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TEASING APART THE COMPLEX RELATIONSHIP BETWEEN  
PSYCHOLOGICAL DISTRESS, MENTAL HEALTH CONDITIONS, SOCIAL  
FACTORS, AND DISABILITY IN THE UNITED STATES

By

ERIC ANDREW LAUER

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Written under the direction of

Dona Schneider

And approved by

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## ABSTRACT OF THE DISSERTATION

Teasing Apart the Complex Relationship Between Psychological Distress, Mental Health  
Conditions, Social Factors, and Disability in the United States

By ERIC ANDREW LAUER

Dissertation Director:

Dona Schneider

**Context:** In the United States, more than 50 million people experience mental illness and disabilities. However, despite research suggesting improved mental health is associated with disability prevention, there has been limited study of mental health indicators and standardized disability identifiers included in national surveys for public health surveillance efforts. Moreover, studies are complicated by the fact that functional limitations are common to both mental disorders and disabilities and it is unclear how well mental health symptoms, function, and disability are differentiable in population-based studies.

**Specific Aims:** The goals of this dissertation were to (1) examine the association between non-specific psychological distress (NSPD), duration of activity limitations due to mental health conditions (ALMH), and the function and activity difficulties used to identify people with disabilities in U.S. national surveys (Study 1); (2) determine the risk of experiencing disabilities among people reporting combinations of NSPD or ALMH to test if mental health symptoms and conditions could be distinguished (Study 2); and (3) measure the association between mental health, social determinants of health (SDH), and

cognitive disability and identify groups with distinct conceptual and empirical differences across measures (Study 3).

**Methods:** 2008-2015 National Health Interview Survey data was used to (1) estimate the risk of disabilities among people reporting NSPD or ALMH (Study 1), (2) estimate risk of disabilities across combined NSPD-ALMH subgroups and demographic factors (Study 2); and (3) estimate the prevalence of SDH and risk of cognitive disability among people with poor mental health (Study 3).

**Results:** The first study found that people reporting NSPD and ALMH were at significantly increased risk of reporting a disability, including hearing and vision disabilities. For example, after adjusting for gender and race/ethnicity, people ages 35-54 years reporting severe NSPD were at 8.5 times greater risk of reporting a cognitive disability, compared to people ages 35-64 reporting no NSPD. The second study found synergy between NSPD and ALMH when estimating disability risk. For example, people reporting NSPD and ALMH were at 7.1 (95% CI = 6.6, 7.6) times the risk of reporting cognitive disabilities, compared to people reporting NSPD and no ALMH. The third study found the prevalence of cognitive disability and adverse SDH increased in a robust, stepwise fashion across gradients of poor mental health (defined by NSPD and/or ALMH). Within NSPD-ALMH groups, cognitive disability risk was increased among people with adverse SDH, compared to people without adverse SDH.

**Conclusion:** The findings of this dissertation provide evidence that people with any psychological distress and/or any duration of mental health conditions are at significantly increased risk of experiencing all disability types. This should be more heavily recognized in the mental health and disability literature and provides evidence that people

with disabilities, especially cognitive disabilities, identified by federally recognized disability questions, represent a population experiencing psychological distress and serious mental illness. Theoretically, the results of this dissertation were consistent with the conceptual framework supported by the International Classification of Functioning, Disability, and Health (ICF). I was able to show that the risk of disabilities increases on a continuum of impairment described by the ICF, with severity of psychological distress and duration of mental health condition. Further, I was also able to validate both the psychiatric literature and ICF and show that the distinction between mental health symptoms and conditions matters in a very concrete, quantitative, inferential manner in a population study. Although federally recognized disability questions are designed to capture conceptually distinct populations, disability as a field should recognize the pervasiveness of poor mental health among people with disabilities. In national surveillance, identifying people based on mental health symptoms and/or conditions identifies subpopulations with differential distributions of social determinants of health and disability risk targetable for public health interventions. Disability and mental health policy can now use this information to improve and provide more specific supports, services, and programs for both groups. The over 65 federally recognized definitions of disability should recognize that mental health plays a substantial role in the disability experience.

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## DEDICATION

The inspiration for and completion of this effort is dedicated to two people:

Jack Harry Wernick

"Many aspects of life and the world are forever beyond the power of the scientific method. There are more things in heaven and earth that can be weighed or measured. The things which count cannot be counted."

-Robert Gordis

Emily Lauer

"How lucky I am to have something that makes saying goodbye so hard."  
"If there ever comes a day when we can't be together, keep me in your heart, I'll stay there forever."

-A.A. Milne

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## INTRODUCTION

In the United States (U.S.) more than 55 million people experience mental and physical disabilities.<sup>1</sup> Worldwide, the World Health Organization estimates over a billion people live with a disability (greater than 15% of the world population).<sup>2</sup> Due in part to effective public health measures preserving and prolonging life, one in five people are projected to be aged 65 years or older by 2030 in the U.S. with a substantial proportion of these people living with disabilities.<sup>1,3</sup> Individual incidences of disability are unique with some disabilities occurring later in life as a result of chronic conditions and others as a result of an event at or before birth, sudden illness, or from injury or acts of violence.<sup>4-6</sup> Irrespective of cause, public health supports for people with and without disabilities are essential to ensuring people live a maximum number of healthy years.

Global estimates of disability-adjusted life years, reflecting the burden of disease, have been projected from 2002 to 2030 by Mathers and Loncar.<sup>7</sup> These projections place unipolar depressive disorder among the top three causes of global burden of disease, alongside HIV/AIDS and ischemic heart disease. Among high-income countries, unipolar depressive disorder and Alzheimer's disease and other dementias are projected as the first and third causes of burden of disease, respectively. By 2030, chronic conditions are projected to be a greater cause of worldwide burden of disease than communicable, maternal, perinatal, nutritional and injury-related causes combined. Moreover, over a quarter (27%) of chronic disease burden will be attributable to neuropsychiatric conditions.

In order to respond to the global shift in disease burden, public health surveillance measures have been developed in the U.S. to assess mental health and disability in the

general population. Since 2005, the U.S. Centers for Disease Control and Prevention's (CDC) National Health Interview Survey (NHIS) has included the Kessler-6 (K6) scale, a measure of non-specific psychological distress and serious mental illness.<sup>8</sup> The K6 scale has been validated for population studies and implemented by agencies in multiple English-speaking countries.<sup>9-11</sup>

Along with asking people about activity limitations that are caused by mental health conditions, the K6 represents the only other question series assessing mental health in the NHIS. Further, since 2008, the NHIS has included a standardized series of six disability identifiers developed for use in U.S. national surveys.<sup>12</sup> These questions were validated by the U.S. Census Bureau and National Center for Health Statistics and their inclusion in all national surveys was mandated by the U.S. Department of Health and Human Services in response to the Affordable Care Act (ACA, 2010), which recognized people with disabilities as a minority population at risk of experiencing health disparities.<sup>13,14</sup>

However, despite the implementation of these question sets, to the best of my knowledge there have been no studies of the association between the K6, activity limitations due to mental health conditions, and the ACA-related disability questions. In order to address this gap in the literature, the goal of my dissertation was to study the relationship between the K6, ACA-mandated disability questions, mental health conditions, and social determinants of health (SDH). I set out to study (1) the severity of psychological distress and duration of mental health conditions associated with disabilities, (2) the risk of disabilities associated with the interaction between psychological distress and mental health conditions, and (3) patterns of cognitive

disability and SDH across combined levels of psychological distress and mental health conditions.

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AN ASSESSMENT OF THE ASSOCIATION BETWEEN MENTAL HEALTH  
INDICATORS AND DISABILITY AMONG ADULTS IN THE UNITED STATES

BY

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Dona Schneider, PhD, MPH

## ABSTRACT

**Background:** More than 50 million people in the U.S. experience mental illness and disabilities. However, despite research suggesting improved mental health is associated with disability prevention, there has been very limited study between mental health indicators and the standardized disability identifiers included in national surveys in response to the Affordable Care Act (ACA).

**Objective:** To examine the association between non-specific psychological distress (NSPD), duration of activity limitations due to mental health conditions (DMHC), and the function and activity difficulties used to identify people with disabilities in U.S. national surveys.

**Methods:** This study analyzed data from the U.S. National Health Interview Survey (NHIS), which added function and activity difficulty questions to identify people with disabilities in response to the ACA. Univariate and bivariate analyses were conducted on NSPD, DMHC, disability types, and demographic factors. Relative risks were estimated using log-binomial models including age, gender, and race/ethnicity.

**Results:** Individuals reporting NSPD and DMHC were at significantly increased risk of reporting a disability, including hearing and vision disabilities. This relationship was strongly modified by demographic factors and varies by disability type. Individuals ages 35-64 years reporting severe NSPD were at 8.5 times greater risk of reporting a cognitive disability, compared to people ages 35-64 reporting no NSPD and adjusting for gender and race/ethnicity.

**Conclusions:** There was a strong association between reporting NSPD, DMHC, and disabilities in the NHIS. Further research is needed to explore the interaction between



mental health conditions, disability types, and demographic factors and better understand the needs of people with serious mental illness and disabilities identified through national surveillance efforts. These results suggest that disability service agencies and public policy, especially groups utilizing standardized disability identifiers for the ACA, consider addressing mental health in their services and programs.

**Keywords:** disabilities; mental health; psychological distress; chronic conditions; adult; health surveillance

## INTRODUCTION

Studies over the last two decades have shown that people with disabilities are generally at increased risk of experiencing health disparities and inequities.<sup>1</sup> People with disabilities are more likely to experience poorer health outcomes, to have complex health conditions, to have greater susceptibility to secondary health complications, and to have earlier onset of chronic health conditions. In addition, they are less likely to have access to quality healthcare than the general population.<sup>2-11</sup> However, it is not always clear which characteristics or factors are associated with better or worse outcomes in this literature.<sup>12</sup> One particular study found that approximately 60 percent of people who report disabilities do not report highly prevalent chronic conditions.<sup>13</sup> Additional studies are needed to understand which subpopulations experience disparities and inequity within specific disabilities and health conditions.<sup>12,14,15</sup> Krahn et al. (2015) has called for the expansion of this research with population studies including: (1) standardized disability identifiers and (2) specific health conditions, disability types, and subgroups based on demographic factors.<sup>1,2,4,12,16,17</sup>

One area in need of expansion is the study of mental health and disabilities. There is a limited literature of population-based studies showing that people with disabilities are at increased risk of mental illness and of experiencing serious psychological distress.<sup>18</sup> People with disabilities experience significantly higher rates of psychological distress and mental illness compared to people without disabilities. Importantly, people with poor mental health or disabilities are more likely to concomitantly experience disabilities or poor mental health, respectively, in their lifetime. Serious psychological distress and mental illness may contribute to the 60 percent of people with disabilities who do not

report chronic conditions mentioned previously. There is a need to build upon the limited existing literature by identifying groups experiencing psychological distress and mental illness at greater risk of experiencing disabilities.

The National Health Interview Survey (NHIS) provides a way to respond to this call to arms by exploring mental health and disabilities using non-specific psychological distress (NSPD), duration of activity limitations due to mental health conditions (DMHC) and standardized questions about functional and activity limitations used to identify a range of disabilities in the U.S. The NHIS includes several indicators of mental health. The first measurement uses the Kessler (K6) Psychological Distress question sequence, a 0- to 24-point scale that has been well-studied (scores of 13 or greater are highly associated with serious mental illness and disability).<sup>19,20</sup> The second measurement captures the status and duration of mental health conditions as causes of activity limitations. In response to the Affordable Care Act mandate to include disability identifiers in all national surveys, the NHIS includes standardized questions pertaining to disability developed in 2008.<sup>21</sup> People are identified as having a disability if they respond affirmatively to any of the questions that ask about serious limitations related to hearing, vision, cognition, ambulation, and independent living and self-care. Two of these questions are qualified with the text, “Because of a physical, mental or emotional condition...,” with the intentional of including mental health as a potential contributing factor to limitations.<sup>22</sup> Further, the cognitive question continues with, “...do you have difficulty remembering, concentrating, or making decisions?” to conceptually capture people with mental health conditions.

Studying continuous or ordinal indicators of impairment and functioning, such as NSPD and DMHC, is a conceptual imperative established by the World Health Organization (WHO). The International Classification of Functioning, Disability and Health (ICF) emphasizes studies include standardized measures with a range of severity to reflect underlying function and disability at the body and person level.<sup>23</sup> Impairment and loss of functioning is believed to contribute to both disability and health in a circular, cascading fashion whereby disabilities and health conditions further contribute to ongoing impairments and functional losses.<sup>1,6</sup> The mental health indicators included in the NHIS allow us to conduct a study that is consistent with the ICF and evaluate, in a limited fashion, the association between severity of impairment (NSPD), duration of condition (DMHC), individual characteristics (demographic factors), and disability status. Further, conducting a study with any longitudinal data also contributes to the limited existing literature supporting the cascade of factors that are believed to contribute to disability and health over a lifetime.

Notably, the relationship between standardized disability identifiers, DMHC, and NSPD (using the K6 scales) has not been well studied. Although there is an existing literature studying mental health and disability,<sup>19,24,25</sup> to date there have not been any studies examining the relationship between NSPD, DMHC, and these standardized disability identifiers. A National Library of Science, Web of Science, and Science Direct Boolean search for publications from 2009 to the present using various combinations of the terms NHIS, N.H.I.S., National Health Interview Survey, disab\*, difficult\*,

psychological distress, non-specific psychological distress, adult\*, US, U.S., or United States returned no articles on this topic.<sup>1</sup>

As a first step towards examining NSPD, DMHC, and disability identified with standardized questions for the ACA, this study set out to test the following exploratory null hypotheses:

1. There is no risk of reporting disabilities among people reporting NSPD or DMHC.
2. There is no difference in the risk of reporting disability types with NSPD or DMHC when adjusting for or stratifying by demographic factors.

## **METHODS**

### **Data Source**

This study used responses to the 2008-2015 NHIS. The NHIS is a major data collection program of the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS) monitoring the health of the nation. The NHIS is a continuous, cross-sectional, in-person household survey sampled to be nationally representative of the civilian noninstitutionalized U.S. population that collects data on socio-demographics, health status and limitations, food security, healthcare access and utilization, health insurance, and income of households, families, children and adults. The annual response rate of the NHIS is approximately 80% of eligible households.<sup>26</sup> The conditional response rates of the adult sample files analyzed for this study were between 74.1-81.6%.<sup>27</sup>

The NHIS dataset provides person, adult and disability sample files with responses to questions about demographics, non-specific psychological distress, causes

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<sup>1</sup> The use of the asterisk (\*), also called a wildcard, indicates a search finding all terms that begin with the given string of text.

and durations of activity limitations, and self-reported difficulties. The NHIS datasets are weighted to account for the probability of selection and nonresponse and to adjust for age, gender, and race/ethnicity. Each sample file has weights for any given year of the survey. For the NHIS dataset, weights were chosen from the adult sample file to be most representative of people responding to non-specific psychological distress. Based the NHIS recommendations, weights were divided by eight to account for eight years of data.<sup>28</sup>

### **Sample & Measures**

Each year approximately 85,000 people participate in the NHIS. The NHIS design does not ask every participant every question and produces subsamples (datasets) with responses to various sets of questions. Subgroups include an adult sample (people ages 18 and over responding to the NHIS in-person, approximately a third of the total NHIS sample), asked about non-specific psychological distress and causes and duration of activity limitations, and a family disability questions sample (a randomized half of the total NHIS sample asked the function and activity difficulty questions). In any given year, approximately half of the people asked the adult sample questions were asked the family disability questions. The majority of people excluded from these analyses were not asked the questions relevant to the study. Respondents were excluded from the 2008-2015 NHIS adult sample if they were missing data for or were not asked the non-specific psychological distress, duration of activity limitations due to mental health condition, or serious difficulty questions ( $n=136,456$ ). After combining sample files and excluding individuals, of the 249,134 NHIS adult sample respondents, this analysis included 112,678 adult respondents (ages 18 and over) in the NHIS.

Demographic variables selected from the NHIS included age (18-34, 35-54, 55+), gender (male, female), and race/ethnicity (non-Hispanic White, Non-White). Non-specific psychological distress (NSPD) was calculated in the adult NHIS sample using Kessler's K6 24-point screening score for non-specific psychological distress based on responses to six standardized ordinal emotional distress questions, "During the past 30 days, how often did you feel... sad/nervous/restless-fidgety/hopeless/everything was an effort/worthless?"<sup>29</sup> K6 questions in the NHIS were converted to values of 0-4 and summed to a 0-24 point scale. Using the Center for Behavioral Health Statistics and Quality's Data Review on Psychological Distress and Mortality as a guide, NSPD was categorized as none (0), mild (1-6), moderate (7-12), and severe (13+, a strong indicator of diagnosable mental illness and considerable disability).<sup>24,30</sup>

Duration of activity limitations due to mental health condition (DMHC) was also calculated in the adult NHIS sample based on having responded affirmatively to and reported the duration of having "mentioned difficulties with activities due to 'depression/anxiety/emotional problem' or 'other mental problems/ADD/Bipolar/Schizophrenia.'" These conditions include "neurotic disorders, personality disorders, and other nonpsychotic mental disorders, excluding alcohol and drug related problems and developmental problems" as well as "any other mental disorders mentioned other than alcohol and drug related problems and developmental problems."<sup>31</sup> This definition is consistent with the National Institute of Mental Health's definition of serious mental illness.<sup>32</sup> Duration in years categorized to 0 (none), greater than 0 to less than or equal to 1 year, greater than 1 year to less than or equal to 10 years, and greater than 10 years.

Using the NHIS disability family file, adults were identified as having a disability (by subtype) if they responded affirmatively to at least one of six standardized questions dichotomously asking about having serious difficulties in the following subtypes: cognitive, independent living, self-care, ambulatory, vision, and hearing. Identification was based on having responded ‘Yes’ to dichotomous questions asking, “Because of a physical, mental, or emotional problem do you have difficulty remembering, concentrating, or making decisions?” for cognitive, “Because of a physical, mental, or emotional problem, do you have difficulty doing self-care alone such as visiting a doctor’s office or shopping?” for independent living, “Do you have serious difficulty dressing or bathing?” for self-care, “Do you have serious difficulty walking or climbing stairs?” for ambulatory, “Are you blind or do you have serious difficulty seeing even when wearing glasses?” for vision, and “Are you deaf or do you have serious difficulty hearing?” for hearing.<sup>33</sup> The sample adult respondent or designated family member responded to the disability questions from this file. More than one limitation could be reported. In analyses disability status was categorized dichotomously (‘yes’ or ‘no’) as a dependent variable by type and again dichotomously (‘yes’ or ‘no’) for having reported one or more additional disabilities as an independent variable (e.g. when modeling the relative risk of reporting a cognitive disability (‘yes’ or no) the model was adjusted for having reported one or more additional disabilities other than cognitive (‘yes’ or ‘no’)).

### **Data Analysis**

All analyses were conducted using Statistical Analysis Software (SAS, Version 9.4) procedures that accounted for complex survey design effects in the NHIS. Percentages and means and medians were estimated in PROC SURVEYFREQ and



PROC SURVEYMEANS, respectively. Taylor Series Linearization was used for variance estimation.<sup>28</sup> Strata and primary sampling unit variables were included in class and repeated subject statements to account for complex survey design effects. Confidence interval calculation used an alpha of 0.05.

This study applies an rarely utilized methodology to estimate risk. Relative risks, relating disability to NSPD, DMHC and demographic characteristics, were estimated in the generalized linear model procedure, PROC GENMOD, using a log-link and binomial distribution with an intercept of -4 in to ensure model convergence.<sup>34</sup> Models using a log link and binomial distribution are a recommended multivariate approach to estimating relative risks.<sup>35</sup> When models fail to converge, changing the intercept value to -4 is a published strategy recommended by SAS.<sup>36-38</sup>

Relative risk analyses examining the association of NSPD, DMHC and disability were further stratified by demographic characteristics in separate models. Stratified models were adjusted for having reported one or more additional disabilities (other than the disability type being modeled). The risk ratios for age stratifications were adjusted for gender and race/ethnicity, the risk ratios for gender stratifications were adjusted for age and race/ethnicity, and the risk ratios for race/ethnicity stratifications were adjusted for age and gender. Nested effects were estimated by including the parenthetical nested variable and removing the main effect of the nested variable from model statements.<sup>39,40</sup> Cutoff points of ages 35 and 55 years were chosen because these were ages at which the overall sample prevalence of NSPD increase and decrease, respectively, and ages 55 years and over is associated with a period of significant mortality of people with serious mental illness.<sup>41</sup> Model outcomes were having reported cognitive, independent living,

self-care, ambulatory, vision, or hearing disabilities (versus not, people responding negatively to a specific disability type could still have responded affirmatively to others).

## RESULTS

Table 1 presents the key characteristics of the NHIS sample and the percentage of people reporting demographic factors, NSPD, and DMHC conditional on disabilities. A majority of the NHIS sample was female, non-Hispanic White, and between the ages of 35 to 54 years. Approximately 1 in 6 people reported a disability and 1 in 2 people reported non-specific psychological distress. Moderate and severe NSPD was reported by 8.8% and 3.3% of people, respectively. DMHC of any length was identified in approximately 2.5% of the population. Each disability subtype was identified in 5-10% of people.

<INSERT TABLE 1 ABOUT HERE>

The bivariate relative risk of reporting a disability dependent on NSPD, DMHC or demographic characteristics are presented in table 2. The risk of reporting a disability (all types) varied significantly by NSPD, DMHC, age, gender and race/ethnicity. More severe NSPD, longer DMHC, older age, and being female were all significantly associated with having a disability (being female was protective for having a hearing disability). There was a significant, non-linear increase in risk of having a disability with increased age that was present for all disability types but was weakest for cognitive disabilities at all age levels. There was a strong, significant, non-linear increase in risk of having a disability with worsening NSPD that was strongest for cognitive disabilities at all levels. The reporting of any DMHC was significantly associated with the reporting of one or more disabilities (all types). Further, people reporting more than 1 year of DMHC or moderate

or severe NSPD were at significantly greater risk of reporting cognitive, independent living, or self-care disabilities than ambulatory, vision, or hearing disabilities.

<INSERT TABLE 2 ABOUT HERE>

The relative risk of reporting disability and NSPD stratified by age, gender, or race/ethnicity are presented in Table 3. Across almost all stratifications of age, gender, and race/ethnicity, increasing NSPD was significantly associated with disabilities (all types). Compared to people with no NSPD, people reporting severe NSPD were at significantly greater risk of reporting cognitive disabilities than all other disability types across all stratifications.

Notably, the risk of reporting disability and NSPD decreases for people ages 55 years and over (all disability types except self-care). Compared to people with no NSPD, people ages 18 to 34 years and 34 to 54 years with severe NSPD were at more than 50% greater risk of reporting a cognitive disability than people ages 55 years and over with severe NSPD. When stratified by gender, males with moderate and severe NSPD are at greater risk than females with moderate and severe NSPD for reporting all disability types. When stratified by race/ethnicity, non-Hispanic whites with moderate or severe NSPD had significantly greater risk of reporting cognitive, independent living, and self-care disabilities than non-Whites at the same levels of NSPD.

<INSERT TABLE 3 ABOUT HERE>

The relative risk of reporting disability and DMHC stratified by age, gender, or race/ethnicity are presented in Table 4. Across almost all stratifications of age, gender and race/ethnicity, DMHC lengths of greater than 1 year were significantly associated with disability (all types except hearing). Compared to people with no DMHC, people

reporting any DHMC were at greater risk of reporting cognitive and independent living than self-care, ambulatory, vision, and hear disabilities. Across all DMHC levels, males were at increased risk of reporting disabilities, compared to females (all types except vision and hearing). The risk of reporting cognitive and independent living disabilities with increasing length of DMHC was greater for Whites than non-Whites.

<INSERT TABLE 4 ABOUT HERE>

## **DISCUSSION**

This study found a strong, robust association between disability, NSPD and DMHC dependent on age, gender and race/ethnicity. People reporting any NSPD or any DHMC were at increased risk of reporting disabilities in all analyses and were at greatest risk of reporting cognitive disabilities. The magnitude of relative risks varied significantly across disability type, demographic factors, severity of NSPD, and length of DHMC in bivariate and stratified models. My results suggest a significant association between NSPD, DMHC, and demographic characteristics. Although age was least associated with reporting cognitive disabilities in the unadjusted analysis, stratifying NSPD and DMHC by age resulted in higher risk of reporting cognitive disabilities than any other disability type.

There is an existing literature relating mental health and disabilities that has not been extended to include the Kessler NSPD measurement, DMHC, and the standardized disability identifiers examined here. I replicated the research finding that increasing NSPD, especially scores predictive of serious mental illness, and DMHC, especially lengths of greater than 1 year, were highly associated with disability. The risk of reporting disabilities was modified significantly by age, gender, and race/ethnicity,

consistent with previous studies.<sup>1</sup> Ages 55 years and over was relatively protective when NSPD and DMHC were nested within age in the models. This may be due to the increased risk of premature death among people with mental health conditions.<sup>42-44</sup> Also consistent with the literature, females were at increased risk of reporting disability, compared to males, in bivariate analyses.<sup>45,46</sup> However, in nested models men with moderate and severe NSPD were at greater risk of reporting disabilities than women with moderate and severe NSPD.

Additional research is needed to better understand the relationships between NSPD, DMHC, disability, and demographic factors in my study. The unweighted observations in my study were consistent with similar studies using the NHIS.<sup>12</sup> Weighted estimates of disabilities, NSPD, and demographic characteristics approximated other national estimates in publications using the NHIS.<sup>13,47-49</sup> As expected, the percentage of people reporting activity limitations due to mental health conditions was substantially lower than the prevalence of mental health conditions in the general population because reporting was conditional on having at least one activity limitation. Because the population reporting activity limitations due to mental health conditions represents a distinct and partial proportion of people with mental illness, further research is needed to be able to generalize the association between the duration of mental health conditions and disabilities measured in this study.

### **Limitations**

The NHIS is a cross-sectional survey and no information regarding the temporality of the relationships was available for this study. The etiology of the disabilities reported are complex, varied, and often comorbid making it impossible to

disentangle the chronology of events that result in health problems, difficulties, or limitations in this data. It is impossible to determine if the duration of activity limitations due to mental health conditions precede and contribute to the reporting of disabilities such as hearing or vision or conversely, if the burden of a hearing disability precedes and contributes to a mental health condition in this data. In order to better understand the concomitant nature of disability and mental health indicators in the NHIS, long-term longitudinal studies are needed.

Although this study focused on mental health (via NSPD and DMHC) and disability types (via serious difficulty questions), the categories in this study were quite broad. Non-specific psychological distress is a broad indicator of well-being reflecting individual and environmental factors that extend beyond mental health status. The cumulative stress and trauma associated with factors such as poverty, unemployment, and neighborhood crime may contribute to the reporting of mental illness, psychological distress, and disability in this study. Racial categories for non-white are especially broad, with limited generalizability, and should be interpreted with caution.<sup>50</sup> In the models presented, unmeasured and residual confounding may be present.<sup>51</sup>

The NHIS' mode of data collection is interviews and all responses are subject to reporting bias. The NHIS interview method is self-report and individuals may exaggerate or over-report and minimize or under-report their symptoms in response to questions.<sup>52</sup> Individuals only report mental health conditions and their duration in the NHIS if they report activity limitations, which contributes to the under-reporting of mental illness. Due to survey design and contextual effects, respondents may systematically refuse to answer, not know the answer to questions, or may not have answers ascertained by surveyors.

These effects can also result in individuals responding for each other with varying degrees of reliability (i.e. proxy effects).<sup>53</sup> It is possible that the location of questions and overall health context of the NHIS influences results in a fashion found in other studies.<sup>54</sup> Surveys such as the NHIS are subject to nonresponse bias. Non-respondents may differ meaningfully from respondents.<sup>53</sup> The self-reported nature of some of the questions used in this study may present limitations because there may be differing response patterns among specific mental health conditions, disability groups, and demographic patterns.

## **Conclusion**

The results in this study utilize a nationally representative sample of adults with disabilities and NSPD. They suggest a strong, robust relationship between non-specific psychological distress, duration of activity limitations due to mental health condition, and disabilities. Although the temporality of these findings cannot be established, people are concomitantly reporting severe NSPD, associated with serious mental illness, activity limitations due to mental health conditions, and disabilities, especially cognitive difficulties.

The questions identifying people with disabilities in this study are used by many federal agencies and funding organizations to conduct research and direct policy and supports in the United States.<sup>55</sup> The finding that affirmative responses to NSPD and DMHC questions are ubiquitously associated with disabilities, even people reporting ambulatory, vision, and hearing disabilities, has far reaching implications. My findings suggest that mental health supports and services be considered in policy for disability-related service on the local, state and federal level because the reporting of even mild NSPD or DMHC of less than 1 year is associated with all disability types.

The CDC and WHO both stress that mental health is an essential part of health, more than a lack of mental disorders or illness, and determined by a range of socioeconomic, biological, and environmental factors.<sup>56,57</sup> Their conceptualization of mental health includes a life course perspective in which repeated and continual trauma and stress have deleterious effects on people decreasing resiliency, worsening mental health, and resulting in mental illness. Combined with vulnerabilities on a psychological and genetic level, social determinants of health play a substantial role in the etiology of mental health decline and mental illness. Understanding the relationship between these factors are vital to creating effective interventions and policy for people with poor mental health and disabilities.



Table 1  
Sample characteristics

	wgt n=103,912,116	unwgt n=112,678
	% (95% CI <sup>†</sup> )	
Age (years)		
18-34	30.56	(29.98,31.14)
34-54	35.80	(35.36,36.24)
55+	33.64	(33.13,34.15)
Mean	46.50	(46.27,46.73)
Median	45.21	(44.91,45.52)
Female	51.78	(51.38,52.19)
Race/Ethnicity <sup>‡</sup>		
Non-White	32.71	(32.01,33.41)
NSPD <sup>§</sup>		
None	46.96	(46.41,47.51)
Mild	40.98	(40.47,41.48)
Moderate	8.75	(8.52,8.98)
Severe	3.31	(3.15,3.47)
ALMH <sup>  </sup> (years)		
0 (None)	97.35	(97.21,97.49)
0-1	0.20	(0.17,0.23)
1-10	1.09	(1.01,1.16)
10+	1.37	(1.27,1.46)
Mean	16.76	(16.06,17.47)
Median	11.16	(10.2,12.11)
Disability		
None	82.74	(82.35,83.12)
Cognitive	5.49	(5.3,5.68)
Independent living	5.67	(5.47,5.88)
Self-care	2.65	(2.52,2.77)
Ambulatory	9.67	(9.4,9.94)
Vision	3.51	(3.34,3.67)
Hearing	5.64	(5.46,5.83)

Notes: All point estimates were weighted. Overall weighted (wgt n) and unweighted (unwgt n) sample sizes were the total number of respondents in the 2008-2015 National Health Interview Survey ages 18 and over who had responses to family disability file questions and adult sample file non-specific psychological distress, and activity limitation due mental health

<sup>†</sup>Confidence Interval

<sup>‡</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories).

<sup>§</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0), mild (1-6), moderate (7-12), and severe (13+).

<sup>||</sup>Activity Limitations due to Mental Health Conditions. Having reported a duration of an activity limitation due to a/an "depression/anxiety/emotional problem" or "other mental problems/ADD/ Bipolar/Schizophrenia." Duration in years was categorized as 0 (None), greater than 0 to 1, greater than 1 to 10, and greater than 10 years.

Table 2  
Relative risk (unadjusted) of reporting disability across non-specific psychological distress, duration of activity limitations due to mental health

	Cognitive		Independent Living		Self-Care		Ambulatory		Vision		Hearing	
	wtg n=5,707,464		wtg n=5,896,926		wtg n=2,751,560		wtg n=10,046,783		wtg n=3,643,259		wtg n=5,864,165	
	unwtg n=7,113		unwtg n=7,559		unwtg n=3,540		unwtg n=13,169		unwtg n=4,813		unwtg n=7,224	
	RR <sup>†</sup>	95% CI <sup>‡</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
NSPD <sup>§</sup>												
None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Mild	2.12	(1.92,2.34)***	1.83	(1.68,1.99)***	1.92	(1.70,2.18)**	1.70	(1.60,1.79)**	1.50	(1.37,1.65)*	1.05	(0.98,1.12)
Moderate	8.69	(7.87,9.60)***	5.58	(5.11,6.09)***	6.31	(5.51,7.22)**	4.18	(3.91,4.46)**	3.57	(3.17,4.02)*	1.71	(1.56,1.89)***
Severe	19.68	(17.84,21.72)*	11.52	(10.50,12.64)*	12.96	(11.25,14.94)*	6.88	(6.40,7.38)**	7.22	(6.40,8.15)*	2.70	(2.40,3.03)***
ALMH <sup>  </sup>												
0 (None)	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
0-1	6.95	(5.41,8.92)***	4.44	(3.28,6.01)***	4.30	(2.91,6.35)**	3.34	(2.59,4.31)**	5.07	(3.45,7.44)*	3.09	(2.16,4.42)***
1-10	10.51	(9.63,11.47)**	7.43	(6.69,8.25)***	6.61	(5.50,7.94)**	3.91	(3.52,4.34)**	3.90	(3.23,4.72)*	2.08	(1.72,2.52)***
10+	11.05	(10.21,11.95)*	6.77	(6.11,7.49)***	4.64	(3.93,5.49)**	3.64	(3.32,3.99)**	4.16	(3.52,4.92)*	2.27	(1.91,2.70)***
Age (years)												
18-34	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
35-54	1.29	(1.17,1.42)***	1.88	(1.64,2.16)***	2.91	(2.37,3.58)***	3.69	(3.26,4.16)**	1.79	(1.54,2.08)*	2.56	(2.22,2.94)***
55+	2.06	(1.87,2.26)***	4.96	(4.39,5.60)***	7.98	(6.63,9.62)**	11.55	(10.33,12.93)*	4.23	(3.68,4.85)*	11.06	(9.73,12.58)***
Gender												
Male	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Female	1.08	(1.01,1.15)*	1.50	(1.41,1.60)***	1.36	(1.24,1.49)**	1.36	(1.30,1.42)**	1.11	(1.03,1.19)*	0.65	(0.61,0.69)***
Race/Ethnicity <sup>¶</sup>												
White	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Non-White	0.97	(0.90,1.04)	0.93	(0.86,1.01)	0.99	(0.90,1.10)	0.84	(0.79,0.89)**	1.12	(1.02,1.22)*	0.50	(0.46,0.54)***

Notes: Log-binomial models estimating the relative risk of reporting disability were unadjusted for reporting one or more disabilities and

demographic factors. Reference categories for disability status were individuals without that disability type. All statistics were adjusted for the complex survey design of the National Health Interview Survey. Weighted and unweighted sample sizes for disability types are the total number of people reporting that particular disability. Statistical significance based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Relative risk

<sup>‡</sup>Confidence interval

<sup>§</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0), mild (1-6), moderate (7-12), and severe (13+).

<sup>||</sup>Activity Limitations due to Mental Health Conditions. Having reported a duration of an activity limitation due to a/an

“depression/anxiety/emotional problem” or “other mental problems/ADD/ Bipolar/Schizophrenia.” Duration in years was categorized as 0

(None), greater than 0 to 1, greater than 1 to 10, and greater than 10 years.

<sup>¶</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories).

Statistical significance: \* indicates  $p < .05$ , \*\* indicates  $p < .005$ , \*\*\* indicates  $p < .0005$ .

Table 3  
Relative risk of reporting disability across levels of non-specific psychological distress and demographic factors

Characteristic		Cognitive		Independent		Self-Care		Ambulatory		Vision		Hearing	
		RR <sup>†</sup>	95% CI <sup>‡</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age (years)	NSPD <sup>§</sup>												
	18-34												
	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	2.18	(1.67,2.85)***	0.99	(0.72,1.35)	0.99	(0.59,1.67)	2.16	(1.57,2.96)**	1.45	(1.04,2.02)*	1.18	(0.86,1.61)
	Moderate	5.11	(3.91,6.69)***	1.44	(1.07,1.94)*	1.31	(0.73,2.33)	4.53	(3.23,6.36)**	2.02	(1.39,2.95)**	1.71	(1.17,2.51)*
	Severe	8.19	(6.28,10.69)**	2.00	(1.46,2.73)**	1.91	(1.12,3.27)*	6.43	(4.53,9.14)**	2.62	(1.75,3.92)**	3.33	(2.13,5.22)***
	35-54												
	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.94	(1.58,2.40)***	1.24	(1.02,1.51)*	1.06	(0.83,1.37)	1.86	(1.63,2.12)**	1.60	(1.31,1.95)**	1.29	(1.08,1.55)*
	Moderate	6.03	(4.89,7.43)***	2.09	(1.74,2.52)**	1.65	(1.29,2.12)**	3.57	(3.10,4.11)**	1.99	(1.59,2.51)**	1.56	(1.23,1.96)***
	Severe	8.56	(6.93,10.57)**	3.04	(2.53,3.65)**	2.30	(1.77,2.97)**	4.34	(3.78,4.97)**	3.20	(2.55,4.03)**	2.33	(1.81,3.00)***
	55+												
	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.64	(1.47,1.82)***	1.39	(1.29,1.50)**	1.52	(1.32,1.74)**	1.41	(1.34,1.49)**	1.20	(1.08,1.33)**	0.95	(0.88,1.01)
	Moderate	3.37	(2.99,3.81)***	1.93	(1.77,2.12)**	2.42	(2.08,2.80)**	1.82	(1.72,1.93)**	1.83	(1.60,2.08)**	1.07	(0.97,1.19)
	Severe	5.08	(4.52,5.70)***	2.23	(2.03,2.44)**	3.03	(2.59,3.55)**	1.88	(1.77,1.99)**	2.47	(2.16,2.82)**	1.10	(0.97,1.24)
Gender													
Female	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.67	(1.46,1.90)***	1.17	(1.07,1.28)**	1.18	(1.01,1.37)*	1.36	(1.28,1.44)**	1.31	(1.16,1.48)**	1.03	(0.93,1.14)
	Moderate	3.89	(3.42,4.43)***	1.65	(1.50,1.81)**	1.87	(1.60,2.17)**	1.79	(1.67,1.91)**	1.83	(1.58,2.12)**	1.24	(1.08,1.42)**
	Severe	5.99	(5.24,6.84)***	1.96	(1.77,2.16)**	2.27	(1.93,2.67)**	1.84	(1.72,1.97)**	2.55	(2.22,2.93)**	1.34	(1.14,1.57)***
Male	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.87	(1.63,2.14)***	1.55	(1.36,1.75)**	1.71	(1.42,2.06)**	1.62	(1.50,1.75)**	1.30	(1.14,1.48)**	0.98	(0.90,1.06)
	Moderate	4.47	(3.86,5.17)***	2.34	(2.03,2.68)**	2.55	(2.09,3.13)**	2.42	(2.21,2.64)**	1.92	(1.62,2.28)**	1.10	(0.98,1.24)
	Severe	6.53	(5.69,7.50)***	3.49	(3.06,3.98)**	3.77	(3.12,4.56)**	2.77	(2.54,3.02)**	2.80	(2.33,3.37)**	1.34	(1.17,1.53)***
Race/Ethnicity <sup>  </sup>													
Non-White	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.88	(1.63,2.16)***	1.22	(1.09,1.36)**	1.23	(1.05,1.45)*	1.46	(1.35,1.57)**	1.55	(1.34,1.78)**	1.31	(1.14,1.49)***
	Moderate	3.74	(3.26,4.30)***	1.55	(1.38,1.73)**	1.58	(1.33,1.87)**	1.79	(1.64,1.94)**	1.91	(1.59,2.28)**	1.57	(1.34,1.85)***
	Severe	5.52	(4.79,6.35)***	1.84	(1.64,2.06)**	2.08	(1.76,2.45)**	1.95	(1.79,2.12)**	2.65	(2.24,3.13)**	2.14	(1.79,2.56)***
White	None		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	Mild	1.73	(1.54,1.95)***	1.37	(1.25,1.52)**	1.49	(1.27,1.76)**	1.50	(1.42,1.59)**	1.20	(1.07,1.35)**	0.94	(0.88,1.00)
	Moderate	4.40	(3.89,4.98)***	2.11	(1.91,2.32)**	2.54	(2.15,3.01)**	2.16	(2.02,2.31)**	1.86	(1.61,2.15)**	1.07	(0.97,1.19)
	Severe	6.69	(5.89,7.60)***	2.77	(2.49,3.09)**	3.32	(2.77,3.98)**	2.25	(2.10,2.42)**	2.68	(2.29,3.13)**	1.19	(1.05,1.35)*

Notes: Log-binomial models were adjusted for having reported one or more additional disabilities and age, gender, and/or race when not stratified by that factor. Each demographic characteristic was a separate model presenting the relative risk of reporting a disability and non-specific psychological distress stratified by age, gender, or race/ethnicity. Reference categories for disability status were individuals without that disability type. All statistics were adjusted for the complex survey design of the National Health Interview Survey. Statistical significance was based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Relative risk

<sup>‡</sup>Confidence interval

<sup>§</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0), mild (1-6), moderate (7-12), and severe (13+).

<sup>||</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories).

Statistical significance: \* indicates p < .05, \*\* indicates p < .005, \*\*\* indicates p < .0005.

Table 4  
Relative risk of reporting difficulty across duration of activity limitations due to mental health conditions and demographic factors

Characteristic		Cognitive		Independent		Self-Care		Ambulatory		Vision		Hearing	
		RR <sup>†</sup>	95% CI <sup>‡</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age (years)	ALMH <sup>§</sup>												
	18-34												
	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	3.72	(2.98,4.64)**	0.91	(0.27,3.02)	1.94	(0.43,8.68)	0.39	(0.09,1.67)	0.72	(0.18,2.88)	1.39	(0.34,5.78)
	1-10	3.30	(2.82,3.86)**	2.53	(2.06,3.12)**	1.87	(1.04,3.37)*	3.41	(2.45,4.75)**	1.33	(0.77,2.28)	2.37	(1.30,4.32)**
	10+	3.44	(3.00,3.95)**	2.08	(1.58,2.73)**	0.97	(0.54,1.75)	1.88	(1.31,2.69)**	1.62	(1.01,2.61)*	2.18	(1.25,3.79)*
	35-54												
	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	2.99	(2.21,4.04)**	1.69	(1.12,2.54)*	1.02	(0.51,2.02)	1.90	(1.40,2.59)**	2.63	(1.46,4.77)**	2.70	(1.44,5.06)**
	1-10	3.50	(3.10,3.96)**	2.21	(1.94,2.52)**	1.68	(1.25,2.25)**	1.86	(1.61,2.14)**	1.54	(1.13,2.09)*	1.66	(1.19,2.31)**
	10+	3.71	(3.31,4.16)**	2.00	(1.75,2.29)**	1.22	(0.94,1.57)	1.54	(1.33,1.77)**	1.69	(1.29,2.22)**	1.57	(1.13,2.17)*
	55+												
	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	2.65	(1.94,3.62)**	1.63	(1.20,2.21)**	1.77	(1.14,2.75)*	1.29	(1.05,1.57)*	2.28	(1.45,3.58)**	1.49	(1.03,2.17)*
	1-10	3.17	(2.79,3.59)**	1.76	(1.56,1.99)**	2.11	(1.75,2.54)**	1.24	(1.14,1.36)**	1.71	(1.38,2.12)**	1.01	(0.80,1.27)
	10+	3.24	(2.91,3.60)**	1.45	(1.27,1.65)**	1.27	(1.02,1.59)*	1.13	(1.03,1.24)*	1.46	(1.19,1.79)**	0.97	(0.79,1.19)
Gender													
Female	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	2.72	(2.07,3.59)**	1.37	(1.00,1.86)*	1.36	(0.82,2.24)	1.24	(0.99,1.56)	1.59	(0.95,2.66)	1.40	(0.79,2.48)
	1-10	3.19	(2.87,3.55)**	1.84	(1.66,2.03)**	1.64	(1.31,2.06)**	1.31	(1.20,1.43)**	1.55	(1.26,1.92)**	1.19	(0.92,1.56)
	10+	3.27	(3.00,3.56)**	1.53	(1.38,1.70)**	1.22	(1.01,1.48)*	1.17	(1.07,1.27)**	1.56	(1.30,1.89)**	1.20	(0.95,1.52)
	Male												
Male	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	3.17	(2.41,4.16)**	1.93	(1.31,2.83)**	1.65	(0.96,2.84)	1.68	(1.33,2.12)**	2.95	(1.87,4.65)**	1.70	(1.16,2.49)*
	1-10	3.44	(3.08,3.83)**	2.48	(2.16,2.86)**	2.34	(1.86,2.95)**	1.63	(1.41,1.89)**	1.61	(1.22,2.12)**	1.25	(0.99,1.59)
	10+	3.71	(3.37,4.07)**	2.22	(1.91,2.58)**	1.22	(0.91,1.64)	1.39	(1.21,1.61)**	1.55	(1.18,2.05)**	1.06	(0.85,1.33)
Race/Ethnicity <sup>  </sup>													
Non-White	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	2.90	(2.21,3.80)**	1.56	(1.16,2.10)**	1.66	(1.05,2.63)*	1.26	(0.99,1.60)	1.30	(0.79,2.12)	2.48	(1.63,3.80)***
	1-10	3.00	(2.70,3.34)**	1.84	(1.64,2.06)**	1.78	(1.43,2.21)**	1.32	(1.19,1.46)**	1.69	(1.36,2.10)**	1.71	(1.35,2.16)***
	10+	3.13	(2.82,3.46)**	1.42	(1.23,1.64)**	1.08	(0.83,1.40)	1.27	(1.15,1.40)**	1.66	(1.29,2.13)**	1.35	(0.97,1.90)
White	0 (None)		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.
	0-1	2.94	(2.25,3.84)**	1.57	(1.09,2.26)*	1.37	(0.79,2.38)	1.42	(1.11,1.83)*	2.98	(1.95,4.54)**	1.50	(1.02,2.20)*
	1-10	3.50	(3.15,3.88)**	2.14	(1.91,2.40)**	1.99	(1.57,2.52)**	1.45	(1.31,1.61)**	1.49	(1.14,1.94)**	1.09	(0.86,1.37)
	10+	3.62	(3.31,3.95)**	1.84	(1.64,2.06)**	1.29	(1.05,1.59)*	1.20	(1.08,1.32)**	1.51	(1.24,1.84)**	1.08	(0.89,1.31)

Notes: Log-binomial models were adjusted for having reported one or more additional disabilities and age, gender, and/or race when not stratified by that factor. Each demographic characteristic was a separate model presenting the relative risk of reporting a disability and duration of activity limitations due to mental health conditions stratified by age, gender, or race/ethnicity. Reference categories for disability status were individuals without that disability type. All statistics were adjusted for the complex survey design of the National Health Interview Survey. Statistical significance was based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Relative risk

<sup>‡</sup>Confidence interval

<sup>§</sup>Activity Limitations due to Mental Health Conditions. Having reported a duration of an activity limitation due to a/an “depression/anxiety/emotional problem” or “other mental problems/ADD/ Bipolar/Schizophrenia.” Duration in years was categorized as 0 (None), greater than 0 to 1, greater than 1 to 10, and greater than 10 years.

<sup>||</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories).

Statistical significance: \* indicates  $p < .05$ , \*\* indicates  $p < .005$ , \*\*\* indicates  $p < .0005$ .

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SEPARATING SYMPTOMS OF DISTRESS FROM FUNCTIONAL LIMITATIONS:  
AN ESSENTIAL PATHWAY FOR UNDERSTANDING THE RELATIONSHIP  
BETWEEN MENTAL HEALTH AND DISABILITIES

BY

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Written under the direction of

Dona Schneider, PhD, MPH

## ABSTRACT

**Background.** Although research has shown an increased risk of disability among people with poor mental health, these studies are complicated by the fact that functional limitations are common to both mental disorders and disabilities. Additional research is needed to disentangle symptoms and function when measuring the association between mental health indicators and disabilities.

**Objective:** To determine the risk of experiencing disabilities among people reporting (1) non-specific psychological distress (NSPD) with and without activity limitations due to mental health conditions (ALMH), (2) no NSPD with and without ALMH, and (3) no ALMH with and without NSPD.

**Methods.** Using 2008-2015 National Health Interview Survey data the relative risk of disabilities across stratifications of NSPD, ALMH and demographic factors were estimated.

**Results.** Significant synergy was found between NSPD and ALMH when estimating disability risk. For example, people reporting no NSPD with ALMH were at 13.1 (95% CI = 8.6, 20.0) times the risk of reporting cognitive disabilities, compared to people reporting no NSPD without ALMH. These effects were modified by demographic factors, having multiple disabilities, and persisted across stratifications of age, gender, and race/ethnicity.

**Conclusion.** Three populations were identified experiencing disabilities and poor mental health that have important implications for how supports and services consider mental health and psychological distress across disabilities. Importantly, a subpopulation was identified reporting no ALMH with NSPD at risk of experiencing disabilities (compared

to people reporting no ALMH without NSPD), representing a population that could be experiencing psychological distress and disabilities due to factors other than mental health conditions.

## INTRODUCTION

People with poor mental health are at risk of experiencing enormous health disparities, inequity, and disability.<sup>1</sup> Research studies found that people with poor mental health were more likely to engage in adverse health behaviors and at greater risk of experiencing (co)morbidities, social inequities, and mortality than people with optimal mental health.<sup>2-6</sup> In the United States (U.S.), mental disorders were associated with significantly greater amounts of severe impairments than chronic medical (non-mental) disorders and significantly less treatment than chronic medical disorders.<sup>7</sup> Mood disorders were found to be the third leading cause of limitations in activities of daily living and functional impairment was one of the core criteria used in the Diagnostic and Statistical Manual of Mental Disorders Version IV (DSM-IV) to define psychiatric disorders.<sup>8,9</sup> Research in the US increasingly recognized disability as a feature of mental health due to the burden and economic cost of mental disorders on people.<sup>10-12</sup> However, problematically, researchers simultaneously recognized that definitions of both mental disorders and disability included impaired function and suggested that studies would be improved if they distinctly considered the symptoms of mental disorders and limitation related to disability.<sup>13</sup>

In the U.S., nationally recognized definitions of mental health incorporate function as an essential feature. The Centers for Disease Control and Prevention (CDC) defines mental health as “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community.”<sup>6</sup> This description recognizes the World Health Organization’s conceptualization that mental health is

“more than the absence of mental disorders, an integral part of health, and determined by a range of socioeconomic, biological, and environmental factors” and aligns with the International Classification of Function, Disability, and Health by describing mental health on a continuum of distress and function experienced by the individual identified through social constructs.<sup>14,15</sup> The CDC definition captures the complicated nature of mental health and highlights how multiple measures are necessary to capture the mental status of an individual in the context of their environment. However, function is still central to this definition and additional research is needed to understand the relationship between symptoms and function in mental health research.

In national surveillance efforts there are limited opportunities to study these definitions and concepts. The National Health Interview Survey (NHIS) is one of the few national surveys that includes nationally recognized measures that can be studied to further separate mental health symptoms, function, and disability. These include questions for the Kessler ‘K6’ scale of non-specific psychological distress, activity limitations due to mental health conditions, and standardized disability identifiers. The K6 is a 6-item scale developed to provide a valid screen for DSM-IV serious mental illness in community epidemiologic surveys in the US. The K6 has been robustly studied; people with psychological distress as measured by this scale have been found at greater risk of mental illness, health disparities, and inequity.<sup>16</sup> Activity limitation questions are part of the NHIS’s core assessment of function and health. The National Center for Health statistics (NCHS) has reported health conditions and associated limitations and impairments since the 1960s.<sup>17,18</sup> Currently, when individuals report activity limitations in the NHIS they are asked to identify the health condition(s) that cause the limitation.

The questions include two that asks people if limitations they experience are due to emotional or mental problems (e.g. depression, anxiety, attention deficit disorder, bipolar disorder, schizophrenia). Although this measure does not reflect the prevalence of mental health conditions in the US, it does represent a reliable estimate of people experiencing an activity limitation due to a specific health condition.<sup>19,20</sup> In addition to these two indicators of mental health, the NHIS includes six standardized disability identifiers developed by the NCHS and Census Bureau. These questions ask people if they have serious difficulties related to each of six areas: vision, hearing, cognition, ambulation, self-care and independent living.

Together these questions provide a way to study people reporting mental health symptoms (via non-specific psychological distress), mental health conditions (that limit function, via activity limitations due to mental health conditions), and disabilities (via standardized identifiers). To date there have not been any studies examining the relationship between NSPD, ALMH, and these standardized disability identifiers. My study set out to determine if there were meaningful differences in the reporting of disabilities across stratified levels of NSPD and ALMH. Using the measures included in the NHIS, the following exploratory null hypotheses were tested:

1. There was no difference in disability risk across levels of NSPD and ALMH.
2. There was no difference in risk of specific disability types across levels of NSPD and ALMH.
3. Demographic factors had no effect on the relationship between NSPD, ALMH, and disabilities.

## **METHODS**

### **Data Source**

This study used data representative of the adult, civilian, noninstitutionalized U.S. population from the 2008-2015 NHIS. The NHIS is a continuous, cross-sectional, in-person household survey of the Centers for Disease Control and Prevention's (CDC) monitoring the health of the nation that collects data on socio-demographics, health status and limitations, food security, healthcare access and utilization, health insurance, and income of households, families, children and adults. Annual response rate of the NHIS are approximately 80% of eligible households.<sup>21</sup> The response rates for adults eligible for this study were between 74.1-81.6%.<sup>22</sup>

The NHIS provides data files with responses to questions about demographic, non-specific psychological distress, and self-reported difficulties. Each NHIS sample was weighted to account for the probability of selection, nonresponse, and the age, gender, and race/ethnicity of the U.S. Weights were selected from the adult sample file to be most representative of people responding to non-specific psychological distress and reporting limitations due to mental health conditions. Based the NHIS recommendations, weights were divided by eight to account for eight years of data.<sup>20</sup>

### **Sample & Measures**

Approximately 85,000 people participate in the NHIS each year. In the NHIS every participant is not asked every question and subsamples (datasets) are produced with responses to various sets of questions. Datasets include an adult sample (people ages 18 and over responding to the NHIS in-person, approximately a third of the total NHIS sample, asked about non-specific psychological distress and activity limitations) and a

family disability questions sample (a randomized half of the total NHIS sample asked the function and activity difficulty questions). Approximately half of the people asked the adult sample questions are asked the family disability questions in any given year. By design, the majority of people excluded from these analyses were not asked the questions relevant to the study. After combining sample files, this analysis included 112,678 adult respondents (ages 18 and over) from the NHIS.

Demographic variables selected from the NHIS included age (18-34, 35-54, 55+), gender (male, female), and race/ethnicity (non-Hispanic White, non-White). Cutoff points of ages 35 and 55 were chosen because these were ages at which the overall sample prevalence of NSPD increase and decrease, respectively, and age 55 and over is associated with a period of significant mortality of people with serious mental illness.<sup>16</sup> Non-specific psychological distress (NSPD) was calculated in the adult NHIS sample using Kessler's K6 24-point screening score for non-specific psychological distress based on responses to six standardized ordinal emotional distress questions, "During the past 30 days, how often did you feel... sad/nervous/restless-fidgety/hopeless/everything was an effort/worthless?"<sup>23</sup> K6 question responses in the NHIS were converted to values of 0-4 and summed to a 0-24 point scale. NSPD was categorized as none (0) or any (1-24).

Duration and status of mental health conditions (ALMH) was estimated in the adult NHIS sample based on having reported difficulties with activities due to "depression/anxiety/emotional problem" or "other mental problems/ADD/Bipolar/Schizophrenia." These conditions include "neurotic disorders, personality disorders, and other nonpsychotic mental disorders, excluding alcohol and drug related problems and developmental problems" as well as "any other mental



disorders mentioned other than alcohol and drug related problems and developmental problems.”<sup>24</sup> This definition is consistent with the National Institute of Mental Health’s definition of serious mental illness.<sup>25</sup> Duration of ALMH was measured continuously in years. ALMH status was categorized as none (responses of ‘not mentioned’ for both question) or any (responses of ‘mentioned’ for either question resulting in some duration of difficulties with activities).

Using the NHIS disability family file, adults were identified as having a disability if they responded affirmatively to six standardized questions asking about having serious difficulties in the following subtypes: cognition, independent living, self-care, ambulation, vision, and hearing.<sup>26</sup> The sample adult respondent or designated family member responded to the disability questions. More than one limitation could be reported. In analyses disability status was categorized dichotomously (‘yes’ or ‘no’) as a dependent variable by type and again dichotomously (‘yes’ or ‘no’) for having reported one or more additional disabilities as an independent variable (e.g. when modeling the relative risk of reporting a cognitive disability (‘yes’ or no) the model was adjusted for having reported one or more additional disabilities other than cognitive (‘yes’ or ‘no’)).

### **Data Analysis**

All analyses were conducted using Statistical Analysis Software (SAS, Version 9.4) procedures that accounted for complex survey design effects in the NHIS. Taylor Series Linearization was used for variance estimation.<sup>20</sup> Strata and primary sampling unit variables were included in class and repeated subject statements to account for complex survey design effects. Confidence interval calculation used an alpha of 0.05. Relative risks, relating disability to NSPD and demographic characteristics, were estimated in the

generalized linear model procedure, using a log-link and binomial distribution with an intercept of -4 in to ensure model convergence.<sup>27</sup> Strata and primary sampling unit variables were again included in class and repeated subject statements to account for complex survey design effects. Models using a log link and binomial distribution were utilized to allow for a multivariate approach to relative risks estimation.<sup>28</sup> When models fail to converge, as they did here, changing the intercept value to -4 is a published finding recommended by SAS.<sup>29-31</sup>

Relative risk analyses examining the interaction of NSPD, ALMH and their association with disability were further stratified by demographic characteristics in separate models. Stratified analyses were utilized to control for the confounding effects of NSPD, ALMH and demographic factors. The risk ratios for age stratifications were adjusted for gender and race/ethnicity, the risk ratios for gender stratifications are adjusted for age and race/ethnicity, and the risk ratios for race/ethnicity stratifications are adjusted for age and gender. Stratified models were also adjusted for having reported one or more additional disabilities (other than the disability type being modeled). Stratified effects were estimated with a full-factorial model that included all main effects and all interactions terms (including three-way interactions in the models where the interaction of NSPD and ALMH were further stratified by demographic factors). Estimate statements utilizing the full-factorial model were included in the generalized linear model procedure to produce effects and test the hypotheses of interest. Model outcomes were having reported cognitive, self-care, independent living, ambulatory, vision, or hearing disabilities (versus not, people responding negatively to a specific disability type could still have responded affirmatively to others).

## RESULTS

Table 1 presents the descriptive statistics of the NHIS sample. The majority of participants were non-Hispanic white, ages 34 to 55 and female. Approximately half of people reported NSPD, 1 in 50 people reported ALMH, and 1 in 6 people reported a disability. Ambulatory difficulties were the most frequently reported disability and self-care was the least frequently reported disability.

<INSERT TABLE 1 ABOUT HERE>

Figure 1 presents the estimates of people in the sample conditional on disability status, age, NSPD, and ALMH. There are noteworthy changes across stratifications of each variable. Across age groups, the mean duration of ALMH increased (the median duration of ALMH did not change), while the total percentage of people reporting ALMH decreased. NSPD was highest among people who were younger and people who reported no ALMH. Almost all (greater than 95%) people reporting ALMH report NSPD.

<INSERT FIGURE 1 ABOUT HERE>

Table 2 presents the relative risk of reporting a disability with and without NSPD and with and without ALMH in two models. The first model present the relative risk of reporting disabilities with and without ALMH stratified by NSPD and the second models present the relative risk of reporting disabilities with and without NSPD stratified by ALMH. In both models, across all levels of NSPD and ALMH people were at increased risk of reporting disabilities (significant for all types except the vision model). There was also synergy across levels of NSPD and ALMH for cognitive, independent living, and self-care disabilities ( $P < 0.01$ ). The risk of reporting disabilities (all types except vision) was highest among people reporting no NSPD with ALMH, compared to people

reporting no NSPD without ALMH. The risk of reporting disabilities (all types except vision) was second highest among people reporting NSPD with ALMH, compared to people reporting NSPD without ALMH. And finally, the risk of reporting disabilities (all types except vision) was the lowest among people reporting no ALMH with NSPD, compared to people reporting no ALMH without NSPD. These effects were strongest for the cognitive disability model.

<INSERT TABLE 2 ABOUT HERE>

Table 3 presents the relative risk of reporting a disability with ALMH, compared to people without ALMH, stratified by NSPD and demographic factors. The risk of cognitive disabilities continued to be the highest of all the disability models (and significant at all levels). Stratifying and adjusting by NSPD, demographic factors, and multiple disabilities resulted in lower risks of reporting all disability types than in unadjusted models. Synergy only remained across levels of NSPD, ALMH, age, and gender for cognitive disability models ( $P < 0.05$ ). Among people reporting ALMH, there remained an increased risk of reporting disabilities across all stratifications of NSPD and demographic factors (all models except select levels in self-care, vision and hearing), compared to people reporting no ALMH. However, unlike people reporting NSPD with ALMH, across stratifications of people reporting no NSPD with ALMH, the only models where the risk of disabilities were consistently significantly elevated were cognitive and independent living. Overall, in these models the risk of reporting disabilities was higher for males, compared to females and higher for people ages 18-34, compared to people ages 55 and over.

<INSERT TABLE 3 ABOUT HERE>

Table 4 presents the relative risk of reporting a disability with NSPD, compared to people without NSPD, stratified by ALMH and demographic factors. Estimates are only presented for people without ALMH due to the majority of people with ALMH also reporting NSPD (greater than 95%, see Figure 1). The risk of cognitive disabilities also continued to be the highest of all the disability models (and significant at all levels). Stratifying and adjusting by ALMH, demographic factors, and multiple disabilities again resulted in lower risks of reporting all disability types than in unadjusted models. However, there remained a significantly increased risk of reporting disabilities across all stratifications of ALMH and demographic factors (all models except select levels in independent living, self-care and hearing). Synergy only remained across levels of ALMH, NSPD, age, and gender for cognitive disability models ( $P < 0.05$ ). In addition, in these models the risk of reporting disabilities varied inconsistently across levels of demographic factors.

<INSERT TABLE 4 ABOUT HERE>

## DISCUSSION

This study found the risk of reporting all disability types was significantly increased for people reporting NSPD and/or ALMH, especially for reporting cognitive disabilities. This risk varied significantly across levels of NSPD and ALMH, suggesting there are different populations experiencing psychological distress, poor mental health and disabilities. Further, these results suggest synergy across levels of NSPD and ALMH that varied depending on the disability type being modeled. Across all analyses, people were at greatest risk of reporting cognitive disabilities and at the smallest risk of reporting vision or hearing disabilities. Notably, a population at risk of all disabilities that

experienced NSPD without ALMH was identified. These associations were modified by demographic factors, especially age.

This study replicated the very limited literature on the relationship between psychological distress, functional limitations and disabilities using national surveys, finding associations between NSPD and disabilities.<sup>32-34</sup> However, to my knowledge there has not been a study of the interaction between NSPD and ALMH and the risk of experiencing disabilities. Although ALMH reflects only a subset of all people with mental health conditions in the general population, it still identifies an important and more severely affected subset. This biased identifier of people with mental health conditions was used to show both synergy with NSPD and to identify populations with differing risk of disabilities depending on level of psychological distress and mental health condition status. After further stratifying and adjusting by demographic factors I found strong differences in the risk of disabilities across levels of age. People with psychological distress or mental health conditions were at relatively lower risk of disabilities in the 55 and over age group compared to people between the ages of 18 and 54. These results reflect the existing literature which has found that people with poor mental health experience a marked increase in mortality after the age of 55 and over.<sup>16</sup>

As expected, people reporting NSPD and/or ALMH were at greater risk of reporting cognitive, independent living, and self-care disabilities than ambulatory, vision and hearing disabilities. I expected people reporting NSPD and/or ALMH to be at greatest risk of cognitive disabilities due to the conceptual nature of the cognitive difficulty question and expected elevated risks of independent living and self-care disabilities because one of my measures was conditional on having reported activity

limitations. This latter group contributes to validating the independent living and self-care standardized disability identifiers by showing that people reporting a range of activity limitations (due to mental health conditions) are also more likely to respond affirmatively to these two questions.

### **Limitations**

The NHIS is a cross-sectional survey and it impossible to disentangle the temporality of events that result in health problems, difficulties, or limitations in this data. It is not possible to determine if the burden of a hearing disability precedes and contributes to poor mental health or conversely, if psychological distress or the duration of activity limitations due to mental health conditions precede and contribute to the reporting of disabilities such as hearing or vision in this data. Longitudinal studies are needed to better understand the complex and varied nature of disability and mental health indicators in the NHIS.

Although this study focused on mental health (via NSPD and ALMH) and disability types (via serious difficulty questions), the categories in this study were quite broad. Further, the mental health indicators in this study were continuous measures categorized dichotomously to maintain cells sizes and ensure convergence in the models presented. This may limit the power or engender residual confounding in model results.<sup>35</sup> Non-specific psychological distress is a broad indicator of well-being reflecting individual and environmental factors that extend beyond mental health status. The cumulative stress and trauma associated with factors such as poverty, employment, income, and neighborhood violence and crime may contribute to the responses to mental health indicators, particularly psychological distress, included in this study. Racial

categories for non-white are especially broad and should be interpreted with caution.<sup>36</sup> Unmeasured and residual confounding may be present in the models in this study.<sup>37</sup> Limitations in daily activities were included as both dependent (via independent living and self-care disabilities) and independent (via activity limitations due to mental health conditions) variables. This may introduce error or confounding in some of the models presented.

The NHIS' mode of data collection is interviews and all responses are subject to reporting bias. Individuals may exaggerate or over-report and minimize or under-report their symptoms in response to questions.<sup>38</sup> Individuals only report mental health conditions and their duration in the NHIS if they report activity limitations, which contributes to the under-reporting of mental illness via the ALMH question. Respondents may systematically refuse to answer, not know the answer to questions, or may not have answers ascertained by surveyors due to survey design and contextual effects. Non-respondents may differ meaningfully from respondents.<sup>39</sup> These effects can also result in individuals responding for each other with varying degrees of reliability (i.e. proxy effects).<sup>39</sup> It is also possible that the location of questions and overall health context of the NHIS influences results in a fashion found in other studies.<sup>40</sup> Some of the questions may have differing response patterns among specific mental health conditions, disability groups, and demographic patterns.

## **Conclusion**

This study has implications for understanding the public health needs of people with any symptoms of poor mental health and disabilities. I found synergy across levels of NSPD and ALMH with populations at significantly different increased risk of



experiencing disabilities. Conditional on measures that represented symptoms (NSPD) and/or mental health conditions (ALMH) people experienced different risks for all disability types that varied by demographic factors.

My study shows that people experiencing any degree of psychological distress and/or duration (of activity limitations due to/of) mental health condition(s) are at increased risk of experiencing all types of disabilities. This study also suggests that there may be a population experiencing disabilities and poor mental health due to psychological distress from other factors on the individual and environmental level. People reporting all disability types, especially cognitive disabilities, may be experiencing psychological distress and impairment due to factors unrelated to an identifiable mental health condition and services and supports should both screen for and address psychological distress regardless of whether the person has a diagnosed severe mental health condition. This study also has implications for the research community using secondary data sets to study disability and mental health from surveys such as the NHIS. Importantly, my findings suggest that there is a significant difference between mental health symptoms and functional limitations and that both must be considered distinctly. Surveys may now have large enough sample sizes to identify these subpopulations at risk of experiencing disabilities with several stratifications of available measures.

My results also reinforce current theories and conceptualizations of mental health and disability. The World Health Organization and International Classification of Disability, Health, and Function both emphasize a biopsychosocial model where cumulative stress and trauma contribute to disability and poor mental health, suggesting a

life course approach is necessary the study of the these phenomenon. People in my study reported increasing percentages of disabilities across age groups and decreases in percentages of mental health conditions and psychological distress across age groups which may be affected by differential survival rates for people with mental health conditions and psychological distress. Although the percentage of people with poor mental health decreases across age, the mean duration of mental health conditions increases across age groups suggesting there is a population surviving and experiencing poor mental health (and disabilities) that decreases in size across the lifespan.

Table 1  
Sample characteristics

Characteristic	wgt n=103,912,116
	unwgt n=112,678
	% (95% CI) <sup>†</sup>
Age (years)	
18-34	30.6 (30.0,31.1)
35-54	35.8 (35.4,36.2)
55+	33.6 (33.1,34.1)
Female	51.8 (51.4,52.2)
Non-White <sup>‡</sup>	32.7 (32.0,33.4)
NSPD <sup>§</sup>	53.0 (52.5,53.6)
ALMH <sup>  </sup>	2.7 (2.5,2.8)
Disability	
Cognitive	5.5 (5.3,5.7)
Independent living	5.7 (5.5,5.9)
Self-care	2.6 (2.5,2.8)
Ambulatory	9.7 (9.4,9.9)
Vision	3.5 (3.3,3.7)
Hearing	5.6 (5.5,5.8)

Notes: All point estimates are weighted. Overall weighted (wgt n) and unweighted (unwgt n) sample sizes are the total number of respondents in the 2008-2015 National Health Interview Survey ages 18 and over who had responses to family disability file questions and adult sample file non-specific psychological distress, and activity limitation due mental health condition questions.

<sup>†</sup>Confidence Interval

<sup>‡</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories)

<sup>§</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0) versus any (1-24).

<sup>||</sup>Activity Limitations due to mental health conditions. Having reported an activity limitation due to a/an "depression/anxiety/emotional problem" or "other mental problems/ADD/Bipolar/Schizophrenia."

Figure 1 Weighted Percentage of People with Disabilities, Activity Limitations Due to Mental Health Conditions, Non-Specific Psychological Distress, and Mean and Median Duration of Activity Limitations Due to Mental Health Conditions Conditional on Age Group, Non-Specific Psychological Distress, and Activity Limitations Due to Mental Health Conditions

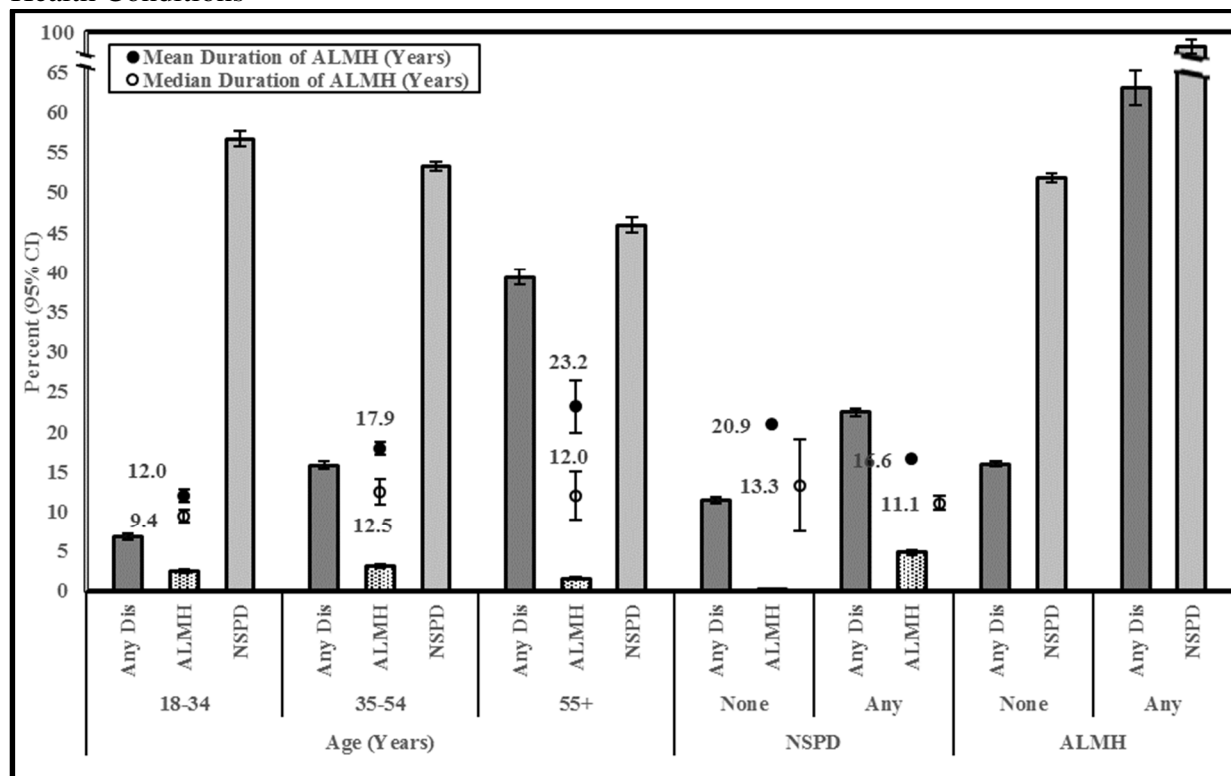


Table 2  
Risk of reporting disability dependent on non-specific psychological distress and activity limitations due to mental health conditions

			Cognitive		Independent Living		Self-Care		Ambulatory		Vision		Hearing	
			wgt n=5,707,464 unwgt n=7,113		wgt n=5,896,926 unwgt n=7,559		wgt n=2,751,560 unwgt n=3,540		wgt n=10,046,783 unwgt n=13,169		wgt n=3,643,259 unwgt n=4,813		wgt n=5,864,165 unwgt n=7,224	
Characteristic			RR <sup>†</sup>	95% CI <sup>‡</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Model 1	NSPD <sup>§</sup>	ALMH <sup>  </sup>												
		None												
		Any	13.1	(8.6,20.0)***	9.2	(6.0,14.0)***	9.1	(4.7,17.6)***	4.1	(2.7,6.2)***	2.0	(0.9,4.1)	2.7	(1.5,4.8)**
	Any	None												
Model 2	ALMH <sup>§</sup>	NSPD												
		None												
		Any	7.1	(6.6,7.6)***	4.9	(4.5,5.3)***	3.7	(3.3,4.2)***	2.8	(2.6,3.0)***	3.2	(2.8,3.7)***	2.1	(1.8,2.4)***
	None	None												
		Any	3.4	(3.1,3.8)***	2.6	(2.4,2.8)***	3.0	(2.7,3.4)***	2.3	(2.1,2.4)***	2.0	(1.8,2.2)***	1.2	(1.1,1.3)***

Notes: Log-binomial models estimating the relative risk of reporting disability were unadjusted for reporting multiple disabilities and demographic factors. Model 1 presents the relative risk of reporting a disability and having reported an activity limitation due to a mental health condition, stratified by non-specific psychological distress. Model 2 presents the relative risk of reporting a disability and having reported non-specific psychological distress stratified by having reported an activity limitation due to a mental health condition. The second stratification level of Model 2 was not presented due to limited response variation (greater than 95% of people reported NSPD if they reported a MHC, see Figure 1). Reference categories for disability status were individuals without that disability type. All statistics were adjusted for the complex survey design of the NHIS. Statistical significance based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Risk Ratio

<sup>‡</sup>Confidence interval

<sup>§</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0) versus any (1-24).

<sup>||</sup>Activity Limitations due to mental health conditions. Having reported an activity limitation due to a/an “depression/anxiety/emotional problem” or “other mental problems/ADD/Bipolar/Schizophrenia.”

Statistical significance: \* indicates p < .05, \*\* indicates p < .005, \*\*\* indicated p < .0005

Table 3

Risk of reporting disability dependent on activity limitations due to mental health conditions stratified by non-specific psychological distress and

Characteristic			Cognitive		Independent Living		Self-Care		Ambulatory		Vision <sup>†</sup>		Hearing	
			RR <sup>‡</sup>	95% CI <sup>§</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age	18-34	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	7.7	(3.8,15.7)***	2.0	(0.8,4.6)	2.1	(0.3,12.5)	5.2	(1.4,18.9)*	---		3.9	(0.5,30.4)
	35-54	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.8	(2.5,3.2)***	2.3	(1.9,2.8)***	1.4	(0.9,2.2)	2.1	(1.6,2.7)***	---		2.0	(1.3,3.1)**
	55+	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	3.4	(1.3,8.9)*	3.3	(1.6,6.6)**	2.8	(1.1,6.8)*	3.0	(1.4,6.6)*	0.6	(0.2,2.3)	3.1	(0.9,10.9)
		None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.9	(2.7,3.2)***	1.9	(1.7,2.1)***	1.3	(1.0,1.6)*	1.4	(1.3,1.6)***	1.5	(1.2,1.8)***	1.5	(1.1,1.8)**
		None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	4.5	(2.8,7.1)***	1.8	(1.1,3.0)*	1.7	(0.7,4.5)	1.2	(0.7,1.9)	0.8	(0.3,2.1)	0.9	(0.5,1.7)
Gender	Female	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	3.4	(1.8,6.2)***	1.3	(0.7,2.3)	2.0	(0.9,4.5)	1.6	(1.0,2.6)*	1.1	(0.4,2.8)	1.8	(0.7,4.9)
	Male	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.8	(2.5,3.0)***	1.5	(1.4,1.7)***	1.3	(1.1,1.5)**	1.1	(1.0,1.2)**	1.4	(1.3,1.7)***	1.2	(1.0,1.4)
		None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	5.4	(3.1,9.3)***	3.9	(2.5,6.1)***	2.6	(1.0,6.6)*	1.2	(0.6,2.3)	0.5	(0.1,1.5)	1.1	(0.6,2.1)
		None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.8	(2.5,3.0)***	1.9	(1.7,2.1)***	1.4	(1.2,1.7)**	1.3	(1.1,1.4)***	1.5	(1.2,1.8)***	1.2	(1.0,1.4)*
	Race / Ethnicity <sup>#</sup>	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	5.7	(3.9,8.4)***	2.5	(1.7,3.8)***	3.6	(2.0,6.4)***	1.3	(0.7,2.5)	0.7	(0.2,2.0)	1.0	(0.3,3.0)
Race / Ethnicity <sup>#</sup>	Non-White	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.5	(2.3,2.7)***	1.5	(1.3,1.6)***	1.3	(1.1,1.5)*	1.2	(1.1,1.3)***	1.5	(1.2,1.8)***	1.4	(1.2,1.7)***
	White	None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	3.6	(1.9,7.1)***	1.7	(0.8,3.7)	0.6	(0.2,2.1)	1.6	(1.0,2.7)	0.8	(0.3,2.2)	1.4	(0.8,2.5)
		None	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
		Any	2.9	(2.7,3.1)***	1.7	(1.6,1.9)***	1.3	(1.1,1.6)***	1.1	(1.1,1.2)**	1.5	(1.3,1.7)***	1.1	(1.0,1.3)

Notes: Log-binomial models were adjusted for having reported one or more additional disabilities and age, gender, and/or race when not stratified by that factor. Each stratification was a separate model presenting the relative risk of reporting a disability and having reported a limitation due to a mental health condition, stratified by non-specific psychological distress and age, gender, or race/ethnicity. Reference categories for disability statuses were individuals without that disability type. All statistics were adjusted for the complex survey design of the NHIS. Statistical significance was based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Estimates for vision disability were recoded 18-54 and 55+ because the generalized Hessian matrix was not positive definite in the original model.

<sup>‡</sup>Risk Ratio

<sup>§</sup>Confidence interval

<sup>||</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0) versus any (1-24).

<sup>¶</sup>Activity Limitations due to mental health conditions. Having reported an activity limitation due to a/an “depression/anxiety/emotional problem” or “other mental problems/ADD/Bipolar/Schizophrenia.”

<sup>#</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories)

Statistical significance: \* indicates p < .05, \*\* indicates p < .005, \*\*\* indicated p < .0005

Table 4

Risk of reporting disability dependent on non-specific psychological distress stratified by activity limitations due to mental health conditions and

Characteristic			Cognitive		Independent Living		Self-Care		Ambulatory		Vision <sup>†</sup>		Hearing	
			RR <sup>‡</sup>	95% CI <sup>§</sup>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age	ALMH <sup>  </sup>	NSPD <sup>¶</sup>												
		None												
	18-34	None												
		Any	2.9	(2.2,3.8)***	1.0	(0.8,1.4)	1.2	(0.7,1.9)	2.8	(2.0,3.8)***	---		1.4	(1.0,1.8)*
	35-54	None												
		Any	3.2	(2.6,3.9)***	1.7	(1.4,2.0)***	1.5	(1.2,1.9)**	2.5	(2.3,2.9)***	1.7	(1.5,2.0)***	1.4	(1.2,1.7)***
Gender	55+ None	NSPD <sup>¶</sup>												
		None												
		Any	2.1	(1.9,2.4)***	1.6	(1.5,1.7)***	1.9	(1.6,2.1)***	1.5	(1.5,1.6)***	1.4	(1.3,1.5)***	1.0	(0.9,1.0)
	Female	None												
		Any	2.3	(2.0,2.6)***	1.3	(1.2,1.4)***	1.5	(1.3,1.7)***	1.5	(1.4,1.6)***	1.5	(1.3,1.7)***	1.1	(1.0,1.2)
	Male	None												
Race / Ethnicity <sup>#</sup>	Non-White	NSPD <sup>¶</sup>												
		None												
		Any	2.5	(2.2,2.8)***	1.4	(1.2,1.5)***	1.5	(1.3,1.7)***	1.6	(1.5,1.7)***	1.7	(1.4,1.9)***	1.4	(1.2,1.6)***
	White	None												
		Any	2.5	(2.2,2.7)***	1.6	(1.5,1.8)***	1.9	(1.7,2.2)***	1.7	(1.6,1.8)***	1.4	(1.3,1.6)***	1.0	(0.9,1.0)

Notes: Log-binomial models were adjusted for having reported one or more additional disabilities and age, gender, and/or race when not stratified by that factor. Each demographic stratification was a separate model presenting the relative risk of reporting a disability and having reported a limitation due to a mental health condition, stratified by non-specific psychological distress and age, gender, or race/ethnicity. The second stratification level of each model was not presented due to limited response variation (greater than 95% of people reported non-specific psychological distress if they reported a limitation due to a mental health condition, see Figure 1). Reference categories for disability status were individuals without that disability type. All statistics were adjusted for the complex survey design of the NHIS. Statistical significance based on chi-squared statistics (alpha 0.05) comparing the predicted model to the null model of no risk.

<sup>†</sup>Estimates for vision disability were recoded 18-54 and 55+ because the generalized Hessian matrix was not positive definite in the original model.

<sup>‡</sup>Risk Ratio

<sup>§</sup>Confidence interval

<sup>||</sup>Activity Limitations due to mental health conditions. Having reported an activity limitation due to a/an "depression/anxiety/emotional problem" or "other mental problems/ADD/Bipolar/Schizophrenia."

<sup>¶</sup>Non-specific psychological distress. Based on Kessler K6 24 point scoring. NSPD was categorized as none (0) versus any (1-24).

<sup>#</sup>White, non-Hispanic vs Non-White (all other race/ethnic categories)

Statistical significance: \* indicates  $p < .05$ , \*\* indicates  $p < .005$ , \*\*\* indicated  $p < .0005$

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THE BURDEN OF ADVERSE SOCIAL DETERMINANTS ON COGNITIVE  
DISABILITIES ACROSS MENTAL HEALTH SUBGROUPS

BY

ERIC ANDREW LAUER

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Dona Schneider, PhD, MPH

## ABSTRACT

**Objectives.** To (1) measure the association between mental health, social determinants of health (SDH), and cognitive disability and (2) identify groups with distinct conceptual and empirical differences across measures.

**Methods.** National Health Interview Survey (NHIS) data (2008-2015) was used to create a nationally representative sample of non-institutionalized civilians in the United States (n=103,912,116) to estimate the prevalence of SDH and risk of cognitive disability among people with poor mental health.

**Results.** The prevalence of cognitive disability and adverse SDH increased in a robust, stepwise fashion across gradients of poor mental health. Within gradient, cognitive disability risk was increased among people with adverse SDH, compared to people without adverse SDH.

**Conclusions.** Subgroups of people with poor mental health and differential distributions of SDH and cognitive disability were identified in the NHIS. Poor mental health was robustly associated with cognitive disability and adverse SDH. Mental health services should be considered for people with cognitive disabilities. These services should consider addressing many, if not all, social determinants of health.

## INTRODUCTION

Recent public health research has recognized that people with disabilities remain an under-studied and under-recognized population experiencing health disparities and inequity.<sup>1</sup> In the United States (U.S.), compared to people without disabilities, people with disabilities show substantial differences in access to health care (e.g. health insurance, usual source of care, ability to afford care), health behaviors (e.g. smoking, obesity, activity levels), health status and social determinants of health. Emphasizing the ongoing need to disentangle the complex relationship between health, disability and social determinants, this literature recognizes that a cascade of factors, more than specific health conditions, contribute to a chronology of altered health status, functional loss, disability, and subsequent deteriorating health.<sup>2</sup> Despite this progress, there are still many areas, such as mental health, that have had little exploration through national surveillance.<sup>3</sup> In order to continue moving disability-related public health research forward, leaders in the field have promoted an agenda utilizing national survey data to identify populations at risk of disability and health disparities using standardized disability questions to develop targeted interventions for people with disabilities in public health programs and services.<sup>1,4</sup>

Although approximately 35% of all Social Security disability insurance recipients qualify for disability based on a mental health condition,<sup>5</sup> the concomitant and predisposing nature of mental health for disabilities has been recognized, but not well-studied, in U.S. national surveys. The high prevalence of mental illness (~18%) and disability (~22%) in the general population has led to the inclusion of psychological distress and disability indicators which strongly predict mental illness and disability,

respectively, in U.S. national surveys.<sup>6,7</sup> However, to date there have been no studies utilizing both sets of current indicators. The paucity of research on current indicators of psychological distress and older questions on disability found that people with severe psychological distress, indicative of serious mental illness, are more likely to experience disabilities, chronic conditions, and barriers to health care.<sup>8,9</sup> People with increased psychological distress and disability were also less likely to have health insurance, life satisfaction, and more likely to have inadequate social supports.<sup>9,10</sup> These papers, in addition to not using current disability questions, do not focus on many social determinants of health other than a few, specific health conditions and health care factors.

While there is an existing literature that has studied mental health indicators, social determinants of health, or cognitive disability separately in the National Health Interview Survey (NHIS), to the best of my knowledge there have been no studies of mental health indicators (i.e. K6 and activity limitations due to mental health conditions), social determinants of health, and cognitive disabilities together (i.e. the cognitive disability question related to the ACA mandate) in the NHIS. Currently, the NHIS provides an opportunity to study the relationship between mental health, disability, and social determinants of health through its inclusion of current standardized disability identifiers (e.g. cognitive disability), nationally recognized mental health questions (e.g. the Kessler ‘K6’ question series), and numerous social determinants of health since late 2008.<sup>11,12</sup> Beginning in 2010, the Affordable Care Act mandated that all national surveys include a series of questions to identify people with disabilities in the United States.<sup>13</sup> One of these questions further asks people if they have difficulty remembering, concentrating, or making decisions and is intended to capture people with cognitive

disabilities.<sup>14</sup> During this same time period, the NHIS has also included two mental health indicators. The first is the Kessler 6 question series designed to measure psychological distress and serious mental illness in the general population.<sup>15</sup> The second is part of the NHIS overall design and asks people to identify mental health problems due to activity limitations.

The goal of this study was to (1) find evidence of populations with differential mental health status based on conceptually distinct mental health indicators, (2) report differences in the distributions of demographic factors, social determinants of health, and cognitive disabilities among groups with poor mental health, and (3) explore how the risk of cognitive disabilities among populations with poor mental health were modified by social determinants of health.

## **METHODS**

### **Sample**

The study population came from 8 successive years (2008-2015) of NHIS data. The NHIS is a continuous, cross-sectional, nationally representative survey of the civilian, non-institutionalized U.S. population. The NHIS focuses on the health and tracks illness, disability, and progress towards national health objectives. The NHIS collects its data through in-person household interviews conducted by the U.S. Census Bureau for the National Center of Health Statistics using computer assisted personal interviewing administered with a laptop computer with interviewers entering responses directly into the computer during interviews. All adult members of a household ages 17 and over at home at the time of the interview were invited to participate and respond for themselves. A randomly selected adult member was chosen to answer questions about psychological

distress as well as questions about social determinants of health and disability as part of the overall survey design. The data for this study came from these adult interviews and there were no proxy responses in this study. The final annual response rate for the sample adult component of the NHIS ranged from 55.2% to 62.6% during 2008 to 2015. A total of 249,134 adults were interviewed by the NHIS from 2008 to 2015. Of these, 112,678 were ages 18 and over, asked and responded to mental health and disability questions, and made up the sample for this study. Data were weighted to account for the probability of selection, nonresponse, and to adjust for age, sex, and race/ethnicity. Weights were selected from the adult sample and divided by eight to reflect 8 years of data.

### **Variable Selection**

Mental health groups were created using two measures. The first measure used the Kessler K6 question series (K6) designed to assess psychological distress in general population surveys.<sup>15</sup> The K6 is a six item rating scale that assesses frequency of non-specific psychological distress over the past 30 days and studies have shown that the K6 is able to reasonably detect DSM-IV mental disorders.<sup>16,17</sup> Items are rated from “none” (0) to “all the time” (4) and culminate in a summary score range of 0 to 24. Non-specific psychological distress (NSPD) was defined as none (0) versus any (1-24). The second measure used to define mental health groups was the question series designed by the NHIS to capture whether people have an activity limitation due to a mental health condition (depression/anxiety/emotional problem, other mental problems/ADD/Bipolar/Schizophrenia, neurotic disorders, personality disorders, and other nonpsychotic mental disorders, excluding alcohol and drug related problems and developmental problems or any other mental disorders mentioned other than alcohol and



drug related problems and developmental problems).<sup>11</sup> This definition is consistent with the National Institute of Mental Health's definition of serious mental illness.<sup>18</sup> Activity limitations due to mental health conditions (ALMH) were defined as none (responses of 'not mentioned' for both questions) or any (responses of 'mentioned' for either question resulting in some duration of difficulties with activities).

Cognitive disability was assessed in the NHIS by asking participants, "Because of a physical, mental, or emotional problem, do you having difficulty remembering, concentrating, or making decisions?" This question is part of the disability questions series chosen by the Department of Health and Human Services to respond to the Affordable Care Act (2010) mandate to include standardized disability identifiers in all national surveys.<sup>13,19</sup> Individuals were able to respond 'yes' or 'no' to this difficulty question and categorized as having a cognitive disability if they responded yes.

Adverse social determinants were broadly selected based on the *Healthy People* model of Social Determinants of Health (SDH) which uses a conceptual framework that encompasses five domains: social context (e.g. social support, family circumstances), neighborhood environment (e.g. housing, neighborhood, and environment), health and health care (e.g. access to health care, access to primary care), economic stability (e.g. income, poverty, employment, food security), and education (e.g. higher education, language, and literacy).<sup>20</sup> NHIS items were systematically reviewed and grouped based on their conceptual context into categories related to these domains. In this study the 'isolation' category included social and neighborhood domain factors, the health and health care domain was split with the 'health status' category including health factors and the 'health care' category including health care utilization and access factors, the

‘economic’ category included economic domain factors, and the ‘education’ category included education domain factors.

In addition, two indicators were included as adverse social determinants of health despite their being known as having decreased risk among people with disabilities: ‘no health insurance’ and ‘no usual source of care’ due to their value in public health research. Not all social determinants of health were included in every year of data in the NHIS. Individual models with adverse SDH were limited to the availability of the data.

Within the category of isolation related variables, ‘poor neighborhood social cohesion’ was based on four NHIS questions that ask people if they definitely agree, somewhat agree, somewhat disagree or definitely disagree with statements that people in their neighborhood “help each other,” “can be counted on,” “can be trusted,” and that their neighborhood is “close-knit.” Poor neighborhood social cohesion was defined as having reported any disagreement with one or more of the four statements. ‘Family size of one’ was defined as people having reported a family size of one versus having reported families of sizes two or more. The NHIS defines family as an individual or a group of two or more related persons who are living together in the same household. ‘Living alone’ was defined as people reporting living alone versus having reported any other family structure (e.g. living with roommates, married couples, unmarried couples, parents with children). ‘Not married’ was defined as having reported being separated, divorced, single, never married, and widowed versus having reported being married using the Centers for Disease Control and Prevention’s standard for legal marital status. ‘Delayed care due to lack of transportation’ was defined as having reported delaying care in the

past 12 months because a respondent didn't have access to transportation versus not having reported this problem.

In the category of health status variables, 'health behaviors' were defined as having reported being currently obese or currently smoking versus having reported neither. Binge drinking was not included because it is known that people with disabilities are less likely to binge drink.<sup>21</sup> 'Chronic health conditions' were identified using 10 physical conditions available in the NHIS recommended by DHHS for consistent and standardized measurement of chronic conditions in the U.S.<sup>22</sup> Respondents were identified as having chronic conditions if they responded 'Yes' to dichotomous questions asking if they had hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, or hepatitis (diagnosed by doctor or health care provider); weak or failing kidneys (during the past 12 months); asthma (currently); or chronic obstructive pulmonary disease (defined as having emphysema or chronic bronchitis in the past 12 months). Coding of these responses was validated with the National Center for Health Statistics. 'Poor or fair self-reported health' was defined as having reported general health as fair or poor versus excellent, very good, or good. 'Pain' was based on five pain-related questions asked whether during the past three months respondents had pain in their neck, low back, leg or knee, facial or jaw, or headaches or migraines. Pain was defined as having reported 'Yes' to any one of these questions.

For the category of health care variables, 'no health insurance' was based on the summary health insurance coverage variable created by the NHIS which defines a lack of coverage as people having not reported any coverage at the time of the interview under private health insurance, Medicare, Medicaid, State Children's Health Insurance Program,

other government programs, and military health plans. ‘Received care 10 or more times’ was defined as having reported receiving care from doctors or other health care professionals 10 or more times in the past 12 months. ‘Overnight hospital stay’ was defined as having reported being hospitalized overnight at least once in the past 12 months (not including overnight emergency room visits). ‘Couldn’t afford prescription medication’ was defined as having reported needing one or more prescription medication(s) in the past 12 months but not getting it due to an inability to afford it. ‘Couldn’t afford medical care’ was defined as having reported needing medical care once or more in the past 12 months but not getting it due to an inability to afford it. ‘No usual source of care’ was defined as having no place a respondent usually goes when they are sick or need advice about health.

Within the category of economic variables, ‘not employed’ was defined as having reported ‘looking for work’ and ‘not working at a job or business and not looking for work’ versus having reported ‘working for pay at a job or business,’ ‘with a job or business but not at work,’ or ‘working, but not for pay, at a family-owned job or business’ in the last week. ‘Poverty’ was based on family income and defined as having reported income below the federal poverty level. NHIS estimates of federal poverty level calculations use thresholds from the Census Bureau. ‘Food insecurity’ was based on the ten point scale constructed using a ten question series recommended by the U.S. Department of Agriculture Economic Research Service to estimate the degree of food security a participant experiences. Affirmative responses indicate some degree of food insecurity. The NHIS provides a summary variable indicating the number of affirmative responses to this question series with scores of high security (0 affirmative responses),

marginal food security (1-2 affirmative responses), low food security (3-5 affirmative responses), and very low food security (6-10 affirmative responses). Food insecurity was defined as having reported high security versus marginal, low and very low food security.

For the education category variables, ‘no college degree’ was defined as having reported less than a college degree (i.e. associate’s degree, some college, high school diploma or less) versus having reported a college degree or higher (i.e. bachelor’s, master’s, professional, or doctoral degree). ‘No college degree in family’ was defined as someone in the participants’ family, other than the participant, having reported less than a college degree versus having reported a college degree or higher. ‘English not spoken very well’ was defined as a participant having reported that they speak English well, not well, or not at all versus a participant having reported that they speak English very well.

Summary variables were created to reflect the five adverse social determinant domains in this study. Each summary indicator was defined as having reporting one or more of the social determinants in the domain it represents. The summary variable for the ‘any healthcare’ domain included all study variables in the healthcare category except ‘no health insurance’ and ‘no usual source of care.’ Demographic variables were age (18-34, 35-54, 55+), gender (male, female), and race/ethnicity (White, Non-Hispanic, Non-White). For coding purposes, all responses of refused, not ascertained, or with “don’t know” responses were defined as missing.

### **Statistical Analysis**

I estimated the prevalence of demographic factors, cognitive disability and adverse SDH using bivariate analyses. Prevalence was reported across categories of mental health defined as having reported no NSPD without ALMH (no non-specific

psychological distress and no activity limitations due to mental health conditions), NSPD without ALMH (non-specific psychological distress and no activity limitations due to mental health conditions), and ALMH with or without NSPD (activity limitations due to mental health conditions with and without non-specific psychological distress).

Notably, for bivariate analyses the category of ALMH without NSPD (activity limitations due to mental health conditions with no non-specific psychological distress) was collapsed into ALMH with NSPD for two reasons. There were sample size constraints in this group resulting in extremely small cell sizes and the prevalence of cognitive disabilities for people with ALMH without NSPD was most similar to people with both NSPD and ALMH. This ensured the validity of inferential analyses across groups and that estimates were based on the entire sample available. For bivariate analyses, Rao-Scott chi-square tests of independence, taking into account survey design effects, were conducted to compare proportions across and between mental health categories.

Full factorial multivariate logistic regression models were conducted to estimate the risk of cognitive disability within mental health groups between people with and without adverse SDH. In these models, mental health was defined as having reported no NSPD without ALMH, NSPD without ALMH, and NSPD with ALMH. Models were not presented for activity limitations due to mental health conditions without non-specific psychological distress (no NSPD with ALMH) due to the small cells sizes in this group. All models were adjusted for demographic factors. In order to compare estimates between models, the log-odds mean estimates and log-odds standard errors from logistic models were used to conduct tests of means between mental health groups.

### **Bonferroni Correction**

All reporting of statistical significance for SDH-related estimates were corrected for multiple comparisons. Comparisons across and between mental health groups were considered separate, distinct hypotheses. The reporting of proportions of SDH and risk of cognitive disability with and without SDH were then considered a repeated testing for each SDH analyzed. Each hypothesis was then considered tested across 27 different SDH variables (22 individual and 5 summary indicators) repeatedly. In order to take into account the inferential testing of these hypotheses multiple times, a Bonferroni correction was applied based on the 27 SDH variables included in this study.<sup>23</sup> All indications of statistical significance related to SDH include a Bonferroni correction for 27 comparisons.

## **RESULTS**

The study sample characteristics and prevalence of cognitive disabilities are presented in table 1. There was a marked mental health gradient in the prevalence of cognitive disability, with a stepwise increase in cognitive disabilities for people reporting no NSPD without ALMH, NSPD without ALMH, and ALMH with or without NSPD ( $p < 0.005$ ). Compared to people reporting no NSPD without ALMH, there was a 4.8-percentage-point increase in cognitive disability prevalence among people with NSPD without ALMH and a 44.2-percentage-point increase in cognitive disability prevalence among people with ALMH with or without NSPD. In bivariate analyses there were significantly greater percentages of people who were female and significantly smaller percentages of people who were non-white among people reporting either NSPD without

ALMH or ALMH with or without NSPD, compared to people with no NSPD without ALMH ( $p < 0.005$ ).

<INSERT TABLE 1 ABOUT HERE>

Table 2 presents the prevalence of adverse SDH among people with and without NSPD and with and without ALMH. The prevalence of most adverse SDH were patterned according to a mental health gradient; across 19 out of 22 indicators I found a significant trend of increasing percentages of adverse SDH across people reporting no NSPD without ALMH, NSPD without ALMH, and ALMH with or without NSPD (after Bonferroni correction,  $p < 0.005$ ). The largest increase between people with no NSPD without ALMH and NSPD without ALMH was for pain, an increase of 24-percentage-points. The largest increase between people with NSPD without ALMH and ALMH with or without NSPD was for fair or poor health, an increase of 32.2-percentage-points. Pain also had the largest increase between people with no NSPD without ALMH and NSPD with ALMH, an increase of 48.1-percentage-points.

<INSERT TABLE 2 ABOUT HERE>

The increasing prevalence trend across groups (no NSPD without ALMH, NSPD without ALMH, and NSPD with ALMH) was also found in my 5 summary variables (any isolation, any health status, any healthcare, any economic, and any education indicators) reflecting each area of adverse SDH (after Bonferroni correction,  $p < 0.005$ ). The any healthcare indicator had the largest increases in percentages between all groups (between no NSPD without ALMH and NSPD without ALMH, NSPD without ALMH and NSPD with ALMH, and no NSPD without ALMH and NSPD with ALMH) with increases of 15-, 30.9-, and 45.9-percentage-points, respectively. The type of trend discussed did not



occur for ‘no web use’, ‘no usual source of care,’ and ‘English not spoken very well.’ In each of these SDH either the NSPD without ALMH or ALMH with or without NSPD groups had lower prevalence than the no NSPD without ALMH group.

Table 3 presents the results of my full factorial multivariate logistic regression models for adverse SDH, NSPD and ALMH, adjusted for age, gender and race/ethnicity. Each adverse SDH was modeled separately. The overall differences in risk between mental health statuses are presented first. Compared to people without NSPD and without ALMH, the baseline odds of having a cognitive disability for people with NSPD without ALMH and ALMH with/without NSPD were 3.9 (3.5, 4.3) and 51.2 (45.2, 58.2), respectively. I did not find significant synergy between people with adverse SDH, NSPD and ALMH, compared to people without adverse SDH and no NSPD without ALMH, (results available upon request). Subsequent measures of risk in this table are within group. Within groups of people with similar mental health status, I found significantly increased risk of cognitive disability with adverse SDH, compared to people without adverse SDH. This effect was significant for 21 of 22 adverse SDH (except not having health insurance and not having a usual source of care, which were significantly protective) and all summary measures for people without NSPD and without ALMH and NSPD without ALMH (after Bonferroni correction,  $p < 0.005$ ). Among people with ALMH with/without NSPD, this effect was significant for 12 of 22 adverse SDH and 4 of 5 summary measures (after Bonferroni correction,  $p < 0.005$ ). Overall, within groups with similar mental health status, risks were generally highest for people with no NSPD without ALMH, next highest for people with NSPD without ALMH, and relatively lowest for people with ALMH with/without NSPD. Not having health insurance and not

having a usual source of care were found to be protective towards the risk of having a cognitive disability. This was expected as people with disabilities are more likely to have health insurance and a usual source of care than people without disabilities.<sup>21,24</sup>

<INSERT TABLE 3 ABOUT HERE>

## DISCUSSION

My results strongly suggest that populations identified by mental health symptoms (via NSPD) and mental health conditions (via ALMH) reflect populations with different distributions of demographics (i.e. age and race), adverse social determinants of health, and cognitive disabilities. Compared to people without NSPD and without ALMH, I found a consistently patterned gradient whereby people with NSPD with and without ALMH had significantly increasing and significantly different prevalence of adverse social determinants and cognitive disabilities. Among these two groups, the presence of almost all social determinants significantly increased the risk of cognitive disabilities. The lack of synergy found between SDH, NSPD and ALMH may require more complicated multivariate modeling to estimate (e.g. additional covariates) or may not be significant due to the extremely large overall risk of cognitive disability across NSPD and ALMH subgroups.

My findings are consistent with those reported by Krahn et al. (2015) which discusses that people with disabilities experience inequalities across almost all social determinants, compared to people without disabilities.<sup>1</sup> Similarly, I found that people reporting poor mental health, compared to without poor mental health, experienced inequalities across almost all social determinants. Understanding how much poor mental health, representing a substantial portion of people reporting disabilities, contributes to

the inequalities experienced by people with disabilities will be important to future research efforts. Stratifying people with disabilities by age and mental health status, in a similar fashion that it is recommended for disability and employment status, may be warranted.

Another avenue of exploration is the concomitant nature of poor mental health with other chronic health conditions. Worsening mental health may represent a preventable inequality experienced by people with disabilities and poor health. Distinguishing between poor mental health that leads to disability and poor mental health that is the result of disabilities and poor health is essential for determining inequities being experienced.

### **Limitations**

The NHIS is a cross-sectional survey and it is not possible to determine if having a cognitive disability precedes and contributes to poor mental health or conversely, if psychological distress or the duration of activity limitations due to mental health conditions precede cognitive disabilities. The categories in this study were quite broad and the mental health indicators in this study were continuous measures categorized dichotomously to maintain cells sizes and ensure model convergence which may limit the power or engender residual confounding in model results.<sup>25</sup> Racial categories for non-white are especially broad and should be interpreted with caution.<sup>26</sup> Unmeasured and residual confounding may be present in the models in this study.<sup>27</sup> Limitations in daily activities were included as an independent (via activity limitations due to mental health conditions) variables and this may introduce error or confounding in some of the models presented.

All responses in the NHIS are subject to reporting bias and individuals over-report or under-report their symptoms in response to questions.<sup>28</sup> Individuals only report mental health conditions and their duration in the NHIS if they report activity limitations, a factor which contributes to the under-reporting of mental illness via the ALMH question. The reporting of more severe mental health conditions may increase the risk of reporting cognitive disabilities. However, this indicator is always included with or without NSPD and it is unclear how this may bias results. Respondents may systematically answer questions differentially due to survey design and contextual effects. Non-respondents may differ meaningfully from respondents.<sup>29</sup> These effects can also result in individuals responding for each other with varying degrees of reliability (i.e. proxy effects).<sup>29</sup> It is also possible that the location of questions and overall health context of the NHIS influences results similar to other studies.<sup>30</sup>

## **Conclusion**

Mental health supports and services should be considered for people with cognitive disabilities. In addition, core competency programs and courses for people with disabilities should consider incorporating mental health information and treatment resources and recommendations. Efforts like these for people with disabilities should recognize that poor mental health may be causing an individual's disability or that people with disabilities may also often be experiencing poor mental health. Considering that people with poor mental health and/or disabilities experience inequalities across almost all social determinants of health research should be encouraged to fully assess effective and specific interventions for these populations. Moreover, due to the stigma, isolation, and exclusion people with poor mental health and disability experience more awareness

and research is needed to ensure the explicit inclusion of these populations in public health efforts.

Table 1  
Sample characteristics

			Activity Limitations due to Mental Health Conditions						
			None		Any				
			Non-Specific Psychological Distress						
			None		Any		None or Any		
			wt n=52,295		wt n=57,185		wt n=3,198		
			unwt n=48,694,685		unwt n=52,460,920		unwt n=2,756,510		
Characteristic			%	95% CI	%	95% CI	%	95% CI	$\chi^2$ (df)
Demographics	Age	18-34 <sup>G* I</sup>	28.2	(27.5,28.8)	32.9	(32.1,33.6)	29.0	(26.7,31.3)	460* (4)
		35-54 <sup>H* I</sup>	35.3	(34.8,35.9)	36.0	(35.4,36.6)	40.5	(38.1,42.8)	
		55+ <sup>G* H</sup>	36.5	(35.8,37.1)	31.2	(30.5,31.8)	30.5	(28.5,32.6)	
	Female <sup>G* H</sup>		47.2	(46.7,47.8)	55.6	(55.1,56.2)	58.9	(56.6,61.2)	841* (2)
	Non-White <sup>G* H* I</sup>		35.5	(34.6,36.3)	30.4	(29.7,31.2)	27.2	(25.2,29.1)	361* (2)
Disability	Cognitive <sup>G* H* I</sup>		1.9	(1.8,2.1)	6.7	(6.4,6.9)	46.1	(43.8,48.4)	10927* (2)

Note. CI = Confidence Interval; wt = weighted; unwt = unweighted;  $\chi^2$  = Rao-Scott chi-square test; df = degrees of freedom; <sup>G, H, I</sup> denote significant differences among people with no activity limitations due to mental health conditions (ALMH) with and without non-specific psychological distress (NSPD), between no ALMH without NSPD and ALMH with or without NSPD, and between no ALMH with NSPD and ALMH with or without NSPD, respectively; All significance tests signify alpha 0.005 after correction.

Table 2  
Percentage of social determinants among people with and without mental health indicators

Characteristic		Activity Limitations due to Mental Health Conditions						$\chi^2$ (df)
		None		Any				
		Non-Specific Psychological Distress						
		None		Any		None or Any		
		%	95% CI	%	95% CI	%	95% CI	
Isolation	Poor Neighborhood Social Cohesion <sup>G H</sup>	7.5	(7.2,7.8)	10.9	(10.5,11.3)	13.0	(11.4,14.6)	400* (2)
	Family Size of One <sup>G H I</sup>	17.7	(17.3,18.2)	20.6	(20.0,21.2)	24.1	(22.4,25.7)	185* (2)
	Living Alone <sup>G H I</sup>	16.0	(15.6,16.5)	17.9	(17.4,18.4)	21.9	(20.3,23.5)	117* (2)
	Not Married <sup>G H I</sup>	41.8	(41.1,42.5)	49.8	(49.1,50.5)	62.3	(60.0,64.7)	1008* (2)
	No Web Use <sup>G H I</sup>	26.4	(25.6,27.2)	22.0	(21.3,22.7)	33.0	(30.0,36.0)	233* (2)
	Delayed Care due to Lack of Transportation <sup>G H I</sup>	0.6	(0.5,0.7)	2.5	(2.4,2.7)	10.5	(9.2,11.9)	1854* (2)
	Any Isolation Indicator <sup>G H I</sup>	52.6	(51.9,53.3)	59.1	(58.4,59.8)	71.9	(69.7,74.1)	770* (2)
Health	Health Behaviors <sup>G H I</sup>	36.6	(36.0,37.2)	44.2	(43.5,44.8)	63.7	(61.5,66.0)	1300* (2)
	Chronic Health Conditions <sup>G H I</sup>	45.1	(44.4,45.7)	53.5	(52.8,54.1)	73.6	(71.4,75.7)	1455* (2)
	Poor or Fair Self-Reported Health <sup>G H I</sup>	7.2	(6.9,7.5)	16.2	(15.7,16.7)	48.4	(46.0,50.8)	5427* (2)
	Pain <sup>G H I</sup>	26.3	(25.8,26.8)	50.3	(49.7,50.9)	74.4	(72.4,76.5)	8145* (2)
	Any Health Status Indicator <sup>G H I</sup>	69.3	(68.7,69.9)	82.0	(81.5,82.5)	94.3	(93.1,95.5)	2978* (2)
Healthcare	No Health Insurance <sup>G</sup>	14.6	(14.1,15.1)	16.9	(16.3,17.4)	18.1	(16.0,20.2)	119* (2)
	Received Care 10 or More Times <sup>G H I</sup>	7.8	(7.5,8.1)	15.2	(14.8,15.6)	37.8	(35.6,40.0)	3208* (2)
	Overnight Hospital Stay <sup>G H I</sup>	6.9	(6.7,7.2)	10.6	(10.2,10.9)	19.0	(17.2,20.7)	794* (2)
	Couldn't Afford Prescription Medications <sup>G H I</sup>	3.9	(3.6,4.1)	11.5	(11.1,11.9)	29.6	(27.4,31.7)	3843* (2)
	Couldn't Afford Medical Care <sup>G H I</sup>	4.4	(4.1,4.6)	10.5	(10.1,10.8)	23.4	(21.4,25.4)	2388* (2)
	No Usual Source of Care <sup>G</sup>	14.4	(13.9,14.9)	15.9	(15.4,16.4)	12.9	(11.1,14.7)	60* (2)
	Any Healthcare Indicator <sup>G H I</sup>	17.7	(17.3,18.2)	32.7	(32.1,33.3)	63.6	(61.3,65.9)	5316* (2)
Economic	Not Employed <sup>G H I</sup>	36.2	(35.6,36.9)	40.0	(39.3,40.8)	68.8	(66.6,71.0)	1310* (2)
	Poverty <sup>G H I</sup>	10.9	(10.5,11.3)	15.2	(14.6,15.8)	30.7	(28.3,33.1)	1114* (2)
	Food Insecurity <sup>G H I</sup>	13.2	(12.5,13.9)	26.5	(25.5,27.4)	48.8	(44.8,52.8)	1378* (2)
	Any Economic Indicator <sup>G H I</sup>	42.2	(41.5,42.8)	48.1	(47.4,48.9)	75.1	(73.1,77.1)	1429* (2)
Education	No College Degree <sup>G H I</sup>	70.0	(69.2,70.7)	71.9	(71.1,72.6)	84.6	(83.0,86.2)	313* (2)
	No College Degree in Family <sup>G H I</sup>	58.8	(58.0,59.7)	62.0	(61.2,62.9)	75.4	(73.3,77.5)	386* (2)
	English Not Spoken Very Well	12.3	(11.6,13.0)	11.2	(10.5,11.9)	12.5	(9.5,15.5)	14 (2)
	Any Education Indicator <sup>G H I</sup>	70.6	(69.9,71.4)	72.5	(71.8,73.3)	84.8	(83.2,86.4)	298* (2)

Note. CI = Confidence Interval;  $\chi^2$  = Rao-Scott chi-square test; df = degrees of freedom; <sup>G, H, I</sup> denote significant differences among people with no activity limitations due to mental health conditions (ALMH) with and without non-specific psychological distress (NSPD), between no ALMH without NSPD and ALMH with or without NSPD, and between no ALMH with NSPD and ALMH with or without NSPD, respectively; All significance tests across or between social determinants of health corrected for multiple comparisons and signify alpha 0.005 after correction.

Table 3

Risk of cognitive disabilities among people with and without adverse social determinants of health, by mental health status

Characteristic		Activity Limitations due to Mental Health Conditions					
		None				Any	
		Non-Specific Psychological Distress					
		None		Any		None or Any	
		OR	95% CI	OR	95% CI	OR	95% CI
	Overall <sup>†</sup>	Ref		3.9	(3.5,4.3)*	51.2	(45.2,58.2)*
Isolation	Poor Neighborhood Social Cohesion	1.7	(1.4,2.2)*	1.5	(1.3,1.7)*	1.3	(1.0,1.8)
	Family Size of One	1.4	(1.2,1.6)*	1.6	(1.4,1.7)*	1.3	(1.1,1.6)
	Living Alone	1.4	(1.2,1.6)*	1.5	(1.4,1.6)*	1.3	(1.1,1.5)
	Not Married	2.8	(2.4,3.4)*	2.3	(2.1,2.5)*	1.7	(1.4,2.1)*
	No Web Use	5.5	(4.3,7.1)*	3.9	(3.4,4.4)*	1.6	(1.2,2.1)
	Delayed Care due to Lack of Transportation	6.8	(4.2,11.1)*	5.3	(4.6,6.0)*	2.2	(1.6,2.9)*
	Any Isolation Indicator	3.3	(2.7,4.1)*	2.8	(2.5,3.1)*	1.9	(1.5,2.4)*
Health	Health Behaviors	1.2	(1.0,1.3)	1.6	(1.5,1.7)*	1.3	(1.0,1.6)
	Chronic Health Conditions	3.3	(2.7,4.0)*	3.1	(2.7,3.5)*	1.7	(1.3,2.1)*
	Poor or Fair Self-Reported Health	11.7	(9.8,13.9)*	7.7	(7.0,8.5)*	3.8	(3.1,4.7)*
	Pain	1.8	(1.5,2.1)*	2.4	(2.2,2.6)*	1.5	(1.2,2.0)
	Any Health Status Indicator	3.1	(2.2,4.5)*	4.3	(3.4,5.4)*	2.3	(1.3,4.1)
Healthcare	No Health Insurance	0.4	(0.3,0.6)*	0.8	(0.7,0.9)	0.8	(0.6,1.0)
	Received Care 10 or More Times	4.1	(3.4,5.0)*	3.6	(3.3,4.0)*	2.3	(1.9,2.9)*
	Overnight Hospital Stay	3.0	(2.4,3.7)*	2.9	(2.6,3.2)*	1.8	(1.4,2.2)*
	Couldn't Afford Prescription Medications	2.3	(1.7,3.1)*	2.6	(2.3,2.8)*	1.6	(1.3,2.0)*
	Couldn't Afford Medical Care	2.1	(1.6,2.8)*	2.2	(2.0,2.5)*	1.5	(1.2,1.9)
	No Usual Source of Care	0.5	(0.4,0.7)*	0.6	(0.5,0.7)*	0.9	(0.6,1.2)
	Any Healthcare Indicator	3.4	(2.9,4.1)*	3.5	(3.2,3.9)*	2.6	(2.1,3.2)*
Economic	Not Employed	6.3	(5.1,7.9)*	6.4	(5.8,7.1)*	4.7	(3.8,5.9)*
	Poverty	2.8	(2.3,3.4)*	3.2	(2.9,3.5)*	2.4	(1.9,3.0)*
	Food Insecurity	3.2	(2.3,4.6)*	3.1	(2.7,3.6)*	2.4	(1.8,3.2)*
	Any Economic Indicator	6.0	(4.7,7.7)*	7.0	(6.2,7.9)*	5.1	(3.9,6.6)*
Education	No College Degree	3.1	(2.5,4.0)*	3.6	(3.2,4.2)*	2.3	(1.8,3.0)*
	No College Degree in Family	1.9	(1.6,2.4)*	2.7	(2.4,3.1)*	2.1	(1.6,2.7)*
	English Not Spoken Very Well	2.0	(1.4,2.8)*	1.6	(1.3,1.9)*	1.2	(0.7,2.2)
	Any Education Indicator	2.7	(2.2,3.5)*	3.6	(3.1,4.1)*	2.4	(1.8,3.0)*

Note. OR = odds ratio; CI = Confidence Interval;  $\chi^2$  = Rao-Scott chi-square test; df = degrees of freedom; ORs were obtained from logistic regression analyses adjusted for age, gender, and race/ethnicity. ORs for each social determinant were modeled separately; <sup>G, H, I</sup> denote significant differences among people with no activity limitations due to mental health conditions (ALMH) with and without non-specific psychological distress (NSPD), between no ALMH without NSPD and ALMH with or without NSPD, and between no ALMH with NSPD and ALMH with or without NSPD, respectively; All significance tests across or between social determinants of health corrected for multiple comparisons and signify alpha 0.005 after correction.



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## CONCLUSION

The studies conducted in my dissertation are a first step towards exploring the relationship between mental health and disability in national public health surveillance.

My first research study found that the presence of any severity of non-specific psychological distress (NSPD) or any duration mental health condition (causing activity limitations, ALMH) was robustly associated with disability types (i.e. cognitive, independent living, self-care, ambulatory, vision, and hearing) at most levels of demographic factors. This association was strongest for cognitive disability.

My second study found significant synergy between ALMH and NSPD. Compared to people without ALMH and without NSPD, people with ALMH and with or without NSPD were at significantly increased and significantly difference risk of reporting most disability types (this effect varied greatly by after demographic stratification and adjustment). Further, compared to most other disability types, this risk was highest for cognitive disabilities, compared to all other disability types, and remained highest after stratifying and adjusting for most demographic factors. This study also identified a population without ALMH and with NSPD at risk of most disability types, compared to people without NSPD and without ALMH.

Lastly, my third and final study found a strong, step-wise gradient of increasing prevalence of cognitive disabilities and most adverse SDH across people without ALMH and without NSPD, without ALMH and with NSPD, and with ALMH with or without NSPD. Within these groups, people with adverse SDH were at significantly increased risk of cognitive disabilities, compared to people without SDH.

## **Research Implications**

My studies found a strong association between specific indicators of poor mental health and disability, especially cognitive disability, for the first time in national surveillance. Although my research was limited by cross-sectional data and a biased indicator of mental health conditions, my findings suggest that there are groups of people with measurable, distinguishable psychological distress and/or mental health condition statuses with differing levels of adverse SDH experiencing cognitive disabilities. This is consistent with the psychiatric literature which emphasizes conceptually distinguishing between symptoms, function, and disability in the Diagnostic and Statistical Manual of Mental Disorders (4<sup>th</sup> edition).<sup>1</sup> These effects were heavily modified by demographic factors. My findings suggest that people with cognitive disabilities should be assessed for both psychological distress and mental health conditions with targeted interventions that distinguish between these two factors and take into account social determinants of health.

The ability to identify and distinguish populations with psychological distress and/or mental health conditions within national survey data has implications for public health research and surveillance. Consistent with the National Institute of Mental Health and CDC's definition of mental health (i.e. any mental illness), people with psychological distress include more than people with mental health conditions.<sup>2</sup> Other factors, such as isolation, poverty, and access to healthcare affect the well-being of an individual. A person in psychological distress living alone and unable to travel to their doctors may require substantially different services than a person in psychological distress from living with schizophrenia. Using multiple years of survey data and large enough sample sizes,

we can identify, surveil, and study these different subpopulations to better target our mental health and disability related programs.

### **Conceptual Implications**

My findings were consistent with those predicted by the International Classification of Functioning, Disability, and Health.<sup>3</sup> I found differences in the risk of disability, especially cognitive disability, between people reporting varying combinations of mental health symptoms and conditions. On a person-level, disability increased along a continuum of impairment such that people reporting psychological distress and mental health conditions were at substantially increased risk of cognitive disabilities, compared to people without psychological distress and without mental health conditions. On the societal-level, demographic and social factors were found to modify relationships. Clear evidence was found that more than a medical model is needed to assess the risk of cognitive disability among people with poor mental health. I was also able to confirm issues that have been promoted in the psychiatric literature regarding the entangling of symptoms, function, and disability for mental disorder diagnosis and definitions.<sup>1</sup> I was able to find a range of factors that varied across people reporting different combinations of mental health symptoms and conditions.

### **Policy Implications**

There are over 65 federally recognized disability definitions in the United States.<sup>4</sup> Many of them should be reconsidered and recognize mental health as a possible element of disability. The disability and psychological distress question sets used in my dissertation are being included in more national surveys each year. Per federal guidelines, the disability questions studied in this dissertation are used to (1) identify vulnerable

populations at disproportionate risk of experiencing health disparities and unmet health needs, (2) report housing needs, (3) prepare and respond to disasters, (4) develop transit service plans, and (5) enforce against discrimination in education and employment.<sup>5</sup>

When combined activity limitation due to mental health condition questions they total 14 brief questions which can be used to better understand the relationship between mental health, function, and disability in programs, supports, and services for people with poor mental health and disabilities.

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