1. Disaggregating Basic Action Difficulties:

The following models address each of the basic action elements individually to order assess the predictive validity of each: mobility as a trichotomy[[1]](#footnote-1) and sensory and cognition each as dichotomies. With Any Complex Activity Limitation as the outcome variable, the odds ratios [with 95% CI] were: 5.9 [5.5-6.4] for moderate mobility difficulty and 32.0 [30.1-34.2] for severe mobility difficulty compared to no/mild mobility difficulty; and in separate analyses, 3.5 [3.3-3.7] and 40.5 [35.2-46.6] for sensory and cognitive difficulties respectively.

Additional analyses were conducted crossing each of these three elements with psychological functioning. With Any Complex Activity Limitation as the outcome variable and adjusting for co-variates, the odds ratios [with 95% CI] were:

Mobility - For severe mobility difficulties: 148.2 [125.2-175.4], 53.2 [48.2-58.7] and 24.6 [24.7-28.9] for SPD, MPD and LDP respectively. For moderate mobility difficulties the odds ratios were: 29.9 [23.6-37.9], 10.9 [9.7-12.3] and 4.9 [4.5-5.4] for SPD, MPD and LDP respectively. For no/mild mobility difficulties the odds ratios were: 10.3 [8.6-12.4] and 2.7 [2.5-3.0] for SPD and MPD respectively. (No/mild mobility difficulty and LPD was the referent group.)

Sensory - For sensory difficulties the odds ratios were: 28.9 [24.2-34.4], 8.6 [7.9-9.5] and 2.8 [2.7-3.0] for SPD, MPD and LDP respectively. For no sensory difficulties the odds ratios were: 16.3 [14.4-18.5] and 4.0 [3.8-4.3] for SPD and MPD respectively. (No sensory difficulty and LPD was the referent group.)

Cognitive- For cognitive difficulties the odds ratios were: 248.6 [160.6-384.9], 74.9 [58.6-95.8] and 30.0 [24.4-36.8] for SPD, MPD and LDP respectively. For no cognitive difficulties the odds ratios were: 12.7 [11.3-14.3] and 3.8 [3.6-4.0] for SPD and MPD respectively. (No cognitive difficulty and LPD was the referent group.)

1. Disaggregating Daily Living Limitations:

Our original analyses combined ADLs and IADLs into a single outcome variable: Daily Living Limitations. To investigate the individual attributes of these outcome components it was thought relevant to address ADLs and IADLs separately as outcomes of the same predictors presented in Table 4. These analyses revealed the same significant gradient of increasing risk of complex activity limitation.

The odds rations [with 95% CI] for IADLs alone were: 1.2 [0.8-1.8], 2.9 [1.7-4.9], 12.6 [11.0-14.4], 25.9 [22.6-29.6], and 49.8 [42.1-59.0] for MPD only, SPD only, physical functioning difficulties only, physical functioning difficulties plus MPD, and physical functioning difficulties plus SPD respectively.

Similar results were found for ADLs alone as outcome variable. The odds rations [with 95% CI] for ADLs alone were: 1.1 [0.6-2.2], 1.2 [0.3-4.3], 10.2 [8.4-12.3], 22.5 [18.4-27.5], and 42.1 [34.3-51.8] for MPD only, SPD only, physical functioning difficulties only, physical functioning difficulties plus MPD, and physical functioning difficulties plus SPD respectively.

As with the model presented in Table 4, in neither of these models did MPD alone achieve statistical significance; nor did SPD alone in the ADL model.

1. Trichotomizing Physical Functioning Difficulties:

The data in the NHIS allow for the creation of more finely differentiated basic actions difficulty exposure groups. We were able to create a trichotomy of physical functioning difficulty[[2]](#footnote-2) and combine that with the K-6 trichotomy to create nine exposure groups. Adjusting for co-variates the odds ratios [with 95% CI] for severe physical functioning difficulties were: 165.1 [139.8-195.0], 61.3 [55.8-67.5] and 26.7 [24.7-28.9] for SPD, MPD and LDP respectively. For moderate physical functioning difficulties the odds ratios were: 33.1 [27.1-40.3], 10.9 [9.9-12.2] and 5.0 [4.6-5.4] for SPD, MPD and LDP respectively. For no/mild physical functioning difficulties the odds ratios were: 8.9 [6.9-11.4] and 2.5 [22.2-2.8] for SPD and MPD respectively. (No/mild physical functioning difficulty and LPD was the referent group.)

1. Those who responded *very difficult* or *cannot do at all* to any of the 8 mobility items (see Indicators of Physical Functioning above) were classified as having a severe physical functioning difficulty. Those who responded *somewhat* to the mobility items were classified as having a moderate physical functioning difficulty. Anyone reporting only *a little* or *no difficulty at all* with the mobility items was classified as having no/slight physical functioning difficulty. [↑](#footnote-ref-1)
2. Those who responded very difficult or cannot do at all to any of the 8 mobility items (see Indicators of Physical Functioning above) or who reported either a lot of trouble hearing or that they were deaf or reported being blind were classified as having a severe physical functioning difficulty. Those who responded somewhat to the mobility items or moderate difficulty to the hearing question or yes to the vision question were classified as having a moderate physical functioning difficulty. Anyone reporting only a little or no difficulty at all with the mobility items and no vision difficulty and hearing that was excellent, good or only caused a little trouble was classified as having no/slight physical functioning difficulty. [↑](#footnote-ref-2)