Adding the AD8 Dementia Screen to the Panel Study of Income Dynamics

Vicki A. Freedman
Brooke Helppie McFall
Lindsay Ryan
Institute for Social Research, University of Michigan

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Abstract

In 2017, the Panel Study of Income Dynamics (PSID) added a brief measure to identify older individuals at risk for developing Alzheimer's disease and related dementias. Because of its brevity and strong predictive power in clinical samples, the AD8 Dementia Screen was selected for inclusion. To our knowledge this is the first time the AD8 has been implemented in a national household study. This technical paper provides background on the AD8 Dementia Screen and assesses its implementation in the PSID. We found that the AD8 Dementia Screen items are highly correlated and scale into a single factor. Item response theory analysis suggests the items discriminate well and misclassification on a latent trait representing cognitive impairment is low based on the standard cutoff of 2 or more. Prevalence estimates are in range with other national surveys that offer more detailed measures (e.g. probable and possible dementia; dementia and cognitive impairment-no dementia). Although concordance with clinical measures could not be explored, the AD8 Dementia Screen has good sensitivity and specificity relative to reports of having a prior diagnosis of a memory-related condition. We also established that the measure has good construct validity; that is, measures of age, activity limitations, and a reported prior diagnosis of a memory-related condition all predict having a score of 2 or more on the AD8. Taken together, these analyses suggest that the AD8 Dementia Screen may be used to distinguish individuals with possible dementia from those with normal cognitive functioning in this long-running national household panel study.

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Introduction

The Panel Study of Income Dynamics (PSID) is the longest running national panel study in the world. Begun in 1968, the panel has followed families for 50 years, making it a valuable resource for understanding early- and mid-life influences on later life health and functioning (Wolf 2018). Because the study invites adult children to participate in their own families when they become financially independent, PSID also provides unique information on multiple generations of families across households.

An explicit goal of the PSID in 2017 was to add a brief measure that could be administered by telephone to identify older adults at risk for developing Alzheimer's disease and related dementias. Since only one person per family is interviewed, the measure had to be valid as both an informant and self-reported instrument. Because of its brevity and strong predictive power in clinical samples, the Eight Item Interview to Differentiate Aging and Dementia (AD8) was selected for inclusion in the 2017 PSID (Galvin et al. 2005). To our knowledge this is the first time the AD8 has been implemented as a dementia screen in a national household study.

This technical paper provides background on the AD8 and assesses its implementation in the PSID.

Background on the AD8 Dementia Screening Interview

The AD8 Dementia Screen is a brief, 8-item screening instrument designed to differentiate individuals with normative cognitive function from those with mild or more severe forms of dementia (Galvin et al., 2005). Dementia is a group of conditions that share a common underlying symptom—a decline in memory or thinking that interferes with the ability to perform everyday activities.

The AD8 Dementia Screen was originally designed as a paper and pencil questionnaire for use in clinical settings with informants. It was proposed as a first step, or "screen," in the diagnostic process for identifying early signs of dementia irrespective of etiology. Informants were asked to report changes in eight activities reflecting problems with memory, orientation to time, judgment, and ability to engage in daily functional activities. Each row of the form had a different problem listed and columns were labeled: YES, a change; NO, no change; and N/A, Don't know. Clinicians were instructed "Yes, a change" indicates that there has been a change in the last several years caused by cognitive (thinking and memory) problems.

A cut-off of 2 or more on the instrument was recommended to identify individuals with possible dementia in need of further evaluation. Using these criteria, the area under the receiver operating characteristic (ROC) curve in the initial validation study was 0.834, with 74% sensitivity[1] and 86% specificity[2] relative to a diagnosis of mild or moderate dementia (Galvin et al., 2005).

The instrument was also validated for use as a self-report measure (Galvin, Roe, Coats, & Morris, 2007). In this validation study, the authors found that standard informant-based AD8 scores using the 2+ cut-off had a sensitivity and specificity of 84% and 93%, respectively, whereas the self-reported AD8 scores had 62% and 73%. The instructions for the self-reported AD8 indicate that self-respondents should not be asked to attribute changes to cognitive problems. The justification for this approach is that

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[1] Sensitivity is the probability that a positive result (here, a score of 2 or higher) is a true positive (that is, among those diagnosed with dementia).

[2] Specificity is the probability that a negative result (here, a score of less than 2) is a true negative (that is, that among those found to not have dementia).

sometimes individuals with cognitive impairment may not recognize their symptoms as related to memory but instead attribute them to illness or aging.

Implementation of the AD8 in the PSID

PSID adapted the AD8 for administration over the telephone.   A uniform question stem was adopted "In the last few years have you/has [target person] experienced a change in…" Informants but not self-respondents were also read the attribution "because of a thinking or memory problem."

Each of the eight individual items was phrased in a manner consistent with the original AD8 item. A few items were simplified to facilitate administration by phone. One item, "less interest in hobbies or activities" was edited slightly so that it would flow with the stem ("…has there been a change in the amount of interest in hobbies or activities."). The AD8 items as included in the 2017 PSID interview can be found in the Appendix.

The AD8 was asked about each individual aged 65 and older living in a PSID family. The target population included age-eligible individuals who lived in the same household as other family members, in an institutional setting, or who moved in or out of the family in the last two years.

Because only one person per family served as the respondent, AD8 responses are a mix of self and proxy responses. Most often the reference person[3] or their spouse or partner will serve as the respondent; in some instances, when neither person is able to respond, another family member may respond. A respondent with multiple age-eligible family members will be asked to answer the AD8 items about each age-eligible individual. When multiple age-eligible persons are present within a family, the administration order is to ask first about the reference person, then about a spouse or partner if present, and then about any other family member(s) if present.

In 2017 the AD8 items were asked about 2,263 individuals ages 65 and older living in PSID families, including 1,456 reference persons, 590 spouses/partners, and 217 other family unit members (see Table 1). Answers were provided by 1,458 reference persons, 719 spouses/partners and 86 other family members. Altogether, 1,289 reference persons and spouses/partners self-responded to the AD8.

Table 1. AD8 Respondents and Target Persons in 2017 PSID

Who is AD8 about?	Who is Responding to AD8?			
	Reference person	Spouse or partner	Other family member	Total
Reference person	1,000	385	71	1,456
Spouse or partner	296	289	5	590
Other family member	162	45	10	217
Total	1,458	719	86	2,263

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[3] In the PSID, the term reference person indicates an individual financially responsible for the family and for whom relationship to all other people in the family is collected. Previously PSID used the term 'Head'. In 2017, in couple-headed families with partners of different genders, the reference person was assigned to the male partner.

Results

Item-Level Scoring

The weighted percentage endorsed is reported in Table 2 for each of the AD8 items.[4] Among all older adults, the percentage endorsing a change is highest for interest in hobbies or activities (23.6%) and lowest for handling complicated money matters (7.7%).

Table 2. Percentage who said "Yes, a change" to the AD8 Items in the PSID

	%
Problems with judgment	13.3
Interest in hobbies or activities	23.6
Repeating the same things over and over	13.9
Trouble learning how to use a tool, appliance or gadget	11.2
Forgetting the correct month or year	8.9
Handling complicated money matters	7.7
Remembering appointments	13.7
Daily problems with thinking and/or memory	17.6
N	2,263

Note: *All percentages weighted.*

Missing data on these items was quite low (<1%). Forty-two cases were missing at least one response. Altogether, 17 cases (.5%) were missing all 8 items and another 9 cases could not be coded on a summary measure indicating 2 or more problems. These 26 cases were omitted from the remainder of analyses for this technical paper.

Reliability

We explored the internal consistency of the items using both classic (Cronbach's alpha, factor analysis) and modern (item response theory (IRT)) measurement techniques. First we calculated Cronbach's alpha. This measure is commonly used to assess reliability (how consistently a concept is measured) for a set of scale items. Cronbach's alpha ranges from 0 to 1, with higher values indicating that the items have shared covariance and therefore likely measure the same underlying concept. In Table 3, we show for each item the correlation between the item and an overall score (item-test) and a score without the item (item-rest) along with the average inter-item covariance and Cronbach's alpha without the item.

Overall, the AD8 in the PSID has very good internal consistency (average inter-item covariance=0.51 and Cronbach's alpha=0.89). The item-test ranges from 0.65 to 0.81 and item-rest ranges from 0.53 to 0.74. The item showing the lowest item-test and item-rest scores asks about interest in hobbies or activities, but the last column indicates that dropping the item would not further improve the overall scale.

Next, we undertook exploratory factor analysis using principal factors. We found 1 factor, with strong loadings (above .40) from each of the items (loadings ranged from .56-.78).

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[4]At the time of this writing, the 2017 weight was not yet available. We therefore used the 2015 weight for respondents who had a 2015 interview (N=2,137). We assigned the 2013 weight for an additional 45 cases that did not have a 2015 weight, and the average weight to 81 cases with neither a 2013 nor 2015 weight.

Table 3. Internal Consistency of the AD8 items in the PSID

	Item-Test	Item-Rest	Average Inter-item covariance	Alpha without item
Problems with judgment	0.81	0.74	0.50	0.87
Interest in hobbies or activities	0.65	0.53	0.54	0.89
Repeating the same things over and over	0.71	0.61	0.53	0.89
Trouble learning how to use a tool, appliance or gadget	0.73	0.64	0.52	0.88
Forgetting the correct month or year	0.78	0.70	0.50	0.88
Handling complicated money matters	0.78	0.70	0.50	0.88
Remembering appointments	0.79	0.72	0.50	0.87
Daily problems with thinking and/or memory	0.81	0.73	0.50	0.87
Total	-	-	0.51	0.89

Note: N=2,221. Items standardized; cases with missing values omitted.

We then used IRT methods to evaluate individual AD8 items against the full test score. Specifically, we estimated a 2-parameter IRT model using a logistic specification. We assumed each item was measured with error and that each item was related to a latent construct indicating the extent of memory problems. This model yields two parameters for each item: how discriminating each item is (that is how well it relates to the overall scale) and the location parameter (where on the scale the item performs best). The scale for these location parameters assumes the group mean is 0 and each unit is equal to the sample standard deviation. Ranks for each item are provided parenthetically.

Table 4. IRT Analysis of the AD8 items in the PSID

	Discrimination Parameter	Location Parameter
Problems with judgment	4.94 (7)	1.12 (4)
Interest in hobbies or activities	2.11 (1)	0.95 (2)
Repeating the same things over and over	2.76 (2)	1.22 (5)
Trouble learning how to use a tool, appliance or gadget	3.16 (3)	1.34 (6)
Forgetting the correct month or year	4.48 (4)	1.38 (7)
Handling complicated money matters	4.89 (6)	1.41 (8)
Remembering appointments	4.67 (5)	1.09 (3)
Daily problems with thinking and/or memory	5.98 (8)	0.93 (1)

Note: Results from 2-item generalized structural equation model. N=2,237

All items had strong discrimination (well above 0.5). Problems with judgment and daily problems with thinking and/or memory are the most discriminating and interest in hobbies or activities and repeating phrases are the least discriminating. In terms of location, interest in hobbies or activities and daily problems with thinking and/or memory are located at the lower end of the scale (just below 1.0; easier/more likely items to endorse) whereas forgetting the date and handling money matters are located near 1.4 (more difficult items that are not endorsed as often).

The cutoff of 2 or more responses corresponds to a standardized latent score of 0.58 or more. Using a cutoff of 2 or more on observed items, 97.5% of the sample is correctly classified as above or below 0.58 on the latent score. The population estimate above 0.58 on theta is 24.4% whereas the estimate is 21.9% using a cutoff of 2 or more. In other words, there is a 90% chance that a case with theta greater

than 0.58 is correctly classified using a cutoff of 2 or more and 100% of cases with theta below this threshold are correctly classified by an observed score of less than 2.[5]

Prevalence of 2 or More Problems

As noted earlier, the original AD8 validation study recommends a cut-off of 2 or more be used. This cutoff maximizes specificity and sensitivity in discriminating those with normal cognitive function from those with mild or more severe forms of dementia (Galvin et al., 2005). Weighted percentages meeting the 2+ criteria on the AD8 are reported in Table 5 by 5-year age groups. The overall estimate is 21.9%, and age-specific estimates range from 13.6% for 65-69 year olds to 44.6% for those ages 85 and older.

Table 5: Percentage with Memory Problems by Age Group

Age range	PSID 2017	NHATS 2015	HRS 2014	
65-69	13.6	6.1	15.3	10.6
70-74	18.2	7.3	20.1	19.7
75-79	19.8	13.3	27.6	31.7
80-84	30.3	23.8	40.2	49.3
85+	44.6	41.4	56.8	70.9
Overall	21.9	14.8	26.2	29.6

Note: All percentages are weighted. N=2,237 for PSID 2017.

The overall and age-specific estimates are in range with estimates from national surveys that draw upon more detailed measures of dementia. The National Health and Aging Trends Study (NHATS) includes several cognitive measures that identify cases with probable and possible dementia (Kasper et al. 2013). The Health and Retirement Study (HRS) and its companion study the Aging, Demographics, and Memory Study (ADAMS) offer measures of dementia and cognitive impairment, no dementia (Heeringa et al. 2009).

As shown in Table 5, using the 2015 National Health and Aging Trends Study, 14.8% of the population age 65 and older is classified as having probable or possible dementia (Freedman 2018).[6] Using data from the 2014 Health and Retirement Study, 26.2% of the population age 65 or older is classified as having dementia or cognitive impairment no dementia (CIND) using a cutoff methodology (see Langa et al. 2017) and 29.6% are classified this way using a prediction model reported in Hudomiet et al. (2018).

Sensitivity and Specificity

The PSID does not include clinical assessments of participants, and thus an investigation of sensitivity and specificity against what is considered a 'gold standard' is not possible. Instead, we explore concordance with reports of a prior diagnosis of a memory-related condition. In the US, a substantial

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[5] In further analyses (not shown) we explored classification errors in two alternative models: 1) requiring 3 or more problems and 2) requiring 2 out of 7 problems and ignoring the interest in hobbies or activities item. We found the chances of correctly classifying cases with theta above the respective thresholds of 0.79 and 0.72 were 84% and 89%.

[6] Note that classification schemes based on survey data vary with respect to specific measures and how they characterize possible/milder cases. The Health and Retirement Study data can be used to identify individuals with dementia and with cognitive impairment, no dementia (CIND). The National Health and Aging Trends Study can be used to classify individuals into probable, possible, and no dementia. Other studies have distinguished between dementia and mild cognitive impairment (MCI).

proportion of older adults with cognitive impairment do not receive a diagnosis of dementia or have a lack of awareness of their diagnosis (Amjad et al. 2018). Nevertheless, if the AD8 is a valid measure, we would expect high sensitivity ("true" positive, where positive is a reported prior diagnosis) and specificity ("true" negative, where negative is no report of a prior diagnosis), but a much lower positive predicted value (having a diagnosis among those screening in on the AD8).

We calculated sensitivity and specificity of the AD8, by comparing the AD8 results using the standard cutoff to responses to an item "Has a doctor or other health professional EVER told [you / [target person]] that [you / he / she] had a permanent loss of memory or loss of mental ability?" (see Table 6).[7] Nearly 90% of PSID participants who reported a diagnosed memory problem had a score of 2 or more on the AD8 (sensitivity). Among those not previously diagnosed with a memory condition, 82.8% did not screen in on the AD8 (specificity). In addition, 22.8% of individuals who screened in on the AD8 using the standard 2+ criteria reported having been diagnosed with a memory condition (positive predictive value; not shown).

Table 6: Agreement between AD8 and reports of diagnosed memory condition

	Reports diagnosed memory problem	
	No	Yes
AD8 2+ Score		
No	82.8[1]	10.5
Yes	17.2	89.5[2]
Total	100.0	100.0
Note: All percentages weighted. N = 2,031.		

Predictors of Possible Dementia

In an attempt to explore the construct validity of the AD8 in the PSID sample, we estimated a logistic regression model predicting screening in on the AD8 using the standard cutoff of 2 or more. We expect the chances of screening in to be higher with age, activity limitations (especially IADL limitations), and for those with a reported diagnosis of a memory condition. In addition, because of the PSID design, we expect that if another family member other than a spouse is the respondent, the chances of screening-in may be higher.

The model includes age (in years), whether female, respondent relationship (self, spouse/partner, other family member), a count of activities of daily living (0, 1, 2+ ADLs),[8] a count of instrumental activities of daily living (0, 1, 2+ IADLs),[9] and a report of a diagnosed memory condition. The model is restricted to reference persons and spouses partners because not all predictors are available for other family members.[10] Results are shown in Table 7.

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[7] PSID respondents were asked to report about health conditions for the family's reference person, and if part of a couple, his/her spouse/partner (N=2031). Consequently other family members are excluded from the sensitivity/specificity analysis.

[8] ADL limitations include trouble bathing, dressing, eating, getting in and out of bed, walking, getting outside and using the toilet.

[9] IADL limitations include difficulty or doesn't do because of health the following activities: preparing meals, shopping, handling expenses, using the telephone, doing heavy housework, doing light housework

[10] We include in model estimates 51 cases that did not have complex survey design variables available as of the time of this writing, but we exclude them in the calculation of test statistics.

Table 7. Logistic Regression Model Coefficients Predicting Score of 2 or More on AD8 Dementia Screen

	Coefficient
Age (in years)	0.02*
Female	-0.18
Spouse/partner responding (vs. self)	-0.10
Other family member responding (vs. self)	1.26*
ADLs (vs 0)	
1	0.71**
2+	0.86**
IADLs (vs. 0)	
1	0.62**
2+	1.33**
Diagnosed memory condition	2.71**
Constant	-3.91**
N	2,031

Note: Weighted regression with test statistics adjusted to take into account PSID's complex design.
*p<.05 **p<.01

Consistent with our expectations, age, activity limitations, and reporting a diagnosed memory condition were all significantly related to scoring 2 or more on the AD8. Women did not differ from men and those having a spouse respond vs. responding for oneself did not differ, but those having another family member respond had higher chances of screening in than those self-responding.

Examination of Priming

In the PSID, informants are read the introductory phrase "because of a thinking or memory problem" immediately before they are asked to report the AD8 for another family member. We refer to these cases as having been "primed." Self-respondents are not read the introductory phrase, but depending on their gender and the composition of their family, they may have been primed earlier in the interview (what we refer to as "indirectly primed"). Table 8 shows sample characteristics by respondent type and priming status.

Table 8. Sample Characteristics by Respondent Type and Priming Status

Type of respondent	Informant	Self-respondent	
Priming Status	Primed	Not primed	Indirectly primed
Mean Age	74.8	74.5	72.9
% Female	50.9	47.8	99.4
% With Spouse/Partner Age 65 or Older	68.8	28.4	99.9
% AD8 2+	28.3	18.7	14.8
N	950	1,033	254

Note: All estimated weighted. N=2,237.

In the 2017 PSID, about 10% of the cases were indirectly primed; the remaining cases were approximately half informant/primed and half self-responding/not primed. Because of the sequencing of questions in PSID, indirectly primed cases were almost exclusively married or cohabiting women with a partner age 65 or older (see Table 8). However, the screen-in rate was not significantly different for those who were indirectly primed and not primed (14.8% vs. 18.7%; p=.22).

We ran two additional logistic regression models to explore whether indirect priming status was associated with performance on the AD8 screen. We first added a variable reflecting the three categories of priming status to the logistic regression model in Table 7 (see Table 9). We found that priming status was not a significant predictor of having two or more problems.

Second, we subset the sample to self-responses for married/partnered women and re-estimated the model after dropping sex and respondent status. Again we found that priming status (indirect vs. not) among self-responding women was not a significant predictor of having two or more problems.

Table 9. Logistic Regression Model Coefficients Predicting Score of 2 or More on AD8 Dementia Screen

	All	Self-responding, married/partnered women
Age (in years)	0.02*	.01
Female	-0.16	--
Spouse/partner responding (vs. self)	-0.11	--
Other family member responding (vs. self)	-1.25*	--
ADLs (vs 0)		
1	0.71**	0.77
2+	0.86**	0.61
IADLs (vs. 0)		
1	0.62**	1.12+
2+	1.33**	0.98
Diagnosed memory condition	2.71**	2.16+
Self, indirectly primed (vs. self, not primed)	-0.09	0.60
Constant	-3.88**	-4.00
N	2,031	287

Note: Weighted regression with standard errors adjusted to take into account PSID's complex design.
*+p<.10 *p<.05 **p<.01*

Conclusions

We found that the AD8 Dementia Screen offers a reliable and valid measure to distinguish in the PSID individuals with possible dementia from those with normal cognitive functioning. Items are highly correlated and scale into a single factor. Item response theory analysis suggests the items discriminate well and misclassification on a latent trait representing cognitive impairment is low based on the standard cutoff of 2 or more. Prevalence estimates are in range with other national surveys that offer more detailed measures (e.g. probable and possible dementia; dementia and cognitive impairment-no dementia). Although concordance with clinical measures could not be explored, the AD8 Dementia Screen has good sensitivity and specificity relative to reports of having a prior diagnosis of a memory-related condition. We also established that the measure has good construct validity; that is, measures of age, activity limitations, and a reported prior diagnosis of a memory-related condition all predict having a score of 2 or more on the AD8. Taken together, these analyses suggest that the AD8 Dementia Screen may be used to distinguish individuals with possible dementia from those with normal cognitive functioning in this long-running national household panel study.

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Appendix: AD8 Items in the PSID

Next, we'd like to know about changes that [you / [target person]] may have had in the last several years [Target person is not respondent: because of a thinking or memory problem].

In the last several years, has there been a change in

1. Problems [you / he / she] may have with judgment, for example, problems making decisions, making bad financial decisions, or with thinking?
     1.   Yes, a change
     5.   No, no change

2. The amount of interest [you / he / she] may have in hobbies or activities?
     1.   Yes, a change
     5.   No, no change

3. [Your / His / Her] repeating the same things over and over, such as questions, stories, or statements?
     1.   Yes, a change
     5.   No, no change

4. The trouble [you / he / she] may have learning how to use a tool, appliance or gadget like a TV remote?
     1.   Yes, a change
     5.   No, no change

5. [Your / His / Her] forgetting the correct month or year?
     1.   Yes, a change
     5.   No, no change

6. The trouble [you / he / she] may have handling complicated money matters, like balancing a checkbook or paying bills?
     1.   Yes, a change
     5.   No, no change

7. The trouble [you / he / she] may have remembering appointments?
     1.   Yes, a change
     5.   No, no change

8. Daily problems [you / he / she] may have with thinking and/or memory?
     1.   Yes, a change
     5.   No, no change