HRS/AHEAD Documentation Report

Documentation of Physical Functioning Measured in the Heath and Retirement Study and the Asset and Health Dynamics among the Oldest Old Study

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I. Overview

This document is part of a series of working papers on health-related measures in the Health and Retirement Study (HRS) and the Asset and Health Dynamics Among the Oldest-Old (AHEAD) study. The series currently contains papers on cognitive function, affective function, and physical function, the latter of which is the focus of this document. The purpose of this document is to aid prospective analysts in the appropriate use of the physical functioning data. To do so, this document provides an inventory of the physical functioning measures included in the survey interviews, describes the formats and origins of these measures, discusses their reliability, validity, and change over time and several options for working with the evolution of the questions, and provides SAS code for recoding the variables and creating simple summary measures.

Briefly, the HRS is a national, prospective, probability study designed to enable characterization of middle-aged people's health transitions and their effects on resources such as finances, formal and informal support, family dynamics, and health care. The study began in 1992 (HRS92 or Wave 1) and re-interviewed participants again in 1994) (HRS94 or Wave 2H), 1996 (HRS96 or Wave 3H), 1998 (HRS98 or Wave 4), 2000 (HRS00 or Wave 5), and 2002 (HRS02 or Wave 6). It surveyed people who were between 51 and 61 years of age in 1992 and their spouses, irrespective of spouse's age. The AHEAD study is a companion to the HRS and as such selected respondents using the same multi-stage area probability sample and screening survey. Its initial target population was non-institutionalized people 70+ years of age in 1993. Respondents' spouses were also interviewed, regardless of whether they were aged 70+ years in 1993. To date, the interviews have been conducted in 1993/1994 (AHEAD93 or Wave 2A, to be consistent with the HRS94 or Wave 2H), 1995/1996 (AHEAD95 or Wave 3A, to be consistent with the HRS96 or Wave 3H), 1998 (HRS98 or Wave 4), 2000 (HRS00 or Wave 5), and 2002 (HRS02 or Wave 6). The HRS and AHEAD merged in 1998 and have remained combined since.

For further information on the design and content of the HRS and AHEAD and to obtain the data, consult the following web site: http://hrsonline.isr.umich.edu. Users must register at this site. For a second resource on the health measures (as well as many others) in HRS and AHEAD, consult the RAND Data Documentation for the HRS (St. Clair et al., 2003). It provides data descriptions, frequencies, and univariate statistics for numerous variables in the HRS data sets 1992 through 2000, by respondent and respondent's spouse. The documentation can be used together with the RAND HRS Data Files, which are available as cross-sectional files or as a longitudinal file with consistent variable construction and naming conventions across waves.

This report is structured as follows. Section II provides a discussion of why physical functioning measures were included in the HRS and AHEAD. Section III presents an inventory of the physical functioning measures for all available waves of HRS and AHEAD. Section IV details the origins of the measures. Section V outlines several methodological issues with the physical functioning measures pertinent to the HRS and AHEAD and discusses the comparability of the measures across waves. Section VI provides the results of investigations into data quality of the measures. This section includes subsections on internal consistency and measurement properties, univariate distributions, construct validity, benchmarking against other surveys, and constructed variables. Section VII discusses certain technicalities of the data, such as changes in the question wording over time, and options for accommodating these technicalities. It also provides example SAS code for constructing summary variables.

II. Rationale for measuring physical functioning

According to the International Classification of Functioning, Disability and Health (ICF), physical functioning and disability are a complex, dynamic interaction among the health conditions of the individual, the environment, and personal factors. Survey questions about physical functioning

are a proven critical set of measures that summarize this interaction. Thus, questions about physical functioning have been included in almost every large survey of older adults, such as the National Health Interview Survey, Supplement on Aging, the NLTCS, and the Established Populations for Epidemiologic Studies of the Elderly, etc. (Wiener et al., 1990). They have also been included in surveys of adults of all ages (e.g., Americans' Changing Lives), and numerous state-level instruments intended to predict individuals' needs for services such as In-Home Aid, Personal Care, and institutionalization (e.g., the Services and Services Outcome Screen, NC).

The HRS and AHEAD have included a comprehensive battery of physical functioning measures, in part to summarize the morbidity and environmental interactions within people; however, there were also other rationales for the inclusion of these measures. One is the evidence that physical functioning is an important cause and/or outcome of numerous other aspects of people's well-being, such as their socioeconomic status (SES) (Bunker, Gomby, & Kehrer; Clark & Maddox, 1992, House et al., 1994), labor market performance (Ficke, 1992; Martini, 1990; Ries, 1991; Wray, 1996), affective functioning (Berkman et al., 1986; Blazer et al., 1991; Phifer & Murrell, 1986), and mortality (Anderson et al. 1998; Wolinsky, Callahan, Fitzgerald, & Johnson, 1993). Of these various causes and outcomes of physical functioning, the HRS and the AHEAD were designed to provide researchers with means to study how changes in individuals' health relates to changes in their labor force participation, retirement process, economic resources, support services, and family dynamics (Juster & Suzman, 1995; Soldo, Hurd, Rodgers, & Wallace, 1997). For example, these data can address such questions as whether people who experience declines in health or catastrophic health events exit the labor force earlier and/or change the consumption of their economic, health, and social resources, thereby accelerating the depletion of those resources. Moreover, do people reenter the labor force and under what circumstances? Does the depletion of such resources contribute to worsening health or impede recovery?

Another rationale for including measures of physical functioning in the HRS and AHEAD was to address the question of whether functional status in the U.S. population differs over time and across cohorts. If so, are optimistic claims about the attenuation of disability and disease in later cohorts warranted (Cf. Fries, 1980)? Some of the work addressing this question is associated with Manton and colleagues (e.g., Manton, 1990; Manton & Stallard, 1992, 1994; Manton, Corder, & Stallard, 1993; Manton, Stallard, & Corder, 1998; Manton, Stallard, &Woodbury, 1994;) and their analyses of the National Long Term Care Survey (NLTCS). Similar to the HRS and AHEAD, the NLTCS is a nationally representative, prospective survey of older adults. One important difference, however, is that the main part of the survey, or the "detailed interview", was designed to characterize the health problems, cognitive status, formal and informal support, etc. of *chronically disabled*, elderly, community-dwelling Americans.[1] The HRS and AHEAD do not have this limitation.

Freedman and colleagues (2002) conducted a literature search for other work addressing the question of changes in functional status in the U.S. population over time. They examined all studies documenting old age (ages >= 65 or 70 years) disability or functioning trends in the U.S. from the late 1980s through the 1990s. They identified 16 studies as relevant to their review and examined the quality, quantity, and consistency of the 8 surveys used in the 16 studies, including AHEAD (through HRS98). Freedman and colleagues then reported the average annual percent change in functioning for a sub-set of these studies. HRS and AHEAD can be useful benchmarks for several of the studies that Freedman and colleagues identified, such as those of local or regional samples (e.g., the Framingham Heart Study) and/or of specific populations (e.g., Medicare population ages 65 years and older).

[1] The NLTCS contains a "screener" component, which enables researchers to track longitudinal and cohort differences in certain aspects of physical functioning (e.g., activities of daily living), but the "screener" does not contain detailed

III. Inventory of measures

Physical functioning is a multidimensional concept encompassing mobility, large muscle functioning, fine motor skills, gross motor skills, and the ability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs). The HRS and AHEAD included as many questions about these activities as possible so as to facilitate the creation of sensitive, hierarchical scales that differentiate among people with no problems to severe problems. Also, because there are disparate points of view on what defines impairment in physical functioning (e.g., needing help to perform a task vs. self-reported difficulty irrespective of help vs. reliance on equipment, etc.), the HRS and AHEAD used unfolding questions designed to reveal the nature of impairments as well as several modules that use different question formats. Here we provide an overview of the measures included in the interviews and other information pertinent to analysts. We discuss the origins of these measures in Section IV.

A. Mobility, strength and fine motor skills

Table 1 reports the question numbers for the indicators of mobility, strength (large muscle functioning), gross motor skills, and fine motor skills in the HRS and AHEAD. All of the questions ask for a self-assessment. While there is some variation in how the questions about these tasks were asked, the kinds of responses that respondents were prompted for (e.g. yes/no versus none, a little, a lot, etc.), and follow-up questions, each interview contained questions asking respondents about whether they have *difficulty* performing the physical functioning tasks. The question numbers shown in Table 1 are for these questions about difficulty. Note that due to a change in survey software, the question numbers in HRS02 and later waves no longer match those of the preceding waves.

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information on salient covariates of physical functioning, such as cognition, SES and comorbidities.

Table 1

Questions About Mobility, Strength, Gross Motor Skills, and Fine Motor Skills in the HRS and AHEAD

Question	HRS92	HRS94		HRS96	AHEAD93	AHEAD95	HRS98	HRS00		HRS02
	Core	Core	Module 3	Core	Core	Core	Core	Core	Module 10	Core
Running/Jogging About 1 Mile	B4a	B4	B4a	E61		E61	E61	E61		HG002
Walking Several Blocks	B4b	B4a	B4b	E60	E47	E60	E60	E60	M10-13	HG001
Walking 1 Block	B4c	B4b	B4c	E62		E62	E62	E62		HG003
Sitting for About 2 Hours	B4e	B4d	B4e	E63		E63	E63	E63		HG004
Getting Up From A Chair	B4f	B4e	B4f	E64		E64	E64	E64		HG005
Climbing Several Flights of Stairs	B4h	B4g	B4h	E65		E65	E65	E65		HG006
Climbing One Flight of Stairs	B4j	B4h	B4j	E66	E48	E66	E66	E66		HG007
Lifting or Carrying Over 10 lbs.	B4k	B4j	B4k	E70	E50	E70	E70	E70		HG011
Stooping, Crouching or Kneeling	B4m	B4k	B4m	E67		E67	E67	E67	M10-14	HG008
Picking a Dime Up	B4n	B4m	B4n	E71	E51	E71	E71	E71		HG012
Reaching or Extending Arms	B4q	B4p	B4q	E68		E68	E68	E68		HG009
Pulling or Pushing Large Objects	B4r	B4q	B4r	E69	E49	E69	E69	E69		HG010

Notes:

This table includes question numbers for questions about respondents' *difficulty* with each task.

Module 10 in HRS00 asks the respondents to report on the functioning of their husbands/wives/partners, rather than themselves.

When assessing the prevalence and incidence of difficulties with mobility, strength (large muscle functioning), gross motor skills, and fine motor skills for the HRS and AHEAD respondents, it is necessary to be aware of several assumptions the HRS and AHEAD staff made about how these items relate to each other. Specifically, they assumed that respondents need not be asked about relatively easy tasks if they reported being able to do more challenging tasks. This assumption is reflected in the "skip patterns" used in the interviews. For example, respondents who could run or jog about 1 mile without difficulty were not asked if they could walk several blocks or 1 block, and respondents who could walk several blocks were not asked if they could walk 1 block (i.e., these questions were "skipped"). Respondents who could climb several flights of stairs were not asked if they could climb 1 flight of stairs. Moreover, in AHEAD93, people who had difficulty getting across a room were not asked if they also had difficulty walking several blocks, climbing a flight of stairs, and pulling/pushing large objects. In later waves of the HRS and AHEAD, people who had no problems with mobility, strength, and fine motor skills were not asked about ADLs. The HRS and AHEAD staff adopted these skip patterns based on their analyses showing that respondents tended to first lose the ability to perform tasks involving considerable mobility and strength, then the ability to perform tasks involving moderate mobility and strength, and lastly, the ability to do IADLs and ADLs. Analysts should consult the codebooks for each wave of the study to determine when skip patterns were used.

B. Activities of daily living (ADLs)

Given its objective to improve understanding of the relationship of health transitions to other areas of people's lives, the HRS and AHEAD incorporated a comprehensive set of questions about activities of daily living (ADLs) (See Tables 2a -2c). First, the surveys included questions about respondents' *difficulties* with ADLs as well as questions about respondents' *help* from other people and equipment in performing these tasks. Second, the surveys contained "core" questions, which

were part of the standard interview, and "module" questions, which asked a randomly selected sub-sample of self-respondents about ADLs using questions from other surveys and/or earlier waves of the HRS and AHEAD. The modules allow comparison of ADL measures in the core of the HRS and AHEAD with ADL measures used in other studies (Soldo, Hurd, Rodgers, & Wallace, 1997). They also enable researchers to assess possible measurement error (or differences) in the core ADL measures (Freedman, 2000; Rodgers & Miller, 1997).

Table 2a

Questions About ADLs in the HRS and AHEAD

	HRS92				HRS94		HRS96
Question	**Core**	**Module B (LSOA)**	**Module C (NLTCS)**	**Module D (Census)**	**Core**	**Module 3 (HRS92 Core)**	**Core**
Walking	B4d	MB1e	MC1d		B4c	B4d	E72
Dressing	B4t	MB1b	MC1f		B4s	B4t	E73
Bathing	B4p	MB1a	MC1g		B4n	B4p	E74
Eating	B4s	MB1c	MC1a		B4r	B4s	E75
Getting In/ Out of Bed	B4g	MB1d	MC1b		B4f	B4g	E76
Using the Toilet		MB1g	MC1h				E77
Getting In/ Out of Chairs			MC1c				
Going Outside		MB1f	MC1e	MD3			
Taking Care of Personal Needs				MD4			
Global ADLs Question							E79

Notes:
Module 1 questions of HRS92 are from the second Longitudinal Study of Aging (LSOA).
Module 2 questions of HRS92 are from the National Long Term Care (NLTCS) screen.
Module 3 questions of HRS92 are from the Census.
Module 1 questions of HRS94 replicated the format used in HRS92; this is because the wording and response categories were modified slightly after HRS92.

Table 2b

Questions About ADLs in the HRS and AHEAD

	AHEAD93				AHEAD95				HRS98				
Question	**Core**	**M3 (LSOA)**	**M4 (NLTCS)**	**M5 (Census)**	**Core**	**M1 & 2 (W1 Core)**		**M3 (LSOA)**	**Core**	**M1 & 2 (W1 Core)**	**M3 (LSOA)**	**M4 (NLTCS)**	**M5 (Census)**
Walking	E33e	M3-6	M4-5		E72	M1-33e	M2-33e	M3-6	E72	M1-33e	M3-6	M4-5	
Dressing	E35b	M3-3	M4-7		E73	M1-35b	M2-35b	M3-3	E73-f	M1-35b	M3-3	M4-7	
Bathing	E37b	M3-2	M4-8		E74	M1-37b	M2-37b	M3-2	E74	M1-37b	M3-2	M4-8	
Eating	E39b	M3-4	M4-2		E75	M1-39b	M2-39b	M3-4	E75	M1-39b	M3-4	M4-2	
Getting In/Out of Bed	E43c	M3-5	M4-3		E76	M1-43c	M2-43c	M3-5	E76	M1-43c	M3-5	M4-3	
Using the Toilet	E44b	M3-7	M4-9		E77	M1-44b	M2-44b	M3-7	E77	M1-44b	M3-7	M4-9	
Getting In/Out of Chairs			M4-4									M4-4	
Going Outside			M4-6	M5-6								M4-6	M5-6
Continence			M4-10									M4-10	
Taking Care of Personal Needs				M5-6a									M5-6a
Global ADLs Question					E79								

Notes:
"M3" refers to "Module 3," "M4" refers to "Module 4," etc.
Module 3 questions in all waves are from the second Longitudinal Study of Aging (LSOA).
Module 4 questions of AHEAD93 are from the National Long Term Care (NLTCS) screen.
Module 5 questions are from the Census.
Module 1 and Module 2 questions replicated the format used in AHEAD93; this is because the wording and response categories were modified slightly after AHEAD93.

Table 2c

Questions About ADLs in the HRS and AHEAD

Question	HRS00 Core	HRS02 Core
Walking	E72	HG016
Dressing	E73Y1	HG014
Bathing	E74	HG012
Eating	E75	HG023
Getting In/Out of Bed	E76	HG025
Using the Toilet	E77	HG030
Getting In/Out of Chairs		
Going Outside		
Continence		
Taking Care of Personal Needs		
Global ADLs Question		

Similar to the questions about mobility, strength, and fine motor skills, certain questions about ADLs were "skipped" or omitted during the interview, depending on the respondent's answers to preceding questions. These skip patterns changed across interviews as HRS and AHEAD staff observed the relationships among ADLs and other indicators of physical functioning in this sample. That is, the ADL questions were asked of all respondents in HRS92-HRS96 and AHEAD93. As of AHEAD95, however, respondents who reported no difficulty with strength and mobility tasks were not asked detailed questions about ADLs. Instead, interviewers asked these relatively high-functioning respondents a global question about whether they have any difficulty with the entire list of ADLs ("Because of a health problem, do you have any difficulty getting across a room, dressing, bathing, eating, getting out of bed, or using the toilet?"). Likewise, in HRS98, HRS00, and HRS02, respondents who either a) had no problems with strength, mobility, and fine motor skills (excluding running 1 mile or climbing several flights of stairs) or b) reported no more than one problem with strength, mobility, and fine motor skills (excluding running 1 mile or climbing several flights of stairs) *and* no difficulty with *dressing* were not asked the specific questions about the remaining

ADLs. The global ADL question in AHEAD95 was not repeated in later waves because it was found that almost all respondents who could perform the physical functioning tasks could also perform the ADLs.

In addition to difficulties with ADL performance, researchers might also be interested in examining the use of assistance from people and/or equipment, either as an outcome variable (Hartke, Prohaska, & Furner, 1998), as another way of measuring disability (Agree, 1999), or as a factor in relieving difficulties (Verbrugge, Rennert, & Madans, 1997). The HRS and AHEAD added questions about the use of assistance from people for each ADL and about the use of equipment for walking across a room and getting in and out of bed. (Note: There were several questions about the use of devices and personal assistance for bathing and money management in Module 7 of AHEAD93 and AHEAD95 and for bending, lifting, jumping, running, walking around the neighborhood, and fully using hands and fingers in Module 7 of HRS00.)

C. Instrumental activities of daily living (IADLs)

Table 3 documents the questions in the HRS and AHEAD about respondents' abilities to do IADLs. Questions about IADLs have been used in many surveys, but there is not a standard list as there is for ADLs. The HRS and AHEAD asked about grocery shopping, preparing meals, managing money, making telephone calls, using a calculator, using a microwave, and driving. Limitations in the latter three activities may manifest before difficulties with other IADLs are evident and/or may make it difficult to complete other IADLs (e.g. it might be more difficult to grocery shop without being able to drive). Thus, while these types of activities often may not be included in other surveys, they were included in the HRS and AHEAD so as to identify the beginning of health and/or cognitive decline among otherwise high-functioning respondents, particularly the younger HRS respondents.

Table 3

Questions About IADLs in the HRS and AHEAD

Question	HRS92	HRS94	HRS96	AHEAD93	AHEAD95	HRS98	HRS00		HRS02
	Core	Core	Core	Core	Core	Core	Core	Module 10	Core
Preparing Hot Meals			E95	E52	E95	E95	E95	M10-15	HG041
Shopping for Groceries			E96	E52	E96	E96	E96		HG044
Making Telephone Calls		B5c	E97	E52	E97	E97	E97		HG047
Taking Medications		B5d	E98	E52	E98	E98	E98		HG050
Managing Money		B5b	E106	E57	E106	E106	E106	M10-16	HG059
Using a Map	B5a	B5	E93		E93	E93	E93		HG040
Driving			E91	E51c	E91	E91	E91		HG037
Using a Microwave	B5b								
Using a Calculator	B5c	B5a							
Using a Computer	B5d								

Notes:
Module 10 in HRS00 asks the respondents to report on the functioning of their husbands/wives/partners, rather than themselves.

Similar to the questions about ADLs, the questions about the IADLs addressed various aspects of functioning. One aspect was respondents' self-reported difficulty in performing IADLs. Another aspect was their dependency, or whether respondents received assistance with the performance of IADLs. A third aspect was whether respondents who had disabilities in IADLs had them due to physiological or mental problems (i.e., they don't or can't do a task because of a health problem) or because they did not need to perform those tasks (for example, a spouse might be responsible for preparing hot meals).

Several skip patterns within the IADL question sequence require note. First, only certain cohorts of respondents received the questions related to driving; e.g., in HRS96, HRS98, HRS00, and HRS02, only respondents 68+ (HRS96) and 65+ years of age (HRS98-HRS02) were asked about driving. Second, respondents were asked if they had any difficulty with IADLs "because of a health a memory problem." If they responded that they "can't do" or "don't do" an activity, they were again asked whether their limitation was "because of a health or memory problem."

D. Accommodations

The ways in which older adults experience and interpret their physical functioning dis/abilities may be related to their use of accommodations (Baltes & Baltes, 1990; Baltes & Carstensen, 1996). For example, people may use personal assistance and equipment to compensate for decline. In turn, the use of personal assistance and/or equipment may mitigate further decline or individuals' perceptions that they are disabled. To address issues such as these, AHEAD93 and AHEAD95 included Module 7, which gathered information about whether and how respondents used strategies to assist them with bathing and managing money. Respondents were asked (a) what sorts of tools they used for bathing (e.g., grab bar, seat or stool, and/or other devices), (b) if someone actively helped them with bathing (e.g., by helping them get in or out of the bath or shower, and/or

wash and dry off), (c) if someone passively helped them with bathing (e.g., by waiting in the house while they bathed), and (d) if someone helped them manage their bills, savings and investments, and/or major decisions. The module also contained follow-up questions about the frequency with which respondents used several of these adjustments and, if someone helped them, who.

Also, HRS00 Module 7 asked several questions about whether respondent had difficulty, without help or use of equipment of any kind, with a) bending, lifting, jumping, and running, b) walking around the neighborhood, and c) fully using hands and fingers. For respondents with difficulty in these domains, a series of follow-up questions asked about whether they usually used assistive devices, what kind, and whether they relied on other people for assistance.

IV. Pedigree of physical functioning measures

Physical functioning measures like those used in the HRS and AHEAD have a history of use in clinical settings for diagnostic purposes, in epidemiologic research characterizing patterns of and risk factors for disability, and in policy research assessing people's needs for health services. Here we describe briefly the derivation of the measures.

The use of measures for people's abilities to lift or carry weight, ascend and descend stairs, walk, stoop, bend, or kneel, reach, and use hands and fingers gained widespread use after appearing in work by Rosow and Breslau (1966) and Nagi (1969, 1976). Rosow and Breslau measured older people's abilities to walk about one-half mile, plus other physical activities like heavy housework, and created a Guttman Scale of physical health that they then used in their examination of older adults' social participation. Nagi used measures of physical functioning, combined with measures of ADLs and certain IADLs, to develop a scheme differentiating among people with no difficulties, people with some difficulties but independent, people needing assistance in mobility outside of the home (these people also need help with housekeeping, work, and shopping) and people needing

assistance in personal care (Nagi, 1976). In a more recent framework ("disablement process") proposed by Verbrugge and Jette (1994), losses of mobility, strength, and fine motor skills were defined as "impairment." Verbrugge and Jette hypothesized that impairment usually (although not inevitably) follows pathology and precedes "disability." They defined disability as individual's inability to work and fulfill social roles.

Katz and associates (Katz et al., 1963) developed the first scale of ADLs now used in the HRS and AHEAD surveys, in order to provide a way of assessing the effectiveness of treatments for older people with hip fractures. Given its usefulness for differentiating among people in this specific population, Katz and associates perceived that it would be a helpful instrument for understanding the course of decline in basic functioning [i.e., "activities which people perform habitually and universally" (p. 94)] among well people also. Their scale covered bathing, dressing, going to the toilet, transfer in and out of chairs, continence, and feeding. It involved rating individuals' "adequacy of performance" (p. 94) in these tasks and their stages of functional loss (e.g., generally people first lose the ability to bathe independently, then dressing, etc.).[2] Since appearing in Katz et al.'s work, ADLs have been used extensively and in various combinations in health-related research.

The IADLs in the HRS and AHEAD borrowed from the inventory developed by Lawton and Brody (1969). In Lawton and Brody's 1969 framework, there are multiple, general areas of human functioning that differ in terms of complexity. In order from least to most complex, these areas are life maintenance, perception-cognition, physical self-care, instrumental self-care, effectance, and social behavior. Lawton and Brody created the IADL scale to assess the instrumental self-care area of functioning, which they asserted had been measured inadequately up to that point. This scale included the ability to use the phone, shop, prepare food, clean house, launder clothing, use

[2] Katz et al.'s (1963) scheme is as follows: a) independent in all activities; b) independent in all except one activity; c) independent in all activities except bathing and one additional activity; d) independent in all activities except bathing, dressing, and one additional activity; e) independent in all activities except bathing, dressing, going to toilet, and one

transportation, take medications, and handle finances. The range of items was explicitly designed to tap functioning of both men and women, who may perform different instrumental tasks, and older people living in a variety of settings, such as homes for aged people, foster homes, the community, etc. Lawton and Brody validated their scale among people living in numerous situations and it has been in wide use since.

V. Special methodological issues

Two methodological issues pertinent to the HRS and AHEAD surveys are discussed here—measurement error and change in question wording/sequencing over time.

A. Measurement error

An underlying assumption of much research using measures of physical functioning is that the observed variables (e.g., self-reported ability to walk, eat, climb stairs, etc.) correlate perfectly with their corresponding latent variables or concepts (Bollen, 1989). This assumption may be erroneous, however; e.g., Jette's (1994) study of ADL disability found that its prevalence differed widely according to how the questions about ADLs were asked. Prevalence was about five times greater for questions about difficulty compared to questions about human assistance. From this finding we can infer that, although each ADL question was intended to be a perfect indicator of a latent variable representing disability in a specific task, some were more or less perfect indicators than others. Which types of indicators are most accurate remains an open question.

Inasmuch as observed variables do not correlate perfectly with corresponding latent variables in the HRS and AHEAD, measurement error exists. This is a problem that the HRS and AHEAD share with most other studies. Yet, with their experimental modules containing differently phrased ADL questions, the HRS and AHEAD provide a unique opportunity to examine the extent of

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additional activity; f) independent in all except bathing, dressing, going to toilet, transferring, and one additional function; g) dependent in all activities; and other (dependent in at least 2 activities, but classifiable as C, D, E, or F).

measurement error. Rodgers and Miller (1997) took such an opportunity by cross-classifying respondents' answers to ADL questions in AHEAD93 of the core with their answers to ADL questions in two modules of AHEAD93. One module contained ADL questions based on the format used in the National Health Interview Survey's Supplement on Aging (LSOA) and the other contained questions based on the format of the National Long Term Care Survey's (NLTCS) screener. Rodgers and Miller found *large* discrepancies in the proportion of people with ADL difficulties as reported using these three question formats. Kappa agreement coefficients for each ADL showed that consistency between answers to the core and module questions was low for the core/LSOA module comparison and moderate for the core/NLTCS module comparison. This finding suggested measurement error. Finally, by correlating other health-related variables with various help and difficulty limitation scales (observed separately) based on (1) respondents' answers to the core questions only, (2) respondents' answers to the module questions only, (3) respondents' answers to the core or module questions, and (4) respondents' answers to the core and module questions, Rodgers and Miller (1997) ascertained that the measurement error is in the direction of *underreporting* of ADL difficulties. In other words, respondents with ADL-related problems may have failed to report them, but individuals without problems rarely reported having them. An additional and as yet uninvestigated methodological issue is the extent to which respondents' functional transitions are "true change" or are due to measurement error in the ADL items over time.

B. Comparison of questions across waves

Analyses of transitions and trajectories using longitudinal data have become increasingly common in social science research. Transitions refer to individual and group short-term, discrete changes from one state to another (e.g., from unimpaired to impaired, from working to retirement, etc.) (George, 1993). Trajectories refer to long-term patterns of stability and change (sequences of transitions) (Elder, 1985; George, 1993). An important prerequisite to observing transitions and

trajectories is repeated measures for the same individuals. To avoid confounding measurement error with substantive change, another prerequisite is to use the same questions at each observation of a longitudinal survey (Cook & Campbell, 1979).

With respect to physical functioning, the HRS and AHEAD facilitate comparison over time by covering the same tasks in every interview, rarely eliminating questions and often adding questions. In addition, the HRS and AHEAD followed all respondents over time irrespective of whether they continued to live in the community. The HRS and AHEAD also interviewed relatives of respondents who died between waves in what is called the "Exit Interview". The Exit Interview contains information about deceased respondents' health (including physical functioning) and health care expenditures prior to death and the disposition of assets.

But there are several ways in which the HRS and AHEAD could make comparison over time less straightforward than might be desirable. First, the *sequence* of ADL-related questions changed between AHEAD93 and AHEAD95. That is, respondents were asked if they had any help performing each task and, if so, the frequency of help and who helped. For the tasks of walking across a room and getting in and out of bed, the interviewers also asked respondents if they used equipment or devices and, if so, what kind of equipment and how often they used it. Then, for each ADL, respondents were asked if they had any difficulty (See Figure 1). In AHEAD95, the difficulty question was first in the sequence, as opposed to second or third (See Figure 2). Fortunately, later waves maintained consistency in the sequencing of the ADL-related questions. Second, the *wording* of the functional status questions changed over time. To illustrate, AHEAD93 ADL-related questions asked, "Does anyone ever help you...?" and "Do you have difficulty...?". For the AHEAD93 IADLs, the questions began with, "Are you able to...?" But questions about ADL functioning in AHEAD95 began with, "Because of a health or memory problem, do you have any difficulty...?" Table 4 shows

the lead-in wording for questions about physical functioning in the core and modules of HRS and AHEAD through HRS02.

Good rationales existed for the change in question sequence and wording. The questions in AHEAD93 were designed to address elders' levels of *help*, consistent with the overarching goals of the HRS and AHEAD study. These questions differed from those used in other surveys of older adults, however, which researchers argued made cross-study comparisons difficult. Moreover, the *help*-oriented format was not as effective at addressing the issue of elders' *actual* difficulty with physical functioning tasks. Finally, the change in question format between AHEAD93 and AHEAD95 was in preparation for the merging of HRS and AHEAD as of HRS98. Strategies for accommodating changes in question wording and format are discussed later in this document.

Figure 1

Question flow of ADLs in the core of AHEAD93

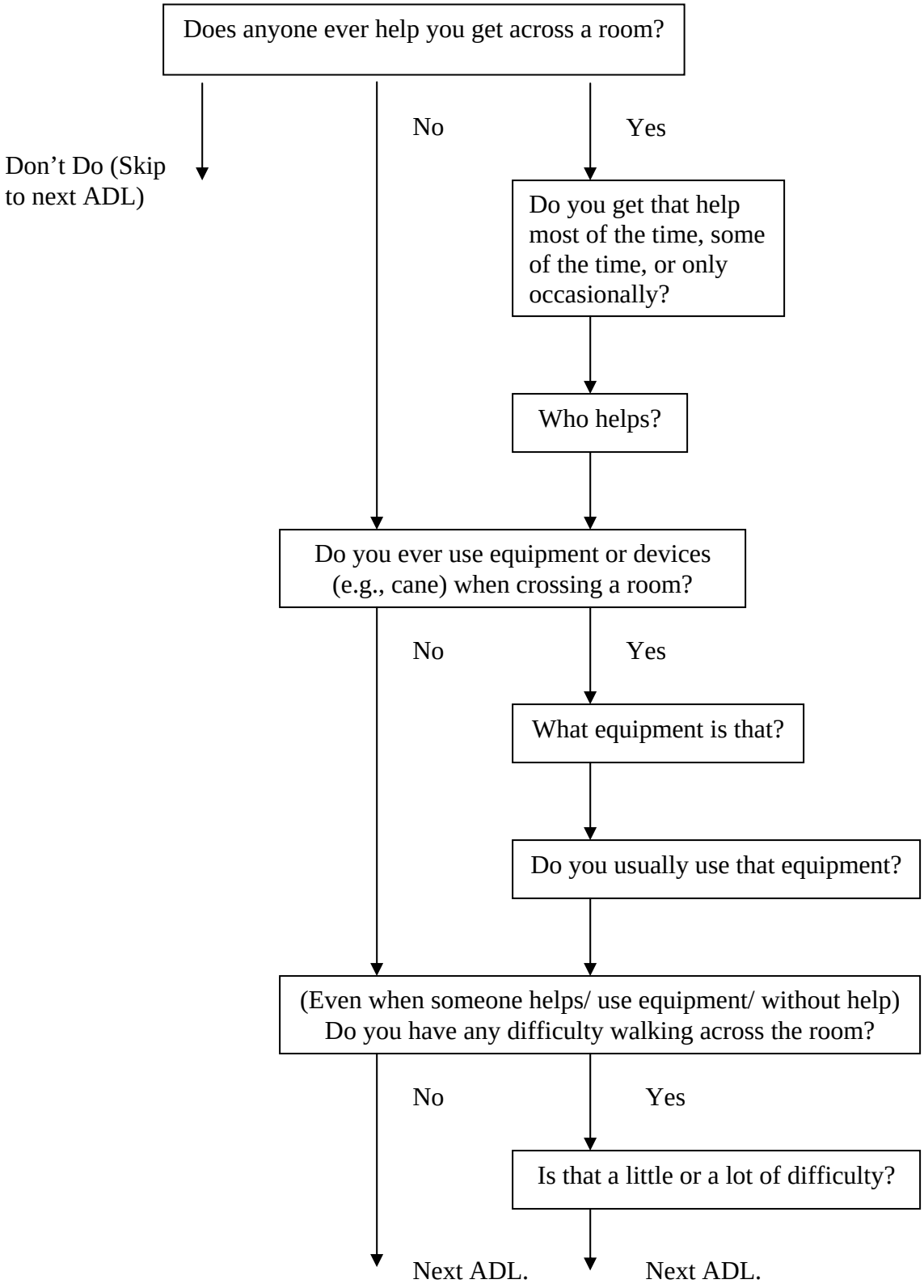

Figure 2

Question flow of ADLs in the core of AHEAD95

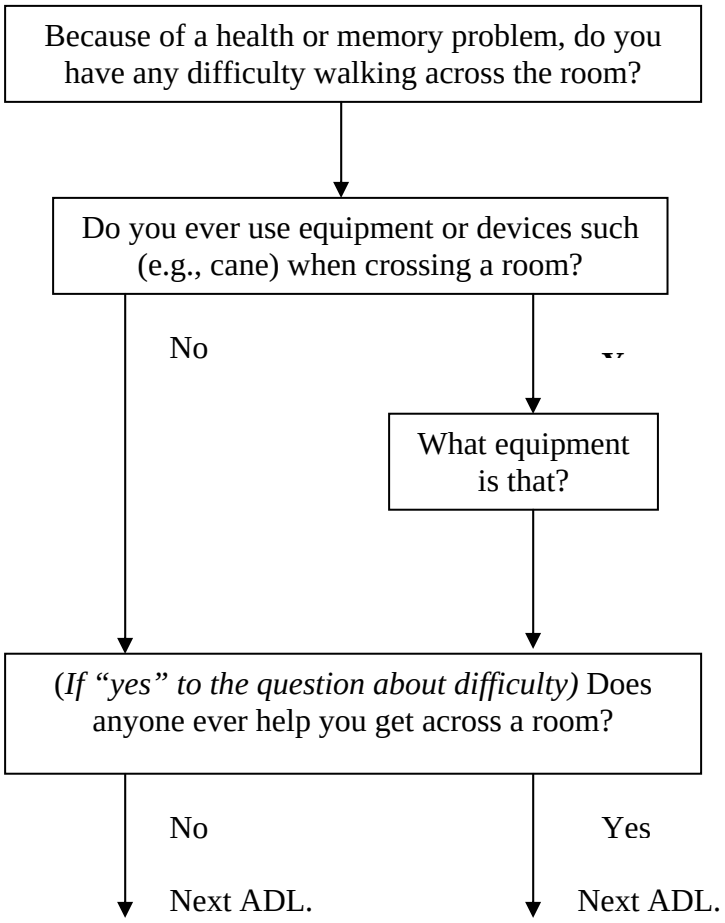

Table 4

Sample Lead-in Questions about Physical Functioning in the HRS Study

Core Questions by Wave

Mobility, Strength, & Fine Motor Skills

HRS92:	How difficult is it for you to…?
HRS94:	Do you have any difficulty….?
HRS96:	Because of a health problem do you have any difficulty with…?
AHEAD93:	Do you have any difficulty….?
AHEAD95:	Because of a health problem do you have any difficulty with…?
HRS98:	Because of a health problem do you have any difficulty with…?
HRS00	Because of a health problem do you have any difficulty with…?
HRS02	Because of a health problem do you have any difficulty with…?

ADLs

HRS92:	How difficult is it for you to…?
HRS94:	Do you have any difficulty….?
HRS96:	Because of a health problem do you have any difficulty with…?
AHEAD93:	Does anyone ever help you to…? (followed by questions about difficulty)
AHEAD95:	Because of a health problem or memory problem do you have any difficulty with…?
HRS98:	Because of a health problem or memory problem do you have any difficulty with…?
HRS00	Because of a health problem or memory problem do you have any difficulty with…?
HRS02	Because of a health problem or memory problem do you have any difficulty with…?

IADLs

HRS92:	How difficult is it for you to…?
HRS94:	Do you have any difficulty….?
HRS96:	Because of a health problem do you have any difficulty with…?
AHEAD93:	Are you able to (activity) without help?
AHEAD95:	Because of a health problem or memory problem do you have any difficulty with…?
HRS98:	Because of a health problem or memory problem do you have any difficulty with…?
HRS00	Because of a health problem or memory problem do you have any difficulty with…?
HRS02	Because of a health problem or memory problem do you have any difficulty with…?

Module Questions by Wave

Mobility, Strength, & Fine Motor Skills

HRS94:	How difficult is it for you to…? (Module 3)

ADLs

HRS92:	Because of a health or physical problem, do you have any difficulty…? (Module B) Do you have any problem (activity) without the help of another person or special equipment? (Module C) Do you have any difficulty taking care of your own personal needs, such as bathing, etc.? (Module D)
HRS94:	How difficult is it for you to…? (Module 3)
AHEAD93:	Because of a health or physical problem, do you have any difficulty…? (Module 3) Do you have any problem (activity) without the help of another person or special equipment? (Module 4)

	Do you have any difficulty taking care of your own personal needs, such as bathing, etc.? (Module 5)
AHEAD95:	Does anyone ever help you to…? (followed by questions about difficulty) (Modules 1 & 2) Because of a health or physical problem, do you have any difficulty…? (Module 3)
HRS98:	Does anyone ever help you to…? (followed by questions about difficulty) (Modules 1 & 2) Because of a health or physical problem, do you have any difficulty…? (Module 3) Do you have any problem (activity) without the help of another person or special equipment? (Module 4) Do you have any difficulty taking care of your own personal needs, such as bathing, etc.? (Module 5)
IADLs	
HRS00	Because of a health or memory problem, does he/she *(husband/wife/partner)* have any difficulty…? (Module 10)

VI. Evaluation of the measures and data quality

A. Previous research on internal consistency and measurement properties

Recent debates on the measurement of physical functioning have raised questions about whether strength, mobility, fine motor skills, ADL ability, and IADL ability comprise one comprehensive domain or multiple, related, hierarchical domains. According to studies by Wolinsky and Johnson (1992), Johnson and Wolinsky (1993), and others (e.g., Clark, Stump, & Wolinksy, 1997; Fitzgerald et al., 1993), strength and mobility, ADLs, and IADLs represent five areas of functioning for respondents of the LSOA: lower and upper body functioning and basic, household, and advanced ADLs. Lower body functioning is comprised of such tasks as stooping, kneeling or crouching and walking several blocks. Upper body functioning consists of tasks like reaching over one's head. Basic ADLs are bathing, dressing, transfer in and out of chairs and bed, walking, and toileting. Household ADLs include shopping, meal preparation, and housework, and advanced ADLs are those that may reflect cognitive functioning, such as managing money, using the telephone, taking medications and eating. Wolinsky and colleagues argue that it is important to examine these functional domains separately, either as causes or outcomes.

Spector and Fleishman (1998) provide a counter perspective to that of Wolinsky and colleagues. They argue that combining IADL and ADL items in one scale could increase the range

and sensitivity of these items to measure functional impairment. Using data from the 1989 National Long-Term Care Survey, they performed factor analyses using tetrachoric correlations of IADL and ADL measures. The measures in their analyses included going outside of walking distance, shopping, doing laundry, preparing meals, taking medicines, finances, light housework, telephoning, getting around outside, bathing, getting around inside, dressing, transferring, toileting, help with incontinence, and feeding. Their study found that all but one of the IADL and ADL measures reflected one dimension. Next, Spector and Fleishman used item response theory (IRT) methods to determine the best psychometric approach for combining the IADL and ADL measures into scales; i.e., they examined the fit of a one-parameter model versus a two-parameter model. From this analysis, Spector and Fleishman conclude that the one-parameter model was most appropriate, meaning that overall levels of functional impairment could be measured simply by identifying the total number of items with which respondents reported difficulty. Had a two-parameter model been more appropriate, the "correct" way to measure functional impairment would have involved consideration of the number, combination, and ordering of activities with which respondents have difficulty.

To our knowledge, two studies to date have looked at internal consistency and/or measurement properties of the physical functioning measures in the context of the HRS and AHEAD. Wallace and Herzog (1995) performed an exploratory factor analysis of the physical functioning items in HRS92 and identified three domains: 1) mobility, including all ambulation items except jogging and climbing stairs (i.e., mobility difficulty index); 2) lower and upper body strength (i.e., large muscle difficulty index); and 3) ADLs (ADL difficulty index). Using AHEAD93, Stump and associates (1997) attempted to confirm the multi-dimensional structure identified by Wolinksy and Johnson (1992). They found that the physical functioning measures formed factors around lower body disability and basic, household, and advanced ADLs. The lower body items included walking

several blocks, climbing one flight of stairs, pulling and pushing large objects, and carrying 10 pounds. The basic ADL items were dressing, bathing, getting in and out of bed, and using the toilet. The household ADLs were preparing hot meals and shopping for groceries and the advanced ADLs were managing money, making telephone calls, and taking medication.

B. A basic examination of internal consistency and measurement properties

This section reports on a systematic examination of the reliability and factor structure of the physical functioning measures included in all waves of the HRS and AHEAD through HRS00. [This information is not shown for HRS02, as these data are in "early release" form (version 1.0) as of the publication of this document and may change slightly during the data cleaning process.] For each wave, we calculated the correlation matrix and Cronbach's coefficient alpha for all of the physical functioning measures together. Next, we conducted exploratory factor analyses of the physical functioning measures to examine whether they represented multiple domains of functioning, such as lower body functioning, basic ADL functioning, etc. Third, we created additive scales for each domain suggested by the factor analysis and assessed the Cronbach's coefficient alphas for these. Arguably, there are alternative methods for examining internal consistency and measurement properties than we used for this documentation. This documentation, however, is meant to illustrate the quality of the physical functioning variables in the HRS and AHEAD, not to prescribe how they should be used in research.

Table 5 shows the Cronbach's coefficient alphas for all of the physical functioning measures together (Column 2) and by conceptual domain (Columns 3-5). It appears from this table that the different physical functioning scales were fairly reliable; i.e., the Cronbach's coefficient alphas generally exceeded the minimum value of .70 suggested by Nunnally (1978) and were as high as .92 in some instances. One exception is the IADL summated scale in HRS92, which contained experimental IADL items including using a map, calculator, computer, and microwave. These

experimental items were added by Drs. Robert Wallace and A. Regula Herzog. The Cronbach's coefficient alpha of the scale with these items was .60.

Tables 6a and 6b show the results from exploratory factor analyses of the physical functioning variables in the HRS and AHEAD. We used an oblique rotation method (Promax), which assumes that the underlying, latent domains are correlated. Indeed, the inter-factor correlations were moderately high in most cases. The correlation between the factor for strength/mobility and the factor for ADLs ranges from .44 (for AHEAD93 and AHEAD95) to .48 (HRS92 -HRS96 and HRS98). The correlation between the factor for ADLs and the factor for IADLs ranged from .19 (for HRS96) to .55 (HRS98). The correlation between the factor for strength/mobility and the factors for IADLs ranged from .26 to .44. These results suggest that the variables might be indicators for a latent, second-order factor of overall physical functioning, yet they are distinct enough from each other to justify grouping them as we did in some of the analyses of internal consistency; i.e., one group was comprised of strength/mobility measures, another of ADLs, and a third of IADLs.

Table 5

Analysis of Internal Consistency Reliability for the Physical Functioning Measures in the HRS and AHEAD (Cronbach's Alphas)

	All Physical Functioning Measures[a]	Strength, Mobility, & Motor Skills	ADLs	IADLs[a]
HRS92	.87/.86	.85	.77	.60[b]
HRS94	.89/.89	.87	.78	.69/.69
HRS96	.88/.88	.86	.78	.71/.61
AHEAD93	.90/.90	.81	.82	.78/.78
AHEAD95	.92/.92	.85	.85	.85/.82
HRS98	.91/.92	.87	.84	.83/.83
HRS00	.92/.92	.87	.84	.85/.86

Notes:

The analytic sample consists of age-eligible respondents with complete information on physical functioning.
All physical functioning variables were dichotomized (no difficulty vs. any difficulty) for consistency.
See Tables 1-3 for a listing of the specific measures available for each category per wave.

[a] The first alpha in each cell is from analyses omitting atypical measures (e.g., driving). The second includes them.

[b] HRS92 only included measures of people's difficulties using maps, microwaves, calculators, and computers.

The exploratory factor analyses also indicated that three latent factors accounted for covariation in the data on physical functioning in both the HRS and AHEAD and that the physical functioning variables corresponded to (or "loaded on") the three factors assumed a priori when developing the HRS/AHEAD and organizing this document -- strength, mobility and motor skills, ADLs, and IADLs.[3] Using 40 as the critical minimum value for the standardized regression coefficients (Hatcher, 1998), the measures of jogging, walking several blocks, getting up from a chair, climbing stairs, lifting or carrying, and pulling or pushing all loaded on the factor representing mobility and strength in HRS92, AHEAD93, etc. Walking across a room, dressing, eating, bathing, and getting in/out of bed loaded on the factor representing ADLs in HRS92, HRS98, and so forth. Additionally, the physical functioning variables usually had high loadings for only one factor.

But the exploratory factor analyses also pointed to several differences in how the HRS and AHEAD physical functioning measures relate to the assumed latent domains. For instance, the measure for "picking a dime up" did not load on any factor in HRS94-HRS96 and loaded on the ADL factor in HRS92, AHEAD93-AHEAD95, HRS98 and HRS00 rather than the factor representing strength, mobility, and motor skills. Climbing one flight of stairs in HRS94, shopping for groceries in AHEAD93, stooping and getting in/out of bed in AHEAD95, and driving in AHEAD93 and AHEAD95 loaded on multiple factors, rather than just one. Moreover, the results for HRS00 differed from those of the other waves, with several of the standard ADL measures having high standardized regression coefficients for both the ADL and IADL factors. In sum, analysts need to be aware of the similarities and differences in how the HRS and AHEAD physical functioning measures relate to the assumed latent domains and examine them further before constructing scales.

[3] These analyses specified that three factors be retained and rotated. We did this so as to be consistent with the three factors commonly referred to in the gerontological and health literature: 1) strength, mobility, and motor skills; 2) ADLs; and 3) IADLs. Analysts may wish to allow their statistical program to freely determine the number of factors.

We did not conduct similar analyses of the physical functioning measures in the experimental modules because the modules only contained questions about tasks likely to fall in the ADL domain. Confirmation of this expectation might be an objective for future research.

C. Univariate distributions

This section presents the univariate distributions of physical functioning scales in the HRS and AHEAD. We constructed simple scales for mobility, strength, and fine motor skills[4] (Table 7), ADLs (Table 8), and IADLs (Table 9). We did this by summing respondents' answers about whether they had difficulty performing these tasks; lower scores indicated better functioning and higher scores indicated worse functioning. Review Tables 1 – 3 in this documentation for guidance on which activities comprised each scale (excluding the global question about ADLs). For the most part, these scales were consistent with the results for the examination of internal consistency and measurement properties of the physical functioning measures.

[4] One "fine motor skill"—"picking up a dime"—did not load on the overall domain of mobility, strength, and fine motor skills. Nonetheless, we added this item to the summated scale shown in Tables 7 because many users might have theoretical reasons for including this task with their own scales tapping mobility, strength, and motor skills.

Table 6a

Exploratory Factor Analysis of the Physical Functioning Measures in the HRS

	HRS92 (n = 9,824)			HRS94 (n = 8,564)			HRS96 (n = 8,129)		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Jogging About 1 Mile	53	-22	1	60	-14	-8	55	-25	10
Walking Several Blocks	66	16	-5	63	30	-10	67	19	-4
Walking 1 Block	39	49	-7	32	63	-10	39	41	-8
Sitting for About 2 Hours	35	10	8	51	-6	24	60	2	-2
Getting Up From A Chair	65	1	0	68	-8	7	70	-1	0
Climbing Several Flights	75	-14	3	77	-4	-4	75	-13	8
Climbing 1 Flight	60	26	0	50	42	-12	52	28	-4
Lifting or Carrying	64	12	2	66	10	7	60	17	5
Stooping, Crouching, etc.	75	-9	2	74	-9	5	72	-2	-2
Picking a Dime Up	6	47	9	7	38	30	13	26	19
Reaching or Extending	31	39	7	42	19	20	43	22	3
Pulling or Pushing	66	10	4	66	8	9	64	10	3
Walking	9	72	-9	8	71	7	3	69	-4
Dressing	-14	85	0	-8	80	2	14	58	-1
Bathing	1	80	0	1	77	-5	-7	72	5
Eating	-25	68	7	-24	67	7	-14	50	16
Getting In/ Out of Bed	24	54	-2	12	56	19	13	60	-5
Using the Toilet							-1	71	-18
Preparing Hot Meals							-12	56	33
Shopping for Groceries							7	54	25
Making Telephone Calls				-9	31	61	1	3	69
Taking Medications				-11	27	58	4	1	62
Managing Money				-6	11	66	-2	15	64
Using a Map	14	-7	64	20	-22	65	29	-18	39
Using a Microwave	-7	11	66						
Using a Calculator	-3	9	74	11	-6	69			
Using a Computer	6	8	60						
Correlation between Factors 1 & 2		0.48			0.48			0.48	
Correlation between Factors 1 & 3		0.26			0.36			0.34	
Correlation between Factors 2 & 3		0.24			0.46			0.19	
Eigenvalue	6.4	1.7	1.6	7.7	2	1.3	7	2	1.3
Percent of variance explained	30.7%	8.3%	7.5%	34.9%	9.2%	5.9%	29.1%	8.4%	5.2%

Notes:

This table reports the standardized regression coefficients from the Promax (oblique) rotated factor patterns.

All factor loadings were rounded and multiplied by 100.

The sample consisted of age-eligible respondents with complete information on physical functioning.

In HRS96, only certain older cohorts were asked about driving ability. This means that a substantial number of cases were excluded from the analyses. However, dropping the driving variable does not alter the general factor pattern. Driving was not asked about in earlier waves.

All physical functioning variables were dichotomized (no difficulty vs. any difficulty).

Table 6b

Exploratory Factor Analysis of the Physical Functioning Measures in HRS and AHEAD

	AHEAD93 (n = 7,410)			**AHEAD95 (n = 6,263)**			**HRS98 (n = 11,014)**			**HRS00 (n = 18,532)**		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Jogging About 1 Mile				-11	70	12	4	52	-24	-11	74	7
Walking Several Blocks				4	70	12	5	70	10	5	74	7
Walking 1 Block	77	-4	6	27	49	15	14	46	31	26	52	13
Sitting for About 2 Hours				-24	7	65	-29	27	42	-24	11	62
Getting Up From A Chair				-14	35	55	-23	47	43	-19	37	54
Climbing Several Flights	75	-3	10	-7	74	1	5	77	-12	-6	77	-1
Climbing 1 Flight				17	61	8	15	60	14	19	64	5
Lifting or Carrying	79	-2	1	13	61	9	17	61	7	15	62	7
Stooping, Crouching, etc.				-16	48	43	-16	59	25	-15	54	34
Picking a Dime Up	8	-13	55	18	-14	54	-3	-1	57	18	-9	53
Reaching or Extending				-1	21	45	-9	26	43	2	16	48
Pulling or Pushing	77	-5	6	7	60	12	13	62	5	9	58	12
Walking	60	1	26	44	16	29	19	10	57	46	14	29
Dressing	22	6	63	38	3	47	15	3	64	38	0	48
Bathing	26	22	46	58	10	22	36	7	48	58	8	25
Eating	-10	36	53	65	-18	28	37	-18	53	62	-17	27
Getting In/ Out of Bed	21	-1	65	41	-6	48	13	-7	72	41	-10	53
Using the Toilet	-5	4	77	38	-9	50	11	-5	70	38	-9	51
Preparing Hot Meals	8	58	25	78	7	0	69	-1	20	81	5	-1
Shopping for Groceries	44	52	-1	67	28	-7	60	17	17	71	21	-3
Making Telephone Calls	-19	73	17	79	-12	1	70	-9	9	78	-8	-4
Taking Medications	-18	74	20	75	-14	4	71	-11	8	76	-9	-4
Managing Money	11	74	-17	80	4	-12	81	0	-2	84	3	-13
Using a Map			-	43	7	-13	56	11	-17			
Using a Microwave			-									
Using a Calculator			-									
Using a Computer			-									

Driving	44	52	-1	52	44	31	60	31	-15	56	38	-26
Correlation between Factors 1 & 2		0.40			0.44			0.37			0.44	
Correlation between Factors 1 & 3		0.44			0.47			0.55			0.45	
Correlation between Factors 2 & 3		0.50			0.44			0.48			0.47	
Eigenvalue	6.9	1.7	1.1	9.0	2.1	1.3	9.0	2.1	1.2	9.0	2.2	1.2
Percent of variance explained	40.6%	10.0%	6.4%	36.0%	8.2%	5.1%	36.2%	8.6%	4.8%	37.4%	9.0%	5.0%

Notes:

This table reports the standardized regression coefficients from the Promax (oblique) rotated factor patterns.

All factor loadings were rounded and multiplied by 100.

The sample consisted of age-eligible respondents with complete information on physical functioning.

In HRS98 and HRS00, only certain older cohorts were asked about driving ability. This means that a substantial number of cases were excluded from the analyses. However, dropping the driving variable does not alter the general factor pattern.

All physical functioning variables were dichotomized (no difficulty vs. any difficulty).

There are several notable trends regarding the distribution of physical functioning difficulties in the HRS and AHEAD. First, respondents had more difficulties with mobility, strength, and fine motor skills than with ADLs or IADLs. ADL impairments were relatively uncommon and the univariate distributions were highly skewed. IADL impairments were more common than ADL impairments, but less so than difficulties with mobility, strength, and fine motor skills. Second, despite probable differences due to changes in the questions, it was clear that physical functioning problems were more common for the older AHEAD respondents. This can be ascertained from a comparison of HRS94 and AHEAD95, which used fairly congruent questions; e.g., 19.1% of HRS94 respondents had no difficulties with mobility, strength, and fine motor skills, compared to 3.3% of AHEAD95 respondents. Unfortunately, additional detailed conclusions about the distributions of impairment over time and between the HRS and AHEAD were difficult due to cross-wave differences in question wording and cross-study differences in the number of items included in certain waves.

Table 7

Distribution of Limitations in Mobility, Strength, and Motor Skills in the HRS and AHEAD

SCORE	HRS92 (n = 9,824)	HRS94 (n = 8,970)	HRS96 (n = 8,366)	AHEAD93 (n = 7,447)	AHEAD95 (n= 6,307)	HRS98 (n = 20,432)	HRS00 (n = 18,532)
Range	0-12	0-12	0-12	0-5	0-12	0-12	0-12
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
0	8.2	19.1	15.0	45.2	3.3	9.8	9.1
1	21.1	23.8	26.0	15.4	14.6	21.5	20.9
2	17.0	15.4	15.8	11.4	12.5	14.7	14.3
3	12.6	10.0	10.5	9.6	11.3	11.2	11.0
4	9.6	7.1	7.3	14.1	9.5	8.4	9.0
5	7.4	5.3	5.4	4.2	8.3	6.9	7.1
6	5.2	4.4	4.5	NA	7.9	5.5	5.7
7	4.6	3.3	4.0	NA	7.3	4.9	4.9
8	3.6	2.8	3.4	NA	6.6	4.7	5.0
9	3.5	2.8	3.1	NA	7.1	4.4	4.9
10	3.2	2.5	2.7	NA	6.2	3.9	4.1
11	2.6	1.7	1.6	NA	3.8	2.8	3.0
12	1.5	1.7	.6	NA	1.6	1.2	1.1

Notes:
Samples included age-eligible respondents only with complete information on mobility, strength, and motor skills. NA means not applicable.

Table 8

Distribution of ADL Limitations in the HRS and AHEAD

SCORE	HRS92 (n = 9,824)	HRS94 (n = 8,970)	HRS96 (n = 8,366)	AHEAD93 (n = 7,447)	AHEAD95 (n = 6,307)	HRS98 (n = 20,432)	HRS00 (n =18,531)
Range	0-5	0-5	0-6	0-6	0-6	0-6	0-6
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
0	88.9	90.9	87.9	69.5	70.3	81.8	80.9
1	6.0	4.4	5.9	13.4	11.9	7.7	8.5
2	2.2	2.3	2.6	6.4	6.6	3.8	3.8
3	1.4	1.1	1.5	4.0	3.5	2.4	2.4
4	1.0	.8	1.1	2.6	2.3	1.4	1.5
5	.5	.5	.5	1.9	1.9	1.3	1.3
6	NA	NA	.4	2.2	3.6	1.6	1.6

Notes:

Samples included age-eligible respondents only with complete information on ADLs. NA means not applicable.

Table 9

Distribution of IADL Limitations in the HRS and AHEAD

SCORE	HRS92 (n = 9,824)	HRS94 (n = 8,970)	HRS96 (n = 8,366)	AHEAD93 (n = 7,447)	AHEAD95 (n= 6,307)	HRS98 (n = 20,432)	HRS00 (n = 18,506)
Range	0-4	0-5	0-5	0-5	0-5	0-5	0-5
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
0	24.0	68.7	90.6	71.2	73.5	84.7	84.6
1	36.6	20.2	5.5	14.8	10.4	7.2	6.8
2	21.7	6.3	2.2	6.2	5.4	3.1	3.2
3	11.0	2.1	.9	3.2	3.4	1.8	1.8
4	6.6	.9	.5	2.0	3.3	1.5	1.6
5	X	1.9	.4	2.7	3.9	1.8	2.0

Notes:

Samples included age-eligible respondents only with complete information on IADLs. NA means not applicable.

The univariate distributions for HRS92 and HRS94 contained IADL items that are not considered "standard";
i.e., using a computer, microwave, etc.

D. Previous research on construct validity

This section reviews previous research on the construct validity of the physical functioning measures included in the HRS and AHEAD. Construct validity refers to how well a scale reflects the underlying concept it is intended or believed to measure. It is believed to reflect that underlying concept well if the observed scale relates to other characteristics of the respondent in ways that theory would predict them to. For example, if the physical functioning measures were valid, they should have had strong bivariate and multivariate relationships with age, health conditions, self-rated health, etc.

To our knowledge, there are only three published studies that have explicitly addressed construct validity in the physical functioning measures of the HRS and AHEAD. The first is a study by Wallace and Herzog (1995) that assessed the construct validity of these domains by juxtaposing respondents' level of difficulty in each against measures of disease included in HRS92. As expected, they found that individuals with health conditions such as diabetes, cancer, heart problems and stroke, had more problems with mobility and ADLs. The second study, by Rodgers and Miller (1997), examined the extent to which three different summary scores representing AHEAD93 respondents' ADL functioning were correlated with several criterion variables such as age, health rating, number of health conditions, and number of doctor visits. Rodgers and Miller obtained the first score by regressing the criteria variables on respondents' answers to ADL questions about getting help, amount of help received, having difficulty, and amount of difficulty and then taking the average values of the regression coefficients to create a composite score. The other two scores were additive scales of respondents' limitations in all six ADLs (measured in terms of whether respondents have help, difficulty, or use equipment), and respondents' limitations in three, principal activities (i.e., getting across the room, dressing, and bathing). All correlations were in the expected direction and statistically significant, providing evidence of moderate to high construct validity. With regard to

differences among the different summary measures that Rodgers and Miller (1997) created, the two additive scales show slightly higher construct validity than the composite score. The third study, by Stump and colleagues (1997), related basic ADL functioning (see section V.A.), household ADL functioning, advanced ADL functioning, and lower body functioning among AHEAD93 respondents to other aspects of health and social-demographics, including perceived health, affective functioning, health conditions, gender, race, and age. As the researchers expected, most of the health conditions were associated with worse functioning, as outlined by Stump and associates. Several of the physical functioning domains were related to poorer affective functioning and perceived health, such as basic ADL functioning and lower body functioning.

In addition to the three studies described above, many studies focusing on issues other than construct validity per se but controlling for physical functioning have established the validity of these measures almost unequivocally. Such studies include an analysis of gender and disability using HRS92 and AHEAD93 (Wray & Blaum, 2001), worsening depressive symptoms and its competing risks (i.e., death, lost to follow-up) in AHEAD93-HRS98 (Fonda, Herzog, & Wallace, 2001), race/ethnicity differences in the transition from health to disability in AHEAD93 (Zsembik, Peek, & Peek, 2000), etc. Refer to the following web sites for a list of additional studies: http://www.umich.edu/~hrswww/pubs/biblio.html. See also reports presented at the symposium titled "Co-morbidity in older age: Findings from the Health and Retirement Study" at the 2001 meeting of the Gerontological Society of America. Since there are so many studies available that confirm the construct validity of the physical functioning measures in the HRS and AHEAD, we will not provide an analysis of construct validity in this documentation.

F. Benchmarking against other surveys and prevalence estimates

One method for evaluating the quality of the physical functioning measures is to compare prevalence rates of difficulty or disability against rates found in similar analyses of other data. We

call this type of comparison “benchmarking.” Benchmarking was not possible for the HRS because there are no other nationally representative surveys assessing the health of people between the ages of 51 and 61 years. However, two data sources provided reasonable benchmarks for the AHEAD--the Supplement on Aging (SOA) II (1995) and the National Medical Expenditures Survey (NMES) (1987). The results from the benchmarking exercise are shown in Table 10.

In general, AHEAD93 did a good job of estimating prevalence as found in other representative studies of older people. The prevalence rates for walking several blocks, bathing, eating, walking across a room, using the toilet, preparing meals, and using the telephone as observed in AHEAD93 were close to those observed in the SOA II and/or the NMES. The global measure of disability status, which took into account the prevalence rates reported with the individual ADL and IADL measures, had roughly the same distribution between the AHEAD93 and the SOA II. Note that these prevalence rates were fairly consistent across studies despite differences in question wording.

Table 10

Percent reporting any difficulty with ADLs and IADLs, among non-institutionalized persons: AHEAD93, SOA II 1995, and NMES 1987.

Measure	AHEAD93 Age 70+	SOA II 1995 Age 70+	NMES 1987 Age 70+
Nagi Measures			
Lifting 10 pounds	33.1%	18.1%	--
Walking 2-3 blocks	32.0%	33.8%	--
ADLs			
Bathing	12.3%	13.7%	11.5%
Dressing	13.0%	8.6%	6.1%
Eating	5.4%	2.5%	1.2%
Walking	23.3%	23.9%	9.5%
Transferring	9.2%	11.4%	7.2%
Using the Toilet	4.7%	6.2%	4.4%
Percent with 1+ ADL difficulty	29.7%	28.4%	16.0%
IADLs			
Preparing meals	9.4%	8.7%	9.5%
Shopping	18.1%	14.2%	13.8%
Using the telephone	5.2%	4.6%	5.7%
Managing money	11.0%	5.7%	8.0%
Percent with 1+ IADL difficulty	22.9%	17.0%	--
Disability status:			
No difficulty	64.2%	68.2%	--
IADL difficulty only	6.1%	3.4%	--
ADL difficulty	29.7%	28.4%	--

Notes:
AHEAD: Does anyone ever help you [do ADL]? Do you ever use equipment or devices such as [xx] when [doing ADL]? (Even when someone helps you) (Even when using the equipment) (Without any help or special equipment) Do you have any difficulty [doing ADL]?
SOA II: Because of a health or physical problem, do you have any difficulty [doing ADL]?
NMES: Do you have any difficulty [doing ADL] without help? Do you receive help from another person [to do ADL]? Do you use special equipment or aids to [do ADL]?

G. Constructed variables

For convenience, it is often desirable to have constructed variables available in publicly available data sets. Currently, HRS and AHEAD staff have constructed summary variables for ADLs and IADLs in AHEAD93 only. This section briefly lists the names and purpose of those variables. The technical appendix provides SAS code for reconstructing most of these variables in the AHEAD93 data set (except for the flags, which we believe were redundant) and for constructing comparable variables for HRS92-00 and AHEAD95.

The names for the constructed ADL variables are WALK, DRESS, BATHE, EAT, BED, TOILET, ADLANY, and NUMADL. The first five variables indicate whether respondents had difficulty or needed help with the tasks for which they are named. ADLANY flags respondents who had one or more difficulties and/or needed any help and NUMADL indicates the number of tasks with which respondents had difficulty or needed help (Range: 0-6).

The constructed IADL variables in AHEAD92 differentiate between people who needed help or couldn't do the activity for health reasons from people who could do the activity or didn't do it for reasons unrelated to health. The SAS names for these variables are MEAL, GROC, PHONE, MEDICINE, and MONEY. Also, there are constructed measures flagging whether respondents needed help/had difficulty with any of the five IADLs (IADLANY) and summarizing the number of IADLs for which they needed help or had difficulty (Range: 0-5) (NUMIADL).

For more summary variables, consult also the RAND Data Documentation (St. Clair et al., 2003) and Data Sets. RAND provides cleaned and processed summary physical functioning variables for HRS and AHEAD through HRS00.

VII. Technicalities

A. Strategies for accommodating changes in questions

There are several approaches that users might consider to deal with the challenges posed by changes in the sequence and wording of the questions. One is to limit observations to respondents who answered identical questions or over time. This would be possible by looking at respondents who completed a module on physical functioning, such as the LSOA module (Module 3) at the end of AHEAD93 and AHEAD95 and the AHEAD93 modules (Modules 1 and 2) at the end of AHEAD95 and HRS98. Similarly, analysts might use only those questions that are consistent (if not identical) over time, such as those ascertaining *difficulty*. Reynolds and Silverstein (2003) used this method to examine the onset of disability in ADL and IADL function among AHEAD respondents. They examined change occurring between AHEAD93 and AHEAD95 and between AHEAD93 and HRS98.

Another approach is to limit observation to changes that occurred between waves after the question format stabilized. Fonda and colleagues (2002) adopted this strategy in a paper examining patterns in physical functioning among HRS and AHEAD respondents. Specifically, they delineated patterns of change between HRS96 and HRS98 and between AHEAD95 and HRS98.

Item response theory (IRT, also known as latent trait theory) and structural equation modeling (particularly path analysis with latent variables) might provide another option for dealing with changes in the questions across waves. Using a series of probabilistic models, IRT and structural equation models relate question responses to the latent traits presumed to underlie such responses. IRT separately estimates person parameters and item parameters, and this property can be used to generate estimates of an underlying physical functioning trait that are on a similar metric, even if different questionnaire formats are used across repeated administration. Structural equation modeling techniques, assumes that the observed variables (e.g., individual ADLs, IADLs, and

mobility/strength/fine motor skills) are imperfect indicators (i.e., they contain measurement error) for the latent construct, so slight variation in question wording should be relatively inconsequential.

Several papers demonstrate how IRT might be used to work with the physical functioning measures in HRS and AHEAD. For example, McHorney (2002) examined whether three sets of physical functioning questions used in AHEAD93 could be equated such that scores from the different questions related on a common metric or underlying ability distribution. One set of questions included those contained in the core of the survey asked of all survey participants, another set was based on the LSOA module questions which were asked of about 10% of the survey participants in addition to the core questions, and the third set was based on the NLTCS module questions which were asked of about 10% of the survey participants in addition to the core questions. From the core, McHorney included questions covering receipt of help in ADLs, difficulty with "higher-order" ADLs, difficulty with and/or inability to perform IADLs, and use of accommodative equipment for and difficulty with ADLs not considered "higher-order". She used all questions from the modules. The analyses involved assessing unidimensionality and eliminating items that formed additional factors, comparising model fit of 1-parameter versus 2-parameter models, and examining differential item functioning and subsequently calibrating the physical functioning measures. In brief, McHorney found that the core and module questions could be linked and placed on a single, underlying distribution. Although McHorney's study investigated one wave of data, it has implications for how one might deal with the changes in the question wording over time for longitudinal analyses. First, given that later waves adopted a question format for the physical functioning measures that is very similar to that in the LSOA, it is likely that HRS92 and AHEAD93 questions form metrics of physical functioning are comparable to the physical functioning metrics formed in later waves (McHorney demonstrated that these different questions relate to the same underlying distribution for 1 wave, or were "equivalent"). Second, although not all respondents

answered the same questions, the IRT analysis generated known item parameters which can be used to estimate respondents' latent trait level of difficulty in physical functioning. If such an analysis were performed on later waves, equivalent latent trait "scores" can be used to examine change in physical functioning over time.

An analysis of the depressive symptom measures in the HRS (Jones and Fonda, in press) provides another example of how to use IRT to deal with changes in survey questions over time. The HRS included items from the Centers for Epidemiologic Studies - Depression scale (CES-D) to address depressive symptoms in this cohort. As with the physical functioning measures, CES-D symptom coverage and response categories varied across study wave. Jones and Fonda applied a IRT based structural equation model to generate linked depressive symptom scores and then used generalized estimating equation models to characterize trajectories of linked depressive symptom scores with age within strata defined by race/ethnicity, sex and birth year. A similar process might be followed for the physical functioning measures.

Currently HRS and AHEAD staff are considering another approach for dealing with changes in the questions about ADLs, which would provide users with constructed variables. This approach would involve the imputation of "new" HRS92 and AHEAD93 ADL scores. It would use information from the 1994 and 1995 cores of HRS and AHEAD (observed separately) as well as information from the 1994 modules that repeated the question format used in HRS92/AHEAD93 (i.e., Module 3 of HRS94 and Modules 1 and 2 of AHEAD95). All of this information would be incorporated, either as an outcome or predictor, into logistic regression models predicting whether respondents had difficulty with tasks. To illustrate, there were fourteen ADL questions in the core of AHEAD95; one difficulty question for each of the six ADLs, one help question for each ADL, and two questions about the use of assistive devices (for walking and getting in/out of bed). These fourteen, core ADL questions would correspond to the dependent variables in fourteen logistic

regression models. In these models, the predictors would be dichotomous variables based on the answers to the ADL questions in Modules 1 and 2. HRS and would first predict to whether respondents reported any difficulty with each ADL question, using only the module variables as predictors. Then, when they predicted to whether or not respondents used equipment or help, they would use the module questions *and* the core questions about difficulty. This process would be repeated through the fourteen regression models for each AHEAD95 core ADL. The strengths and limitations to this potential strategy for dealing with the change in questions over time have yet to be explored fully, however.

B. SAS code

This section contains SAS code for users to refer to as they make re-coding decisions about the physical functioning measures in the HRS and AHEAD. As with other parts of this documentation, this section is meant to guide, not prescribe, use of the data. Ultimately, decisions about how to code and combine the data are the user's responsibility. Further, since variables are occasionally modified in the process of data cleaning, it is the responsibility of the user to check this SAS code carefully for errors and consistency with the variable format they are planning.

```
******* HRS92 / WAVE 1
data temp1;
  set hrsw1.health;

array funcw1{21} v304-v324;
   do i = 1 to 21;
      if funcw1(i) = 1 then funcw1(i) = 0;
         else if fincw1(i) > 1 then funcw1(i) = 1;
   end;

*** Assign intuitive names;
w1run = v304;
w1sevblk = v305;
w1block = v306;
w1cross = v307;
w1sit = v308;
```

```
w1getup = v309;
w1bed = v310;
w1stairs = v311;
w1stair = v312;
w1lift = v313;
w1stoop = v314;
w1dime = v315;
w1bathe = v316;
w1raise = v317;
w1pull = v318;
w1eat = v319;
w1dress = v320;
w1map = v321;
w1micro = v322;
w1calc = v323;
w1comp = v324;

*** Create summary measures;
w1nagi = sum (of w1run w1sevblk w1block w1sit w1getup w1stairs w1stair w1lift w1stoop w1dime
                w1raise w1pull) ;
w1adl = sum (of w1cross w1bed w1bathe w1eat w1dress);
w1iadl = sum (of w1map w1micro w1calc w1comp);

run;


******* HRS94 / WAVE 2H;
data temp2;
  set hrsw2.health;

array func2 {22} w306-w327;
  do i = 1 to 22;
     if func2(i) in (0, 1, 2, 3, 4, 6) then func2(i) = 1;
        else if func2(i) = 5 then func2(i) = 0;
        else if func2(i) in (8, 9) then func2(i) = .;
  end;

*** Assign intuitive names;
w2run = w306;
w2sevblk = w307;
w2block = w308;
w2cross = w309;
w2sit = w310;
w2getup = w311;
w2bed = w312;
w2stairs = w313;
w2stair = w314;
w2lift = w315;
```

```
w2stoop = w316;
w2dime = w317;
w2bathe = w318;
w2raise = w319;
w2pull = w320;
w2eat = w321;
w2dress = w322;
w2map = w323;
w2calc = w324;
w2money = w325;
w2phone = w326;
w2meds = w327;

*** Create summary variables;
w2nagi = sum (of w2run w2sevblk w1block w2sit w2getup w2stairs w2stair w2lift w2stoop w2dime
                w2raise w2pull);
w2adl = sum (of w2cross w2bed w2bathe w2eat w2dress);
w2iadl = sum (of w2map w2calc w2money w2phone w2meds);

run;


*******HRS96 / WAVE 3H;
data temp3;
  set hrsw3.health;

*** Re-codes addressing skips in questions regarding mobility, strength, & fine motor skills;
if q1858 = 1 then q1861 = 1;
if q1858 = 5 then q1864 = 5;
if q1873 = 5 then q1876 = 5;

*** Q1895 = ADL checkpoint for skipping ADL series. . = missing, 1 = do series, 5 = skip;
array skip {6} q1895 q1908 q1918 q1928 q1938 q1951;
  do i = 1 to 6;
     if skip(i) = . and q1894 = 5 then skip(i) = 5;
  end;

*** IADLs. Makes use of question: Is that because of a health or memory problem?;
if q2038 = 1 then q2036 = 1;
if q2038 = 5 then q2036 = 5;

if q2043 = 1 then q2041 = 1;
if q2043 = 5 then q2041 = 5;

if q2048 = 1 then q2046 = 1;
if q2048 = 5 then q2046 = 5;

if q2053 = 1 then q2051 = 1;
```

```
if q2053 = 5 then q2051 = 5;

if q2094 = 1 then q2093 = 1;
if q2094 = 5 then q2093 = 5;

array func3 {22} q1858 q1861 q1864 q1867 q1870 q1873 q1876 q1879 q1882 q1885 q1888 q1891
                 q2036 q2041 q2046 q2093 q1895 q1908 q1918 q1928 q1938 q1951;
  do i = 1 to 22;
    if func3(i) = 5 then func3(i) = 0;
      else if func3(i) in (1, 6, 7) then func3(i) = 1;
      else if func3(i) in (8, 9) then func3(i) = .;
  end;

*** Questions about medication and map use are a bit different because respondent might not do
these things;
array other {2} q2027 q2051;
  do i = 1 to 2;
    if other(i) in (5, 7) then other(i) = 0;
      else if other(i) in (1, 6) then other(i) = 1;
      else if other(i) in (8, 9) then other(i) = .;
  end;

*** Assign intuitive names;
w3run = q1861;
w3sevblk = q1858;
w3block = q1864;
w3cross = q1895;
w3sit = q1867;
w3getup = q1870;
w3bed = q1938;
w3stairs = q1873;
w3stair = q1876;
w3lift = q1888;
w3stoop = q1879;
w3dime = q1891;
w3bathe = q1918;
w3raise = q1882;
w3pull = q1885;
w3eat = q1928;
w3dress = q1908;
w3map = q2027;
w3money = q2093;
w3phone = q2046;
w3meds = q2051;
w3toilet = q1951;
w3meal = q2036;
w3shop = q2041;
```

```
*** Create summary variables;
w3nagi = sum (of w3run w3sevbk w3block w3sit w3getup w3stairs w3stair w3lift w3stoop w3dime
              w3raise w3pull);
w3adl = sum (of w3cross w3bed w3bathe w3eat w3dress w3toilet);
w3iadl = sum (of w3map w3money w3phone w3meds w3meal w3shop);

run;

******* AHEAD93 / WAVE 2A;
data temp4;
  set ahd1.health;

%macro nagi1 (walk, diffvar, rsnvar, newvar);
 if &walk = 1 or &diffvar in (1, 6) or (&diffvar = 7 and &rsnvar = 1) then &newvar = 1;
   else if &diffvar = 5 or (&diffvar = 7 and &rsnvar = 5) then &newvar = 0;
   else &newvar = .;
%mend nagi1;

%nagi1 (v768, v852, v854, w1sevblk);
%nagi1 (v768, v865, v867, w1stair);
%nagi1 (v768, v872, v874, w1pull);

%macro nagi2 (diffvar,rsnvar,newvar);
 if &diffvar in (1, 6) or (&diffvar = 7 and &rsnvar = 1) then &newvar = 1;
   else if &diffvar = 5 or (&diffvar = 7 and &rsnvar = 5) then &newvar = 0;
   else &newvar = .;
%mend nagi2;

%nagi2 (v879, v881, w1lift);
%nagi2 (v882, v884, w1dime);

%macro adls (helpvar, ablevar, newvar);
  if &helpvar = 5 and &ablevar = 5 then &newvar = 0;
    else if &helpvar in (1, 7) or &ablevar = 1 then &newvar = 1;
    else &newvar = .;
%mend adls;

%adls (v779, v781, w1dress);
%adls (v787, v789, w1bathe);
%adls (v795, v797, w1eat);

%macro adls2 (helpvar, eqvar, ablevar, newvar);
  if &helpvar = 5 and &eqvar = 5 and &ablevar = 5 then &newvar = 0;
    else if &helpvar in (1, 7) or &eqvar = 1 or &ablevar = 1 then &newvar = 1;
    else &newvar = .;
%mend adls2;

%adls2 (v768, v770, v773, w1cross);
```

```
%adls2 (v803, v808, v811, w1bed);

*** This is how imputed variable are coded in latest public release version of data;
/*if v768 in (.,5) and v770 in (.,5) and v773 in (.,5) then walktest=0;
  else walktest=1;*/

if v814 = 5 and v816 = 5 then w1toilet = 0;
  else if v814 = 1 or v816 = 1 then w1toilet=1;
  else w1toilet=.;

if v903a1 = 5 or (v903a1 = 7 and v904a1 = 1) then w1meal = 1;
  else if v903a1 in (.d,.r) then w1meal = .; /* no one refused/didn't answer v9804a1*/
  else w1meal = 0;

if v903a2 = 5 or (v903a2 = 7 and v904a2 = 1) then w1groc = 1;
  else if v903a2 in (.d,.r) then w1groc = .;
  else w1groc = 0;

if v903a3 = 5 or (v903a3 = 7 and v904a3 = 1) then w1phone = 1;
  else if v903a3 in (.d,.r) then w1phone = .;
  else w1phone = 0;

if v903a4 = 5 or (v903a4 = 7 and v904a4 = 1) then w1meds = 1;
  else if v903a4 in (.d,.r) then w1meds = .;
  else w1meds = 0;

if v948 = 5 and (v949 = 1 or v972 = 1) then w1money = 1;
  else if v948 in (.d,.r) or v949 = .d or v972 in (.d,.r) then w1money = .;
  else w1money = 0;

if v893 = 1 then w1drive = 0;
  else if v893 in (5, 6) then w1drive = 1;
  else if v893 in (.d, .r) then w1drive = .;

*** Create summary variables;
w1nagi = sum (of w1sevblk w1stair w1pull w1lift w1dime);
w1adl = sum (of w1eat w1dress w1bed w1bathe w1toilet w1cross);
w1iadl = sum (of w1money w1phone w1meds w1meal w1groc);

run;

******* AHEAD95 / WAVE 3A;
data temp5;
  set ahd2.health;

array nagi{9} d1834 d1843 d1846 d1849 d1855 d1858 d1861 d1964 d1867;
  do i  = 1 to 9;
    if nagi(i) in (1,6,7) then nagi(i) = 1;
```

```
      else if nagi(i) = 5 then nagi(i) = 0;
      else nagi(i) = .;
  end;

*** Assign intuitive names;
w2sevblk = d1834;
w2sit = d1843;
w2getup = d1846;
w2stairs = d1849;
w2stoop = d1855;
w2raise = d1848;
w2pull = d1861;
w2lift = d1864;
w2dime = d1867;

array adl{5} d1884 d1894 d1914 d1927 d1904;
  do i  = 1 to 5;
     if adl(i) in (1,6,7) then adl(i) = 1;
        else if adl(i) = 5 or d1870 = 5 then adl(i) = 0;
        else adl(i) = .;
   end;

***Assign intuitive names;
w2dress = d1884;
w2bathe = d1894;
w2bed = d1914;
w2toilet = d1927;
w2eat = d1904;

if d1871 in (1, 6, 7) then w2cross = 1;
  else if d1871 = 5 or d1870 = 5 then w2cross = 0;
  else w2cross = .;

if w2sevblk = 1 then w2run = 1;
  else if d1837 in (1, 6, 7) then w2run = 1;
  else if d1837 in (5) then w2run = 0;
  else w2run = .;

if w2sevblk = 0 then w2block = 0;
  else if d1840 in (1, 6, 7) then w2block = 1;
  else if d1840 in (5) then w2block = 0;
  else w2block = .;

if w2stairs = 0 then w2stair = 0;
  else if d1852 in (1, 6, 7) then w2stair = 1;
  else if d1852 in (5) then w2stair = 0;
  else w2stair = .;
```

```
if d2021 in (5) then w2meal = 0;
  else if d2021 = 1 then w2meal = 1;
  else if d2021 in (6,7) and d2023 = 1 then w2meal = 1;
  else if d2021 in (6,7) and d2023 ne 1 then w2meal = 0;
  else w2meal = .;

if d2026 in (5) then w2groc = 0;
  else if d2026 = 1 then w2groc = 1;
 else if d2026 in (6,7) and d2028 = 1 then w2groc = 1;
  else if d2026 in (6,7) and d2028 ne 1 then w2groc = 0;
  else w2groc = .;

if d2031 in (5) then w2phone = 0;
  else if d2031 = 1 then w2phone = 1;
  else if d2031 in (6,7) and d2033 = 1 then w2phone = 1;
  else if d2031 in (6,7) and d2033 ne 1 then w2phone = 0;
  else w2phone = .;

if d2036 in (5) then w2meds = 0;
  else if d2036 = 1 then w2meds = 1;
  else if d2036 in (6,7) and d2038 = 1 then w2meds = 1;
  else if d2036 in (6,7) and d2038 ne 1 then w2meds = 0;
  else w2meds = .;

if d2099 in (5) then w2money = 0;
  else if d2099 = 1 then w2money = 1;
  else if d2099 in (6,7) and d2100 = 1 then w2money = 1;
  else if d2099 in (6,7) and d2100 ne 1 then w2money = 0;
  else w2money = .;

if d2012 in (1, 6) then w2map = 1;
  else if d2012 in (5, 7) then w2map = 0;
  else w2map = .;

if d2008 = 1 then w2drive = 0;
  else if d2008 in (5, 6) then w2drive = 1;
  else if d2008 in (8, 9) then w2drive = .;

w2nagia = sum (of w2run w2sevblk w2block w2sit w2getup w2stairs w2stair w2stoop w2raise
                w2pull w2lift w2dime);
w2nagib = sum of (of w2sevblk w2block w2sit w2getup w2stair w2stoop w2raise w2pull w2lift
                w2dime);
w2adl = sum (of w2dress w2bathe w2eat w2bed w2toilet w2cross);
w2iadl = sum (of w2meal w2groc w2phone w2meds w2money);

run;

******* HRS98 / WAVE 4;
```

```
data temp6;
  set hrs98.health;

*** Re-code and re-name Nagi-type items with skips;
if f2391 ne 5 or f2392 in (1, 6, 7) then w4run = 1;
  else if f2392 = 5 then w4run = 0;
  else if f2392 in (8, 9) then w4run = .;

if f2391 = 5 or f2394 = 5 then w4block = 0;
  else if f2394 in (1, 6, 7) then w4block = 1;
  else if f2394 in (8, 9) then w4block = .;

if f2403 = 5 or f2406 = 5 then w4stair = 0;
  else if f2406 in (1, 6, 7) then w4stair = 1;
  else if f2406 in (8, 9) then w4stair = .;

*** Re-code remaining Nagi-type items;
array nagis {9} f2391 f2397 f2400 f2403 f2409 f2412 f2415 f2418 f2421;
  do i = 1 to 9;
     if nagis(i) in (1, 6, 7) then nagis(i) = 1;
       else if nagis(i) in (8, 9, .) then nagis(i) = .;
       else if nagis(i) = 5 then nagis(i) = 0;
  end;

*** Assign remaining Nagi-type items intuitive names;
w4sevblk = f2391;
w4sit = f2397;
w4getup = f2400;
w4stairs = f2403;
w4stoop = f2409;
w4raise = f2412;
w4push = f2415;
w4lift = f2418;
w4dime = f2421;

*** The '.' in the ADLs indicates that people were skipped--believed to have no ADL problems.
Double-check using Nagisum1, Nagisum2, dress variable, or ADL checkpoint loop.;

array adls{6} f2425 f2427 f2444 f2454 f2464 f2477;
 do i = 1 to 6;
   if adls(i) in (1, 6, 7) then adls(i) = 1;
    else if adls(i) = . then adls(i) = 0;
    else if adls(i) in (8, 9) then adls(i) = .;
    else adls(i) = 0;
 end;

*** Assign intuitive names;
w4dress = f2425;
```

```
w4cross = f2427;
w4bathe = f2444;
w4eat = f2454;
w4bed = f2464;
w4toilet = f2477;

*** IADLs;
%macro iadls (diffvar,rsnvar,newvar);
 if &diffvar = 1 then &newvar = 1;
   else if &diffvar in (6,7) and &rsnvar = 1 then &newvar = 1;
   else if &diffvar in (8,9,.) then &newvar = .;
   else &newvar = 0;
%mend iadls;

%iadls (f2562,f2564,w4meal);
%iadls (f2567,f2569,w4groc);
%iadls (f2572,f2574,w4phone);
%iadls (f2618,f2619,w4money);

if f2577 = 1 then w4meds = 1;
 else if f2577 = 7 and f2578 = 1 then w4meds = 1;
 else if f2577 = 6 and f2579 = 1 then w4meds = 1;
 else if f2577 in (8, 9, .) then w4meds = .;
 else w4meds = 0;

if f2553 in (1, 6) then w4map = 1;
 else if f2553 in (5, 7) then w4map = 0;
 else if f2553 in (8, 9, .) then w4map = .;

*** Note: people in certain cohorts and of certain ages were not asked driving questions.;
*** Driving vars;
if f2549 = 1 then w4drive = 0;
 else if f2549 in (5, 6) then w4drive = 1;
 else if f2549 in (., 8, 9) then w4drive = .;

w4nagia = sum (of w4sevblk w4run w4block w4sit w4getup w4stairs w4stair w4stoop w4raise
w4push w4lift w4dime);
w4nagib = sum (of w4sevblk w4block w4sit w4getup w4stair w4stoop w4raise w4push w4lift
w4dime);
w4adl = sum (of w4dress w4bathe w4eat w4bed w4toilet w4cross);
w4iadl = sum (of w4meal w4groc w4phone w4meds w4money);

run;


******* HRS00 / WAVE 5;
data temp7;
  set EXTRACT.H00E_R;
```

```
* 1 = yes, difficulty;
* 6 = can't do;
* 7 = don't do;
* 5 = no, difficulty;
* 8 and 9 are refusal or don't know;
*** Re-code and re-name Nagi-type items with skips;
if g2689 ne 5 or g2690 in (1, 6, 7) then w5run = 1;
  else if g2690 = 5 then w5run = 0;
  else if g2690 in (8, 9) then w5run = .;

if g2689 = 5 or g2692 = 5 then w5block = 0;
  else if g2692 in (1, 6, 7) then w5block = 1;
  else if g2692 in (8, 9) then w5block = .;

if g2701 = 5 or g2704 = 5 then w5stair = 0;
  else if g2704 in (1, 6, 7) then w5stair = 1;
  else if g2704 in (8, 9) then w5stair = .;

*** Re-code remaining Nagi-type items;
array nagis {9} g2689 g2695 g2698 g2701 g2707 g2710 g2713 g2716 g2719;
  do i = 1 to 9;
     if nagis(i) in (1, 6, 7) then nagis(i) = 1;
       else if nagis(i) in (8, 9, .) then nagis(i) = .;
       else if nagis(i) = 5 then nagis(i) = 0;
  end;

*** Assign remaining Nagi-type items intuitive names;
w5sevblk = g2689;
w5sit = g2695;
w5getup = g2698;
w5stairs = g2701;
w5stoop = g2707;
w5raise = g2710;
w5push = g2713;
w5lift = g2716;
w5dime = g2719;

*** The '.' in the ADLs indicates that people were skipped--believed to have no ADL problems.
Double-check using Nagisum1, Nagisum2, dress variable, or ADL checkpoint loop.;
* 1 = yes, difficulty;
* 6 = can't do;
* 7 = don't do;
* 5 = no, difficulty;
* 8 and 9 are refusal or don't know;
array adls{6} G2723 G2725 G2742 G2752 G2762 G2775;
 do i = 1 to 6;
   if adls(i) in (1, 6, 7) then adls(i) = 1;
    else if adls(i) = . then adls(i) = 0;
```

```
   else if adls(i) in (8, 9) then adls(i) = .;
   else adls(i) = 0;
 end;

*** Assign intuitive names;
w5dress = G2723;
w5cross = G2725;
w5bathe = G2742;
w5eat = G2752;
w5bed = G2762;
w5toilet = G2775;

*** IADLs;
%macro iadls (diffvar,rsnvar,newvar);
 if &diffvar = 1 then &newvar = 1;
   else if &diffvar in (6,7) and &rsnvar = 1 then &newvar = 1;
   else if &diffvar in (8,9,.) then &newvar = .;
   else &newvar = 0;
%mend iadls;

%iadls (G2860,G2862,w5meal);
%iadls (G2865,G2867,w5groc);
%iadls (G2870,G2872,w5phone);
%iadls (G2916,G2917,w5money);

if g2875 = 1 then w5meds = 1;
 else if g2875 = 7 and G2876 = 1 then w5meds = 1;
 else if g2875 = 6 and G2877 = 1 then w5meds = 1;
 else if g2875 in (8, 9, .) then w5meds = .;
 else w5meds = 0;

if G2851 in (1, 6) then w5map = 1;
 else if G2851 in (5, 7) then w5map = 0;
 else if G2851 in (8, 9, .) then w5map = .;

*** Note: people in certain cohorts and of certain ages were not asked driving questions.;
*** Driving vars;
if G2847 = 1 then w5drive = 0;
 else if G2847 in (5, 6) then w5drive = 1;
 else if G2847 in (., 8, 9) then w5drive = .;

w5nagia = sum (of w5sevblk w5run w5block w5sit w5getup w5stairs w5stair w5stoop w5raise
w5push w5lift w5dime);
w5nagib = sum (of w5sevblk w5block w5sit w5getup w5stair w5stoop w5raise w5push w5lift
w5dime);
w5adl = sum (of w5dress w5bathe w5eat w5bed w5toilet w5cross);
w5iadl = sum (of w5meal w5groc w5phone w5meds w5money);
run;
```

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