

A Model-Based Method for Estimating Serious Mental Illness Using Household Interview Data Combined with Clinical Interviews

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Description of NSDUH

- Annual HH survey across 50 states + DC
- Civilian, non-institutionalized population
- Ages 12 or older
- Since 1999, total N \approx 67,500 per year
- Produces national and state estimates of substance abuse and mental illness

Motivation

- SAMHSA needs estimates of **Serious Mental Illness (SMI)** as indicated in Federal Register
- No space on NSDUH Qx for full diagnostic assessment of SMI
- Full psychological assessment on **small subsample using clinical interviews**
- Models used to **calibrate** mental health items in full NSDUH sample to assessments from clinical interviews

Outline

- **Definition of Serious Mental Illness (SMI)**
- **Description of NSDUH**
 - **Mental health (MH) module**
- **Mental Health Surveillance Study (MHSS):**
 - **Based on NSDUH subsample**
 - **Clinical interviews to measure SMI**
- **Models to calibrate SMI estimates from MH module to clinical interviews**

Serious Mental Illness (SMI)*

- Persons aged 18 or older
- SMI has 2 components:
 - Mental Disorder:
 - Diagnosable DSM-IV mental disorder (DO) in past year (excluding substance use and developmental DOs)
 - Functional Impairment:
 - Level of functional impairment substantially interferes with one or more major life activities

* Federal Register: June 24, 1999 (Vol 64, No 121), pp 33890-33897

Scales in MH Module

- **Psychological Distress:**

- **K6 scale***

- **6 items: item scores = 0 - 4, total score = 0 - 24**

0 = no distress/impairment
Highest score = worst level

- **Functional Impairment:**

- **World Health Organization Disability Assessment Schedule (WHODAS)****

- **8 items: item scores = 0 - 3, total score = 0 - 24**

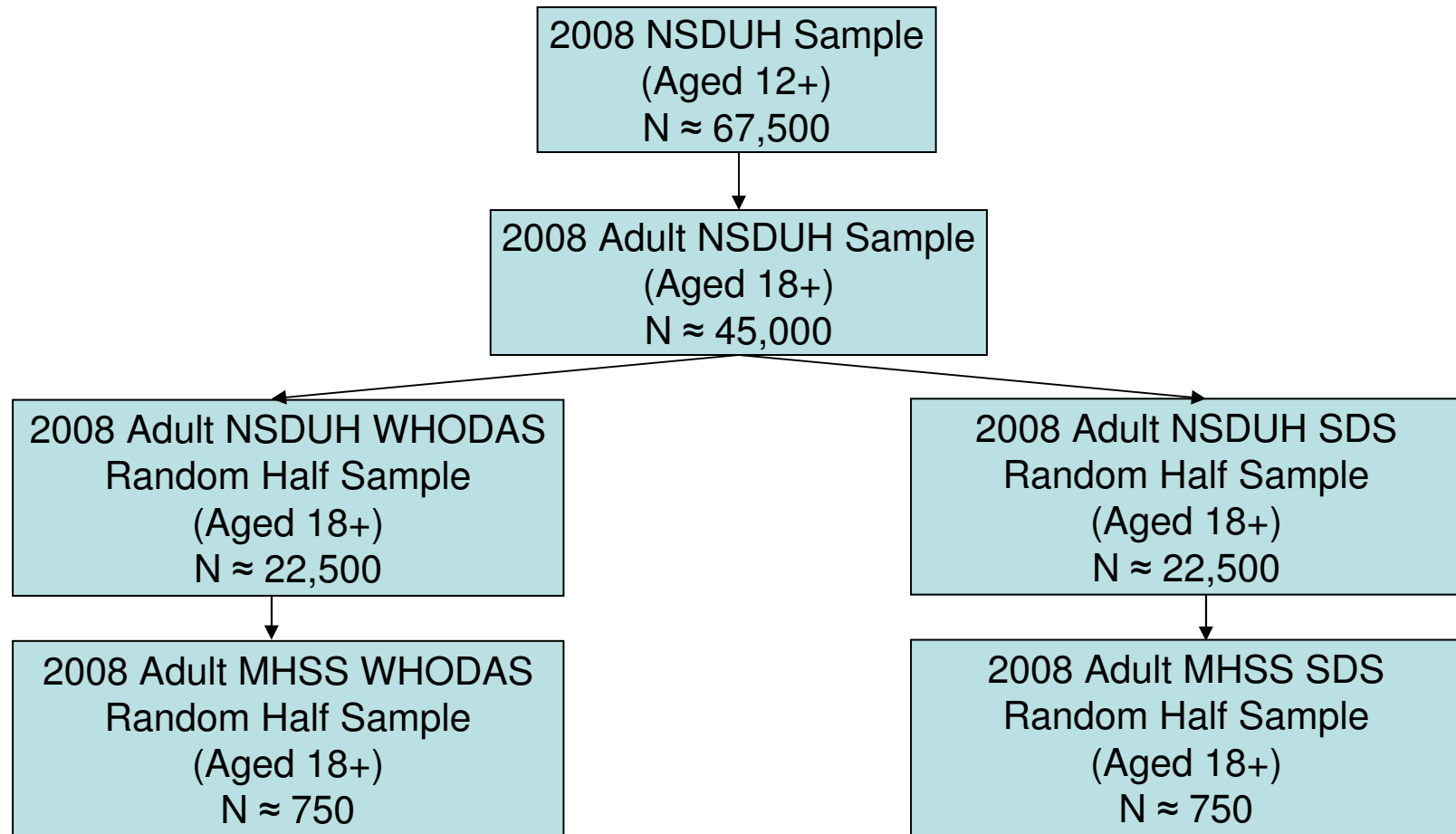
- **Sheehan Disability Scale (SDS)**

- **4 items: item scores = 0 - 10, total score = 0 - 40**

* Kessler et al (2003). Arch of Gen Psych, 60(2)

** Abbreviated version (original has 16 items)

Mental Health Surveillance Study (MHSS) in 2008



MHSS in 2008

- **1,500 Respondents in MHSS subjected to clinical interviews:**
 - Recruited at end of NSDUH interview
 - Interviews done a few days later by phone
 - Stratified sample - oversampling of high K6 scores

	N Selected	N Comp'd	URR (%)	WRR (%)
WHODAS	1,174	761	64.8	58.5
SDS	1,117	741	66.3	58.3
Total	2,291	1,502	65.6	58.4

MHSS in 2008 (2)

- **MHSS clinical interviews measured:**
 - **Mental Disorder:**
 - Past year DSM-IV DOs (with exceptions as noted)
 - **Functional Impairment:**
 - Global Assessment of Functioning (GAF) scale

MHSS in 2008 (3)

- Respondents determined to have SMI if:
 - Diagnosis of any applicable past year DSM-IV DO
 - GAF score ≤ 50
 - Level of impairment serious or worse
 - Compare with “substantially interferes with...” (FR def’n)
- Gold standard (“true”) SMI estimates

2008 MHSS Objectives

- The 2008 MHSS had 2 primary objectives:
 - To determine which of the WHODAS and SDS (in combination with the K6) predicts SMI more accurately*
 - To develop algorithms based on the K6 and WHODAS/SDS that accurately predict SMI, and to use these algorithms to produce 2008 estimates of SMI prevalence

* The WHODAS was selected, based on 6-month analysis

MHSS Analysis

Analysis had 3 basic procedures:

1. Models fitted in MHSS subsample:

- “True” SMI modeled in terms of K6 and WHODAS/SDS
- Resulted in predicted probability of SMI for each R

2. Cutpoint for “predicted” SMI status determined:

- Misclassification error between “true” and “predicted” SMI status minimized and unbiased

3. SMI predicted in full adult sample

- Predicted probability of SMI generated in full sample
- Predicted SMI status generated in full sample (using cutpoint)

MHSS Models

- **Weighted* logistic regression models:**

Let $\pi = \text{Pr}(\text{"true" SMI+})$

1. $\text{logit}(\pi) = \text{K6 term(s)} + \text{WHODAS term(s)}$

2. $\text{logit}(\pi) = \text{K6 term(s)} + \text{SDS term(s)}$

- **In some models, demographic covariates also were included (eg, gender, age, race, education)**

* All analyses weighted, since inferences about adult US population

ROC Statistics

- ROC setup:

- Based on model each R has predicted $\Pr(\text{SMI}+) = \hat{\pi}$
- Select cutpoint = π_0
- If $\hat{\pi} \geq \pi_0$ then predicted SMI status = positive (+)
- If $\hat{\pi} < \pi_0$ then predicted SMI status = negative (-)

ROC Statistics (2)

- 4 possible classifications in 2x2 ROC matrix:

Predicted SMI	"True" SMI	
	+	-
+	TP	FP
-	FN	TN

TP, FP, FN, TN = weighted counts

- ROC statistics:
 - Sensitivity = $TP / (TP + FN)$
 - Specificity = $TN / (TN + FP)$

ROC Statistics (3)

- ROC matrix and optimal cutpoint:

Predicted SMI	"True" SMI	
	+	-
+	TP	FP
-	FN	TN

TP, FP, FN, TN = weighted counts

- Optimal cutpoint:
 - Optimal cutpoint selected so FP and FN equal (\pm)

ROC Statistics (4)

- SMI prevalence low ($< 10\%$)*
 - Specificity always very high ($> .95$)
 - Sensitivity much more sensitive to changes in cutpoint (key discriminating statistic)

* Can't display actual results – will only be released in September 2009

Recoded MH Scales

- **Alternative versions:**
 - **K6 scale**
 - Total score (TS) recoded to account for nonlinearity
 - **WHODAS**
 - Item scores recoded to dichotomize items into moderate or worse vs. mild or better
 - **SDS**
 - Item scores recoded to dichotomize items into severe or worse vs. moderate or better

Actual WHODAS Models

6 models identified for further analysis:

1. K6 TS only

- Historical comparison; to check effect of WHODAS term(s)

2. Selection of K6 and WHODAS items

- Small p-values, +ve betas; collinearity problems, info loss

3. K6 TS and WHODAS TS

4. K6 TS, K6 TS squared, WHODAS TS

- K6 squared term for nonlinearity

5. Alt K6 TS and Alt WHODAS TS

- For nonlinearity and dichotomization

6. Alt K6 TS, Alt WHODAS TS, and Race

- Race was statistically significant

WHODAS Results

- **ROC statistics based on optimal cutpoint:**
 - **Model 1: Sensitivity = 0.387**
 - **Models 2-6: Sensitivity = 0.481 - 0.506**
- **Some conclusions:**
 - **Need WHODAS term(s) to predict SMI**
 - **ROC statistics robust to inclusion/exclusion of Race**
 - **Model 5:**
 - **Most parsimonious that also addresses nonlinearity of K6**
 - **Sensitivity = 0.506**

WHODAS Results (2)

- **Predict SMI in full adult sample*:**
 - **Predictions based on Model 6 (Model 5 plus Race):**
 - **Severe imbalances across Race subgroups**
 - **Predictions based on Model 5:**
 - **Showed no subgroup imbalances**
 - **Estimates in line with what was expected**

* Can't display actual results – will only be released in September 2009

SDS Results

- **SDS modeling procedure identical:**
 - **6 candidate models (identical to WHODAS models, but with SDS terms), with very similar conclusions:**
 - **K6 alone not sufficient**
 - **Education variable significant**

SDS Results (2)

- **Predict SMI in full adult sample:**
 - **Predictions based on SDS Model 6 (SDS Model 5 plus Education):**
 - **Severe imbalances across Education subgroups**
 - **Predictions based on SDS Model 5:**
 - **Showed no subgroup imbalances**
 - **Estimates in line with what was expected**
 - **Matched WHODAS Model 5 predictions very closely (even at the subgroup level)!**

Exclusion of Covariates

- **Several reasons for excluding covariates in models:**
 - Goal was for simple, parsimonious model robust enough to be useful in later years and other surveys (without having demographic effects locked in)
 - Inclusion of covariates has adverse effects on predictions generated in full sample (subgroup-level imbalances)
 - Different covariates significant in each case (Race, Education) suggests local anomalies (small sample size, variable weights)

Final Models Selected

- Based on model fit and ROC statistics, and SMI predictions for the full adult data set, the following models were selected:
 - WHODAS Model 5:
 - Alt K6 TS and Alt WHODAS TS
 - SDS Model 5:
 - Alt K6 TS and Alt SDS TS

Conclusions

- **Parsimonious (2 DF) models selected**
 - Both K6 and WHODAS/SDS scales represented
 - More generalizable to external data sets
- **Both models provide very similar SMI predictions in the full adult sample**
- **Final note of caution:**
 - # of FPs and FNs suggests limitations to a modeling approach to SMI prediction, in comparison with a direct approach based on clinical interviews (which would be economically and practically unfeasible)

Future Directions

- SMI estimates to be released in **September '09**
- Currently developing models to estimate **other levels of mental illness** (e.g., moderate or any)
- The **MHSS will continue in 2009 and beyond** (WHODAS only) and will be incorporated in the NSDUH redesign