

Documentation Report

Documentation of the

Summary Cognitive Performance and Functional Performance Measures Data File

in the Health and Retirement Study / Harmonized Cognitive Assessment Protocol Study

Product of the HRS/HCAP Working Group:

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I. HRS/HCAP: Overview and previous publications and documentation reports

The HRS/HCAP summary cognitive and functional measures data file contains processed HRS/HCAP data described in two manuscripts, one describing a factor analysis of HRS/HCAP cognitive performance items (Jones et al., 2023) and a second a dementia algorithm using HRS/HCAP and other data collected in HRS (Manly et al, 2022). The purpose of this document is to describe the context of the generation, and technical details regarding the contents, of the HRS/HCAP summary cognitive and functional measures data file.

A. Background and relevant resources

The aim of the Health and Retirement Study (HRS) Harmonized Cognitive Assessment (HCAP) project is to create a new HRS data resource to better assess the current and future trends in mild cognitive impairment (MCI) and dementia in the United States. The first HRS sub study on dementia, the Aging, Demographics, and Memory Study (ADAMS) provided the first estimates of dementia incidence and prevalence in the United States using a nationally representative sample. The new Harmonized Cognitive Assessment Protocol (HCAP) project builds on the experience and methods of the HRS and ADAMS for studying cognition, cognitive decline, and dementia. The main strategy is to administer an expanded battery of cognitive tests and informant interviews to a random subsample of HRS respondents aged 65 and older. The first wave of HRS/HCAP participants was fielded in 2016.

The following are key reports and publications that describe the US Health and Retirement Study Harmonized Cognitive Assessment Protocol (HRS/HCAP).

1. HRS/HCAP technical documentation

- Weir, D., McCammon, R., Ryan, L., & Langa, K. (2014). Cognitive test selection for the harmonized cognitive assessment protocol (Health and Retirement Study Users Guides to Study Content. http://hrsonline.isr.umich.edu/sitedocs/userg/HCAP_testselection.pdf

2. Design paper (Langa et al 2020)

Langa, K. M., Ryan, L. H., McCammon, R. J., Jones, R. N., Manly, J. J., Levine, D. A., Sonnega, A., Farron, M., & Weir, D. R. (2020). The Health and Retirement Study Harmonized Cognitive Assessment Protocol Project: Study Design and Methods. *Neuroepidemiology*, 54(1), 64-74. <https://doi.org/10.1159/000503004>

3. Factor analysis of HCAP (Jones et al 2023)

Jones, R. N., Manly, J. J., Langa, K. M., Ryan, L. H., Levine, D. A., McCammon, R., & Weir, D. (2023). Factor structure of the harmonized cognitive assessment protocol neuropsychological battery in the Health and Retirement Study. *Journal of the International Neuropsychological Society*, in press. Preprint available at <https://doi.org/10.31234/osf.io/rvmhj>

4. Dementia classification in HRS/HCAP (Manly et al 2022)

Manly, J. J., Jones, R. N., Langa, K. M., Ryan, L. H., Levine, D. A., McCammon, R., Heeringa, S., & Weir, D. (2022). The prevalence of dementia and mild cognitive impairment (MCI) in the United States. *JAMA neurology*, 79(12), 1242-1249. <https://doi.org/doi:10.1001/jamaneurol.2022.3543>

5. Code repository for Manly et al (2022) and Jones et al (2023) manuscripts

<https://github.com/rnj0nes/HCAP22>

A repository of computer code used in the Manly et al (2022) and Jones et al (2023) manuscripts is publicly available on GitHub.

B. Other relevant data

The HRS/HCAP summary cognitive and functional measures data file contains data generated in the process of completing the Manly et al (2022) and Jones et al (2023) manuscripts (described above). Additionally, investigators may find HRS/HCAP relevant data in the following HRS data files:

HRS Data file	Relevance to HRS/HCAP and URL
Cross-Wave Tracker file	Eligibility, sociodemographics, weights https://hrsdata.isr.umich.edu/data-products/cross-wave-tracker-file
Core (2016)	Self-reported cognitive impairment, informant-rated cognitive impairment, medical and residential history. https://hrsdata.isr.umich.edu/data-products/2016-hrs-core
HRS/HCAP Data file	Raw neuropsychological and cognitive testing performance data https://hrs.isr.umich.edu/data-products/hcap

Table 1. Other HRS/HCAP relevant data available at hrsdata.isr.umich.edu/data-products

C. Workflow and variable sets

The workflow for the factor analysis (Jones et al, 2023) and dementia classification (Manly et al, 2022) products using HRS/HCAP data is illustrated in **Figure 1**. The HRS/HCAP projects involved data from different sources (claims, HRS Core, HRS/HCAP, etc.) and generated distinct sets of variables (colored boxes in Figure 1) throughout the factor analysis and dementia classification steps. These distinct generated variable sets are separately identified in the HRS/HCAP summary cognitive and functional measures data file.

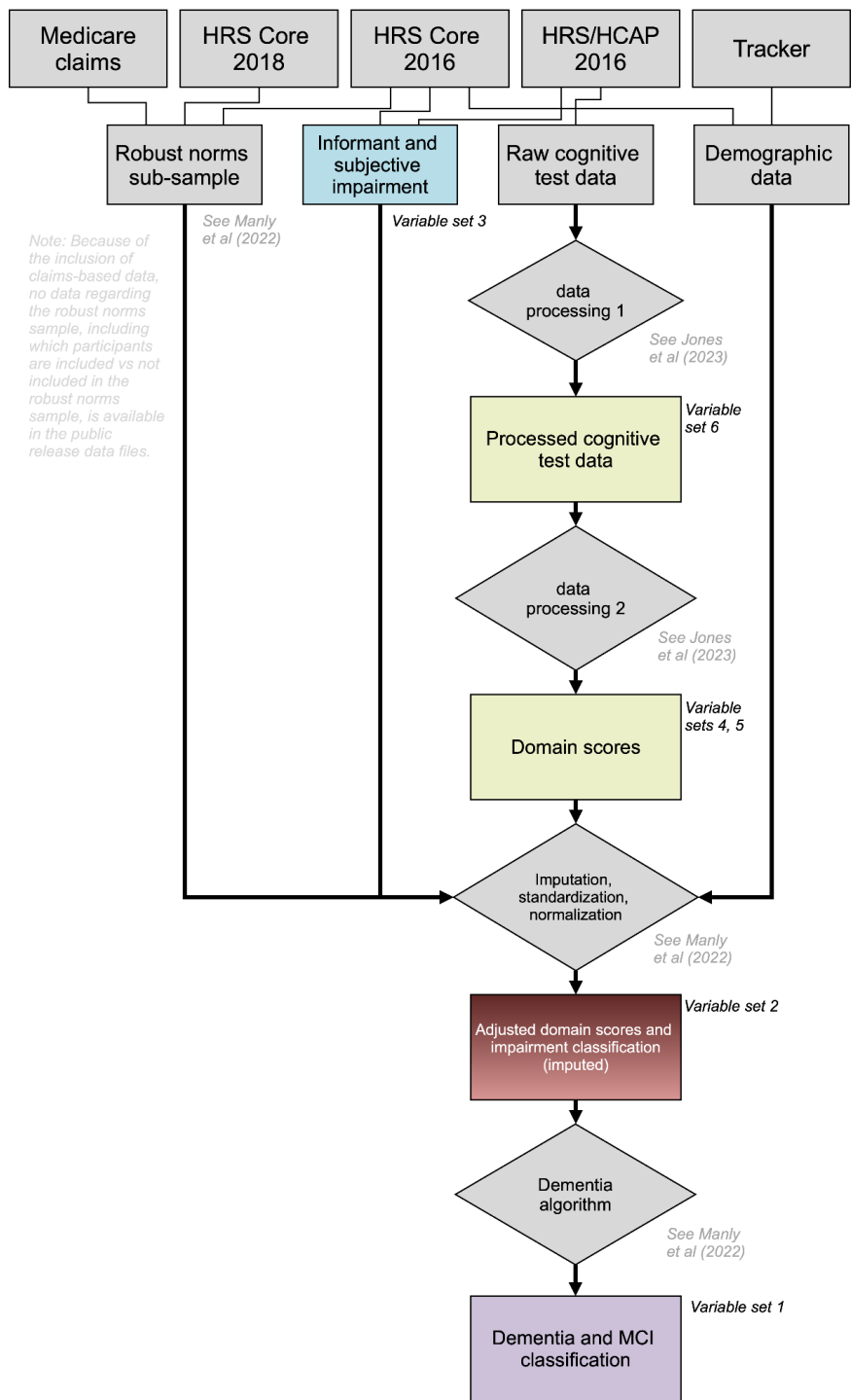


Figure 1. Workflow for the HRS/HCAP summary cognitive and functional measures data file. The source data for the HRS/HCAP summary cognitive and functional measures data file and the Jones et al (2023) and Manly et al (2022) manuscripts include Medicare Claims, HRS Core data files from 2016 and 2018, the HRS/HCAP data file (2016), and the HRS Tracker file. We made seven key sets of variables, and users can access six of them in a single HRS/HCAP summary cognitive and functional measures data file (Figure 1, colored boxes). These six variable sets can be easily identified by their variable name. One of the generated variable sets -- the identification of a robust norms sample -- is not distributed in the HRS/HCAP summary cognitive and functional measures data file. The distributed data variable sets include informant and subjective cognitive impairment ratings, processed HRS/HCAP cognitive test performance data, domain scores for individual and global domains of function, adjusted domain scores, and dementia classification.

As described in Jones et al (2023) and associated technical documentation, raw HRS/HCAP cognitive test performance data were recoded for factor analysis. We share these processed cognitive performance data as **variable set 6** (and variable prefix “vd” in the HRS/HCAP summary cognitive and functional measures data file). These processed cognitive performance data were analyzed with factor analysis methods as described in Jones et al (2023) and resulting from this are a set of factor or domain score estimates. These domain score estimates are distributed as **variable sets 4** (domain specific) **and 5** (global cognitive performance) and identified in the HRS/HCAP summary cognitive and functional measures data file with variable prefixes vs4 and vs5, respectively. Selected of these domain scores were used in the dementia classification algorithm, and those that were subjected to standardization, adjustment, and imputation procedures as described in Manly et al (2022). These adjusted, standardized, and imputed variables are distributed in **variable set 2** and identified in the HRS/HCAP summary cognitive and functional measures data file with variable prefix vs2. The algorithm also makes use of self and informant rated cognitive impairment (also subjected to imputation) and these variables are distributed and described as **variable set 3** and identified with variable prefix vs3 in the HRS/HCAP summary cognitive and functional measures data file. Finally, we describe the single three-level variable (normal, MCI, dementia) in **variable set 1**.

It is important to note that the algorithm makes use of a robust norms sample in the adjustment and standardization step (Manly et al, 2022). Our definition of the robust norms sample includes information derived from the Medicare claims data linked to HRS. These data are not available in the public use data files. Therefore, information on which of the HRS/HCAP participants were included in the HRS/HCAP dementia classification algorithm is only available through restricted access.

II. Technical details

A. Imputations

As is described in **Figure 1** and in **Table 2**, missing data were imputed for the purposes of estimating dementia prevalence as described in Manly et al (2022). Note: These imputations are distinct from the imputations done for the 2016 HCAP final release dataset. Missing values for cognitive performance data or informant data were singly imputed as Bayesian plausible values using Mplus software. The procedure now imputes missing cognitive performance scores and missing self- and informant ratings of impairment given observed cognitive performance scores and self- and informant ratings of impairment.

B. Note about expected a posteriori (EAP) and Bayesian plausible value (PV) estimates of factor scores

We have generated factor score estimates as expected a posteriori (EAP) estimates and single draws from a Bayesian posterior distribution (Bayesian plausible values, PV). Both of these estimates were derived using Mplus software (version 8.8, Muthén & Muthén, Los Angeles CA)(Asparouhov, 2010; <https://www.statmodel.com/download/Plausible.pdf>). Factor scores are estimates of a latent variable. And latent variables are, by definition, not directly observable. Therefore, any estimate of that latent variable has some level of imprecision. In the context of categorical data item factor analysis (or item response theory), the imprecision is determined by the number of items used in the factor model, the strength of the correlation between the items

and the underlying factor, and the distribution of difficulty levels of the items. Factors with more items, items with strong relationships with the underlying factor, and many widely dispersed difficulty levels will have less imprecision than factors with only a few items with weak relationships with the underlying factor and coarse and skewed responses. If a factor is measured by all continuous indicators, imprecision is constant across the level of the latent trait. But if a factor is measured with at least one categorical indicator, imprecision will vary across the level of the latent trait, generally being higher at the extremes.

When we generate factor score estimates as plausible values, each person's score is a draw from the posterior distribution of their factor score estimate, which is determined by the level of imprecision of the factor score. These are analogous to imputations in multiple imputation. In fact, it might be desirable to use multiple plausible values generated for each participant as if they were multiply imputed values in a data analysis. If we were to take many draws from the posterior for each participant, and then compute the mean of each persons' plausible values - that mean would approach the EAP estimate we obtain for each person.

We recommend using plausible values (or multiple plausible values) in any circumstance where population-level parameter estimation and inference is desired. Use of EAP estimates in such circumstances is anti-conservative and may result in biased low standard errors in inflated type-I error levels. In some situations, such as descriptive analysis, or in a high-stakes decision making procedure (e.g., selecting participants for a module or sub-study) the EAP estimates would be preferable.

III. Data Files

The HRS/HCAP summary cognitive and functional measures data are provided in ASCII format, with fixed-length records, and "ready-to-use" files. Use the associated SAS, SPSS or Stata program statements to read the data into the analysis package of your choice.

The following extensions are used for the 2016 HCAP Final release files:

- HC16HP_F.da for the ASCII data file
- HC16HP_F.sas for the SAS program statements
- HC16HP_F.sas7bdat for "ready-to-use" SAS file
- HC16HP_F.sps for the SPSS program statements
- HC16HP_F.sav for "ready-to-use" SPSS file
- HC16HP_F.do for the STATA do statements
- HC16HP_F.dct for the STATA dictionary statements
- HC16HP_F.dta for "ready-to-use" Stata file
- HC16HP_F.txt for the codebook file

III. Codebook

Below we describe the contents of the data file.

Variable	Description
hhid	HOUSEHOLD IDENTIFIER Missing values: 0/3496 Distinct values: 3465
pn	PERSON NUMBER Missing values: 0/3496 Distinct values: 10
r1hcapdx	HRS HCAP Dementia and MCI Classification (HRS HCAP variable set 1) Missing values: 0/3496 Distinct values: 3 1: 2299 [Normal (1)] 2: 804 [MCI (2)] 3: 393 [Dementia (3)] <i>NOTE: This variable is also included in the 2016 HCAP Respondent data set HC16HP_R.</i>
vs2memsc	Memory score (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 3313 Mean (SD): 46.821 (11.591) <i>NOTE: This is a singly imputed, standardized and adjusted (for age, sex, race, ethnicity, and educational attainment), plausible value factor score estimate for the memory domain and used indirectly in the HRS/HCAP dementia algorithm by defining cognitive impairment criteria.</i>
vs2exfsc	Executive function score (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 3314 Mean (SD): 45.836 (11.734) <i>NOTE: This is a singly imputed, standardized and adjusted (for age, sex, race, ethnicity, and educational attainment), plausible value factor score estimate for the executive functioning domain and used indirectly in the HRS/HCAP dementia algorithm by defining cognitive impairment criteria.</i>
vs2lflsc	Language and fluency score (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 3329 Mean (SD): 47.711 (11.091)

Variable	Description
vs2vissc	<p><i>NOTE: This is a singly imputed, standardized and adjusted (for age, sex, race, ethnicity, and educational attainment), plausible value factor score estimate for the language and fluency domain and used indirectly in the HRS/HCAP dementia algorithm by defining cognitive impairment criteria.</i></p> <p>Visuospatial score (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 2330 Mean (SD): 47.523 (11.428) <i>NOTE: This is a singly imputed, standardized and adjusted (for age, sex, race, ethnicity, and educational attainment), performance score on CERAD constructional praxis, and used indirectly in the HRS/HCAP dementia algorithm by defining cognitive impairment criteria.</i></p>
vs2vdori1	<p>Orientation score (vdori1, HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 145 Mean (SD): 9.256 (1.395) <i>NOTE: This is the singly imputed sum score on the MMSE orientation questions (scored 0-10). Equivalent to vdori1 other than for the imputation of missing values. This variable was indirectly used in the dementia algorithm by informing the missing data imputation model for the orientation impairment indicator.</i></p>
vs2memimp	<p>Memory impairment (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 2 0: 2990 [Not impaired (0)] 1: 506 [Impaired (1)] <i>NOTE: This is the impairment flag for v2memsc, on which scores of less than 35 are considered impaired. The impairment indicators were directly used in the dementia algorithm.</i></p>
vs2exfimp	<p>Executive function impairment (HRS HCAP variable set 2) Missing values: 0/3496 Distinct values: 2 0: 2958 [Not impaired (0)] 1: 538 [Impaired (1)] <i>NOTE: This is the impairment flag for v2exfsc, on which scores of less than 35 are considered impaired. The impairment indicators were directly used in the dementia algorithm.</i></p>

Variable	Description
vs2lflimp	<p>Language and fluency impairment (HRS HCAP variable set 2)</p> <p>Missing values: 0/3496 Distinct values: 2 0: 3065 [Not impaired (0)] 1: 431 [Impaired (1)]</p> <p><i>NOTE: This is the impairment flag for v2lflsc, on which scores of less than 35 are considered impaired. The impairment indicators were directly used in the dementia algorithm.</i></p>
vs2visimp	<p>Visuospatial impairment (HRS HCAP variable set 2)</p> <p>Missing values: 0/3496 Distinct values: 2 0: 3051 [Not impaired (0)] 1: 445 [Impaired (1)]</p> <p><i>NOTE: This is the impairment flag for v2vissc, on which scores of less than 35 are considered impaired. The impairment indicators were directly used in the dementia algorithm.</i></p>
vs2orimp	<p>Orientation impairment (HRS HCAP variable set 2)</p> <p>Missing values: 0/3496 Distinct values: 2 0: 2961 [Not impaired (0)] 1: 535 [Impaired (1)]</p> <p><i>NOTE: This is the impairment flag for orientation, and is based on a singly imputed impairment indicator for the orientation score, where a score of 8 or less is considered impaired. This variable is not directly coded from vs2vdori1, and due to the imputation procedure for vs2vdori1 some apparent discrepancies are present.</i></p>
vs3jormsc	<p>Jorm score (HRS HCAP variable set 3)</p> <p>Missing values: 0/3496 Distinct values: 458 Mean (SD): 3.178 (0.552)</p> <p><i>NOTE: This is a singly imputed version of a core HCAP variable h1jormsc (Jorm IQCODE score), and used in the dementia algorithm indirectly in coding the informant-rated concern and informant-rated impairment indicators.</i></p>
vs3blessedsc	<p>Blessed score (HRS HCAP variable set 3)</p> <p>Missing values: 0/3496 Distinct values: 240 Mean (SD): 1.156 (1.611)</p>

Variable	Description
	<i>NOTE: This is a singly imputed version of a core HCAP variable h1bl1tot (Blessed score), and used in the dementia algorithm indirectly in coding the informant-rated concern and informant-rated impairment indicators</i>
vs3informant_concerns	<p>Informant-rated concerns (HRS HCAP variable set 3) Missing values: 0/3496 Distinct values: 2 0: 1115 [No (0)] 1: 2381 [Yes (1)]</p>
vs3informant_impairment	<p>Informant-rated impairment (HRS HCAP variable set 3) Missing values: 0/3496 Distinct values: 2 0: 2523 [No (0)] 1: 973 [Yes (1)] <i>NOTE: This is an informant-rated impairment indicator variable based on the Jorm and Blessed, and used in the dementia algorithm.</i></p>
vs3self_concerns	<p>Self-rated concerns (HRS HCAP variable set 3) Missing values: 0/3496 Distinct values: 2 0: 2391 [No (0)] 1: 1105 [Yes (1)] <i>NOTE: This is an indicator variable coded directly from pd102, and is 1 if pd102 is 1 or 2, otherwise it is 0 (including missing on pd102). It is used directly in the dementia algorithm to identify participants with positive evidence of self-rated cognitive concerns.</i></p>
vs4mem_pv	<p>Memory estimate, PV (HRS HCAP variable set 4) Missing values: 151/3496 Distinct values: 886 Mean (SD): 50.000 (10.000) <i>NOTE: This is the factor score estimate for the mem domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i></p>
vs4exf_pv	<p>Executive function estimate, PV (HRS HCAP variable set 4) Missing values: 153/3496 Distinct values: 706 Mean (SD): 50.000 (10.000)</p>

Variable	Description
	<i>NOTE: This is the factor score estimate for the exf domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i>
vs4lfl_pv	<p>Language and fluency estimate, PF (HRS HCAP variable set 4)</p> <p>Missing values: 149/3496 Distinct values: 517 Mean (SD): 50.000 (10.000)</p> <p><i>NOTE: This is the factor score estimate for the lfl domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i></p>
vs4mem_eap	<p>Memory estimate, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 151/3496 Distinct values: 816 Mean (SD): 50.000 (10.000)</p> <p><i>NOTE: This is the factor score estimate for the mem domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i></p>
vs4mem_se_eap	<p>Memory standard error, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 151/3496 Distinct values: 54 Mean (SD): 3.414 (0.344)</p> <p><i>NOTE: This is the estimated standard error for the factor score estimate for the mem domain.</i></p>
vs4exf_eap	<p>Executive function estimate, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 153/3496 Distinct values: 676 Mean (SD): 50.000 (10.000)</p> <p><i>NOTE: This is the factor score estimate for the exf domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i></p>
vs4exf_se_eap	<p>Executive function standard error, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 153/3496 Distinct values: 55 Mean (SD): 2.899 (0.624)</p> <p><i>NOTE: This is the estimated standard error for the factor score estimate for the exf domain.</i></p>

Variable	Description
vs4lfl_eap	<p>Language and fluency estimate, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 149/3496 Distinct values: 423 Mean (SD): 50.000 (10.000)</p> <p><i>NOTE: This is the factor score estimate for the lfl domain. It has been standardized to a mean of 50 and standard deviation of 10 in the HRS/HCAP sample.</i></p>
vs4lfl_se_eap	<p>Language and fluency standard error, EAP (HRS HCAP variable set 4)</p> <p>Missing values: 149/3496 Distinct values: 45 Mean (SD): 8.222 (0.753)</p> <p><i>NOTE: This is the estimated standard error for the factor score estimate for the lfl domain.</i></p>
vs5gcp_pv	<p>Global cognitive performance, PV (HRS HCAP variable set 5)</p> <p>Missing values: 149/3496 Distinct values: 809 Mean (SD): 50.000 (10.000)</p>
vs5gcp_eap	<p>Global cognitive performance, EAP (HRS HCAP variable set 5)</p> <p>Missing values: 149/3496 Distinct values: 741 Mean (SD): 50.000 (10.000)</p>
vdori1	<p>MMSE 10 items (number of correct, 0-10) (HRS HCAP variable set 6)</p> <p>Missing values: 156/3496 Distinct values: 11 Mean (SD): 9.322 (1.349)</p> <p><i>NOTE: Captures orientation to time and place using 10 items from the MMSE. It is coded as the sum of the number of h1rmse1-h1rmse10 that have a value of 1, with 97, 98, and 99 responses treated as missing values. Persons who do not have at least 1 item in the list that has a response of 1 or 5 are treated as missing.</i></p>
vdori2	<p>TICS name president correct (0,1) (HRS HCAP variable set 6)</p> <p>Missing values: 277/3496 Distinct values: 2</p>

Variable	Description
	<p>0: 62 1: 3157 <i>NOTE: Identifies whether the respondent can correctly identify the President. It is a simple recode of the TICS name the President item. Responses of 7, 8, 9 are treated as missing.</i></p>
vdmie1	<p>CERAD word list immediate sum of 3 trials (0-30) (HRS HCAP variable set 6) Missing values: 158/3496 Distinct values: 31 Mean (SD): 17.424 (5.229) <i>NOTE: The sum of three learning trials on the CERAD 10 item word list. Coded values of 97, 98, and 99 are treated as missing values. Persons who do not have at least 1 item in the list that has a response between 0 and 10 are treated as missing.</i></p>
vdmie2	<p>MMSE 3 word recognition (0-3) (HRS HCAP variable set 6) Missing values: 162/3496 Distinct values: 4 0: 5 1: 51 2: 242 3: 3036 <i>NOTE: Number of words immediately recalled on a 3 word list. It is the first registration trial of the MMSE. It is simply a recoded version of the original variable h1rmse11t1, with responses of 97, 98, 99 treated as missing.</i></p>
vdmie3	<p>Logical memory immediate (0-25) (HRS HCAP variable set 6) Missing values: 190/3496 Distinct values: 24 Mean (SD): 9.833 (5.097) <i>NOTE: The number correct on the WMS-IV Logical Memory I immediate story recall task. It is simply a renaming of h1rlmimmscore.</i></p>
vdmie4	<p>Brave man immediate (0-12) (HRS HCAP variable set 6) Missing values: 164/3496 Distinct values: 13 Mean (SD): 7.105 (2.437) <i>NOTE: A renaming of h1rbmimmscore. No accommodation for missing or other non-response codes has been used.</i></p>
vdmdel	<p>CERAD word list delayed (0-10) (HRS HCAP variable set 6)</p>

Variable	Description
	<p>Missing values: 165/3496 Distinct values: 11 Mean (SD): 5.113 (2.653) <i>NOTE: The number correct on the CERAD delayed 10 word recall task. It is simply a renaming of h1rwdelscore.</i></p>
vdmde2	<p>Logical memory delayed (0-25) (HRS HCAP variable set 6) Missing values: 387/3496 Distinct values: 25 Mean (SD): 7.340 (5.438) <i>NOTE: The number correct on the WMS-IV Logical Memory I delayed story recall task. There are 25 story points to be recalled, and the source variable is the sum of these that are recalled. Essentially a renaming of h1rlmdelscore, but if the HRS/HCAP variable h1rlmdeltest has a value of 9 (imputed) the created variable is set to missing.</i></p>
vdmde3	<p>MMSE 3 word delayed recall (0-3) (HRS HCAP variable set 6) Missing values: 209/3496 Distinct values: 4 0: 87 1: 217 2: 765 3: 2218 <i>NOTE: The number of words recalled after a delay on the MMSE 3 word list. It is simply a recoded version of the original variable h1rmse13, with responses of 97, 98 , 99 treated as missing.</i></p>
vdmde4	<p>CERAD constructional praxis delayed (0-11) (HRS HCAP variable set 6) Missing values: 191/3496 Distinct values: 12 Mean (SD): 5.807 (3.246)</p>
vdmde5	<p>Brave man delayed score (0-12) (HRS HCAP variable set 6) Missing values: 164/3496 Distinct values: 13 Mean (SD): 4.983 (3.347) <i>NOTE: Simply a renaming of h1rbmdelscore. No accommodation for missing or other non-response codes has been used.</i></p>

Variable	Description
vdmre1	<p>CERAD word list recognition task (0-20) (HRS HCAP variable set 6) Missing values: 173/3496 Distinct values: 18 Mean (SD): 18.527 (2.357) <i>NOTE: The number correct yes and number correct no on the CERAD delayed recognition task.</i></p>
vdmre2	<p>Logical memory recognition (0-15) (HRS HCAP variable set 6) Missing values: 257/3496 Distinct values: 16 Mean (SD): 10.291 (2.719) <i>NOTE: The number correct on the WMS-IV Logical Memory I story recognition task. It is simply a renaming of h1rlmrecscore but with missing codes (97, 98, 99) are treated as missing.</i></p>
vdvis1	<p>CERAD Constructional praxis (HRS HCAP variable set 6) Missing values: 188/3496 Distinct values: 12 Mean (SD): 8.179 (2.330) <i>NOTE: CERAD constructional praxis immediate. The summary variable is a simple recode (for missing, other non-response codes as system missing) version of h1rcpimmscore</i></p>
vdvis2	<p>MMSE copy polygons (HRS HCAP variable set 6) Missing values: 212/3496 Distinct values: 2 0: 1532 1: 1752 <i>NOTE: The copy polygons item from the MMSE. It is based only on h1rmse22, with missing codes excluded (97, 98, 99).</i></p>
vdexf1	<p>Raven's progressive matrices (HRS HCAP variable set 6) Missing values: 209/3496 Distinct values: 18 Mean (SD): 12.396 (3.691)</p>
vdexf2	<p>Trails B time (observed 32-300 seconds) (HRS HCAP variable set 6) Missing values: 669/3496 Distinct values: 259 Mean (SD): 0.168 (0.079) <i>NOTE: This variable is the log-transformed and log-normalized time to complete Trails B, and is equal to $1 - \frac{\log(T_B)}{\log(300)}$, where</i></p>

Variable	Description
vdexf3	<p><i>{B}\$ is the number of seconds needed to complete the Trails B task, and 300 is the ceiling on the number of seconds allowed to complete the task. The resulting score is 0 when the participant took 300 seconds to complete the task (or did not complete the task in 300 seconds and was assigned a score of 300), and 1 when the task was completed in 0 seconds (unsurprisingly, we do not observe scores of 1). The direction of this log transformed score is such that higher scores (approaching 1) are better and indicate faster performance. Values on the source variable not between 0 and 300 are treated as missing. Note that the reverse transformation is $300^{(1-B)}$ where \$ is the log transformed, log-normalized complement number of seconds to complete the Trails B task.</i></p> <p>Errors, Cancellation number of missed letters (HRS HCAP variable set 6) Missing values: 300/3496 Distinct values: 41 Mean (SD): 5.061 (4.506) <i>NOTE: Simply a renaming of h1rlcmisssed. The source item derives from the ELSA study. No accommodation for missing or other non-response codes has been used.</i></p>
vdexf4	<p>Errors, Cancellation number of incorrectly marked letters (HRS HCAP variable set 6) Missing values: 299/3496 Distinct values: 17 Mean (SD): 0.178 (1.193) <i>NOTE: Simply a renaming of h1rlcscincorr. The source item derives from the ELSA study. No accommodation for missing or other non-response codes has been used.</i></p>
vdexf5	<p>Errors, Symbol Digit Modalities Test (HRS HCAP variable set 6) Missing values: 324/3496 Distinct values: 25 Mean (SD): 1.469 (2.585) <i>NOTE: This item is simply a renaming of with the additional restriction that values in are not carried to vdexf5 if a missing value code (997, 998, 999). Note that according to the , the SDMT score is the number of correct pairings minus any mistakes or skips. This implies that information encoded in vdexf5 is also contained in the SDMT score. This lack of independence creates a logical dependency that will violate the</i></p>

Variable	Description
vdexf6	<p>Errors, fluency (HRS HCAP variable set 6) Missing values: 175/3496 Distinct values: 14 Mean (SD): 0.817 (1.361) <i>NOTE: A renaming of h1rafnumincorr. Also, if the checkpoint item h1rafincorr (IWER: DID YOU RECORD ANY INCORRECT NAMES?) has a value of 5 (no) then zero is imputed for the number of incorrection mentions. No accommodation for missing or other non-response codes has been used.</i></p>
vdexf7	<p>HRS Number Series (HRS HCAP variable set 6) Missing values: 727/3496 Distinct values: 29 Mean (SD): 522.448 (31.400) <i>NOTE: According to the 2016 Harmonized Cognitive Assessment Protocol (HCAP) Study Protocol Summary, this item was developed for the HRS, this section evaluates Respondents ability for numeric reasoning by presenting a series of 6 individual series of numbers, where one or two numbers in the series is missing. The Respondent is asked to take as much time as s/he needs, with the help of scrap paper and a pencil, to identify the missing number/s. This test is a block-adaptive test. Respondents are given a set of three number series questions of varying difficulty to first complete. Based on the number of correct responses in this first set of three (score Range = 0 to 4), Respondents are then assigned to a second set of three questions, for which the difficulty level is based on the number correct on the first set. The HRS uses two versions of the Number Series questions and respondents are assigned to the version that was not done in the previous wave. For HRS-HCAP, Respondents were assigned to the Number Series that was not assigned in the 2016 Core interview. If a Respondent was not able to do the Number Series section in the 2016 Core interview (not able to do practice questions, was too confused), then they were skipped out of this section. In creating vdexf7, missing codes (codes 996 and higher) on the source variable h1rnsscore are treated as missing.</i></p>
vdasp1	<p>Symbol Digit Modalities Test score (HRS HCAP variable set 6) Missing values: 328/3496</p>

Variable	Description
vdasp2	<p>Distinct values: 68 Mean (SD): 32.493 (12.523) <i>NOTE: Simply a renaming of h1rsdmscore. No accommodation for missing or other non-response codes has been used. Note that according to the 2016 Harmonized Cognitive Assessment Protocol (HCAP) Study Protocol Summary, the SDMT score is the number of correct pairings minus any mistakes or skips. This will create logical dependency or local dependence with SDMT errors (in executive function domain).</i></p> <p>Trails A (HRS HCAP variable set 6) Missing values: 286/3496 Distinct values: 190 Mean (SD): 0.320 (0.085) <i>NOTE: This variable is the log-transformed and log-normalized time to complete Trails A, and is equal to $1 - \frac{\log(T_A)}{\log(300)}$, where $\{A\}$ is the number of seconds needed to complete the Trails A task, and 300 is the ceiling on the number of seconds allowed to complete the task. The resulting score is 0 when the participant took 300 seconds to complete the task (or did not complete the task in 300 seconds and was assigned a score of 300), and 1 when the task was completed in 0 seconds (unsurprisingly, we do not observe scores of 1). The direction of this log transformed score is such that higher scores (approaching 1) are better and indicate faster performance. Missing codes (i.e., not between 0 and 300 on the source variables) are treated as missing.</i></p>
vdasp3	<p>MMSE spell world backwards (HRS HCAP variable set 6) Missing values: 320/3496 Distinct values: 6 0: 52 1: 87 2: 159 3: 338 4: 150 5: 2390 <i>NOTE: The sum of 5 recorded responses to the MMSE spell world backwards task, recored with five correct/incorrect indicators. Only correct responses are summed (code 1 on source variables). At least 1 of the five indicators must have a non-missing code (not missing or 96, 97, 98, 99) to get the 0-5 score on vdasp3.</i></p>
vdasp4	<p>Backwards counting (HRS HCAP variable set 6)</p>

Variable	Description
vdasp5	<p>Missing values: 196/3496 Distinct values: 70 Mean (SD): 29.309 (11.398) <i>NOTE: According to the 2016 Harmonized Cognitive Assessment Protocol (HCAP) Study Protocol Summary this test assesses speed and attention and is derived from the Backward Count measure in the MIDUS Study. Respondents are asked to begin at 100 and to count backwards as fast as possible. They are given 30 seconds and the number they reach and number of errors are recorded.</i></p>
vdasp5	<p>Letter cancellation (HRS HCAP variable set 6) Missing values: 299/3496 Distinct values: 37 Mean (SD): 14.775 (5.270) <i>NOTE: According to the 2016 Harmonized Cognitive Assessment Protocol (HCAP) Study Protocol Summary this test has been included in ELSA and assesses attention and speed. Respondents are given a paper with a large grid of letters and are asked to scan the grid as quickly as possible in a minute and to cross out as many P and W letters as they can in that time. This variable vdasp5 is a renamed and otherwise unaltered version of h1rlcscor, the number of correctly crossed-out letters.</i></p>
vdlfl1	<p>Category fluency (animals) (HRS HCAP variable set 6) Missing values: 151/3496 Distinct values: 41 Mean (SD): 15.969 (6.570) <i>NOTE: Simply a copied or renamed version of h1rafscore. No handling of missing response codes was implemented (none were observed).</i></p>
vdlfl2	<p>Naming 2 items HRS TICS scissors, cactus (HRS HCAP variable set 6) Missing values: 162/3496 Distinct values: 3 0: 21 1: 266 2: 3047 <i>NOTE: This is the number of correct responses to the HRS TICS items name two objects (scissors, cactus). Respondents must have at least 1 non-missing (not system missing, not 7, 8, 9) to get a score.</i></p>

Variable	Description
vdflf3	<p>Naming 2 items MMSE (HRS HCAP variable set 6) Missing values: 158/3496 Distinct values: 3 0: 5 1: 35 2: 3298 <i>NOTE: This is the number of correct responses to the two MMSE name objects questions. Respondents must have at least 1 non-missing (not system missing, not 97, 98, 99) to get a score.</i></p>
vdflf4	<p>MMSE write a sentence (HRS HCAP variable set 6) Missing values: 260/3496 Distinct values: 2 0: 213 1: 3023 <i>NOTE: An indicator as to whether h1rmse21 is scored as correct (value 1). Missing codes (any value coded 96 or higher) are treated as missing.</i></p>
vdflf5	<p>MMSE read and follow command (HRS HCAP variable set 6) Missing values: 172/3496 Distinct values: 2 0: 129 1: 3195 <i>NOTE: An indicator as to whether h1rmse16 is scored as correct (value 1). Missing codes (any value coded 96 or higher) are treated as missing.</i></p>
vdflf6	<p>1066 object naming (HRS HCAP variable set 6) Missing values: 155/3496 Distinct values: 5 0: 7 1: 12 2: 102 3: 698 4: 2522 <i>NOTE: The number of correct responses to the three step command task in the MMSE. Respondents must have at least 1 non-missing (not system missing, not 97, 98, 99) to get a score.</i></p>