

HEALTHY AGING IN NEIGHBORHOODS OF DIVERSITY ACROSS THE LIFE SPAN (HANDLS): OVERCOMING BARRIERS TO IMPLEMENTING A LONGITUDINAL, EPIDEMIOLOGIC, URBAN STUDY OF HEALTH, RACE, AND SOCIOECONOMIC STATUS

Objective: Examine the influences of race, socioeconomic status, sex, and age on barriers to participation in a study of cross-sectional differences and longitudinal changes in health-related outcomes.

Methods: We designed a multidisciplinary, community-based, prospective longitudinal epidemiologic study among socioeconomically diverse African Americans and Whites. We recruited 3722 participants from Baltimore, Md. with a mean age of 47.7 (range 30–64) years, 45% males; 2200 African Americans (59%) and 1522 whites (41%); 41% reported household incomes below the 125% poverty delimiter.

Results: There were no significant age differences associated with sex or race. Participants below the 125% poverty delimiter were slightly younger than those above the delimiter. Age, race, and sex, but not poverty status, were associated with the likelihood of a physical examination. Older participants, women, and Whites were more likely to complete their examinations. Among those who completed their examinations, there were no age differences associated with sex and poverty status, but African Americans were negligibly younger than Whites.

Conclusions: Although some literature suggests that minorities and low-income people are less willing to participate in clinical research, these baseline data suggest that African Americans individuals and individuals from households with incomes below 125% of the poverty level are at least as willing to participate in observational clinical studies as Whites and higher income individuals of similar age and sex. (*Ethn Dis.* 2010;20:267–275)

Key Words: Healthcare Disparities, Socioeconomic Status, Population Groups, Epidemiologic Research Design, Health Surveys, Longitudinal Studies

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INTRODUCTION

In 1985, the Task Force on Black and Minority Health reported that racial and ethnic minorities were underrepresented in health research.¹ The report noted that the consequence of this underrepresentation was significant gaps in knowledge about the health of racial and ethnic minority populations and their responses to interventions.

More recent studies show that in some instances minorities enroll and participate in observational clinical research at rates comparable to non-minorities.² However, it is also evident that significant barriers to participation exist for minorities and other population subgroups.^{3,4} The challenges of recruiting both minority participants and those from diverse socioeconomic status (SES) backgrounds, regardless of race have not been thoroughly examined. Unfortunately the failure to consistently evaluate the inclusion of minority and socioeconomically diverse research participants has hampered efforts in clinical research to address disparate health outcomes.

Health disparities are marked differences or inequalities in health measures

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such as morbidity or mortality between two or more population groups based on race or ethnicity, sex, education, SES, or other criteria.⁵ There are disparities for overall life expectancy as well as for specific chronic and acute diseases. Recent work by Murray and colleagues examined mortality disparities across races and counties in the United States.⁶ This work defined eight subgroups of the US population based on a number of sociodemographic and geographic variables and showed there were significant disparities in mortality among these subgroups. These disparities were most pronounced for urban dwelling African American men who experienced a 20.7-year life expectancy gap compared to Asian women who had the best overall survival.

The challenge in investigating health disparities is to design and implement studies that recruit and retain racially and socioeconomically diverse cohorts.^{7,8} However, systematic reviews of the threats to the validity of clinical trials could not identify clearly all of the barriers to participation in clinical research.⁹ In comparison with ethnicity, there is little literature about participation in clinical research associated with SES. Anecdotal reports suggest that it is more difficult to recruit participants among low socioeconomic strata, particularly among minorities. There is little empirical evidence on this issue, but the evidence available indicates that this widely held belief is incorrect. In fact, lower SES minorities may be the most willing, but lower socioeconomic

Whites may be the least willing to participate in clinical research.¹⁰

With this background, we developed the Healthy Aging in Neighborhoods of Disparities across the Life Span (HANDLS) study to investigate whether race and SES influence health status and age-related health disparities separately or synergistically as co-factors of behavioral, psychosocial, and environmental conditions. The scientific objectives of HANDLS are to establish a single-site, prospective longitudinal epidemiologic study of health disparities in socioeconomically diverse African Americans and Whites residing in the city of Baltimore. Specifically, we designed HANDLS to disentangle the effects of race and SES on risk factors for morbidity and mortality, to examine the incidence and progression of preclinical disease, and to assess the development and persistence of health disparities, longitudinal health status, and health risks. This report also summarizes the recruitment strategies developed specifically for this study to meet our baseline recruitment goals.

METHODS

Study Design

Healthy Aging in Neighborhoods of Disparities across the Life Span is a prospective population-based longitudinal study. Our baseline is representative of working-age African Americans and Whites aged 30–64 years recruited as a fixed cohort of participants by household screenings from an area probability sample of twelve neighborhoods (contiguous census tracts) in Baltimore City and one dress rehearsal neighborhood. Power analyses for longitudinal analyses after twenty years of follow-up with repeated assessments every three years specify at least 80% power for a minimum sample size of 30 participants per cell defined by race (African American, White), socioeconomic status (self-reported household income based on 125% of the 2004 Health and Human

Services Poverty Guidelines), age (seven 5-year age groups 30–64 years), and sex. We identified neighborhoods that were likely to yield representative distributions of Baltimore City with sufficient individuals to fill the sampling design based on 2000 census data. Neighborhoods in Baltimore City are generally well-defined combinations of contiguous census tracts.

Study Planning and Execution

A central objective of HANDLS is to examine the effect of SES on health in urban-dwelling African Americans and Whites. Consequently, it was crucial to develop a community-based presence in neighborhoods that historically do not participate in clinical research. In doing so, we hoped to eliminate participation barriers related to traveling to a central examination site at a major medical center or related to a mistrust of physicians or healthcare institutions. We also believed that establishing a community-based presence would increase overall recruitment because participation in clinical research has declined even in higher SES and majority population groups.¹¹

Community-based Research Platform: Medical Research Vehicles

The most effective way to establish a community-based research platform in different neighborhoods of the city was to follow the National Health and Nutrition Examination Survey (NHANES) model of mobile examination centers. We designed two trucks to serve as mobile examination centers after consulting with NHANES staff.

We designed a flexible space in which participants would feel safe and comfortable that we could use to administer tests and examinations central to ongoing research in aging. Medical Research Vehicle (MRV) 1 is a 53-foot customized semi-trailer with an examination room and blood donor station, a cardiovascular fitness and

physical performance testing area, and a bone density and vascular studies testing area; MRV 2 is a 40-foot customized truck with three interview rooms for cognitive and neuropsychological testing, psychosocial and other questionnaires and inventories, and psychophysiological testing.

Cultural Competency in Clinical Research

The changing demographics of the US population makes it imperative for all health-related professionals to provide culturally competent care. Failure to understand the principles of cultural competence and the failure to modify care patterns accordingly have had substantial detrimental effects on health outcomes for individuals and for communities.¹² Many believe that the development of cultural competence or cultural proficiency is a crucial strategy for the amelioration or elimination of disparities among racial and ethnic health outcomes as well as health care.^{13,14} The majority of the literature on cultural proficiency and cultural competency is focused on healthcare systems, healthcare access, healthcare professionals, and the quality of care delivered.^{14,15} However, understanding the cultural context of an individual and a community is equally important or perhaps even more important for the ethical and successful conduct of clinical research. Therefore, the HANDLS study principal investigators developed a cultural competence-training course that is mandatory for all HANDLS-related research staff. Cultural competency is not a static technical skill or proficiency. We regard cultural competence as a key element in researchers' toolkits for understanding experiences and values that differ from their own. An anthropological interpretation of this core competency is in keeping with work that emphasizes that culture is not homogeneous or static even among individuals with a similar ethnic background.¹⁶

The introductory sessions of the curriculum consist of three thematic

Table 1. Total recruited sample and ages (N=3722), and baseline medical examinations completed (n=2802) by race, 125% poverty level, and sex

		≤125% Poverty		>125% Poverty		Overall
		Black	White	Black	White	
Total recruited sample	Women	588 (16)	295 (8)	614 (16)	539 (15)	2036 (55)
<i>n</i> (% total)	Men	455 (12)	198 (5)	543 (15)	490 (13)	1686 (45)
	Overall	1043 (28)	493 (13)	1157 (31)	1030 (28)	3722
Age	Women	47.2 (9.2)	47.6 (9.3)	48.7 (9.6)	47.7 (9.5)	47.8 (9.4)
Mean (SD)	Men	47.2 (9.0)	47.6 (9.4)	47.6 (9.3)	48.0 (9.4)	47.6 (9.2)
	Overall	47.2 (9.1)	47.6 (9.4)	48.2 (9.5)	47.9 (9.4)	47.7 (9.3)
Medical examinations completed	Women	446 (16)	236 (8)	466 (17)	432 (15)	1580 (56)
<i>n</i> (% total exams)	Men	317 (11)	143 (5)	388 (14)	374 (13)	1122 (44)
	Overall	763 (27)	379 (14)	854 (30)	806 (29)	2802

units taught in three 4-hour sessions. The goals of this portion curriculum are to: 1) Explain the scientific rationale for including underserved populations and minority groups in clinical research and the changing diversity dynamics nationwide; 2) Define, describe, and explain the need for cultural competence and sensitivity among community-based health care professionals and clinical researchers; 3) Introduce the concepts of ethnic and social class diversity, and specific facets of African American culture, White culture, and poverty and its effects and diversity within the US African American population; 4) Provide the historical contexts in which minorities and low SES medically underserved individuals view healthcare services and biomedical research; 5) Help researchers avoid cultural generalization and introduce researchers to cross-cultural communication techniques; 6) Discuss how ethnocentrism, prejudice, anxiety, assumptions, and stereotyping influence interpersonal relationships with persons from a culture other than one's own; and 7) Explain the dynamics of healthcare delivery in medically underserved, minority, or socioeconomically disadvantaged communities, and how they may influence rates of research participation in those communities.

Pilot Studies

We conducted two pilot studies. In the first, from October 2000 through

December 2001, we assessed the feasibility of a community-based study using a mobile medical research vehicle (MRV). The first task was to test the logistics for conducting clinical research using a MRV. The second task was to test whether we could recruit sufficient numbers of volunteers and collect meaningful data in such a setting. The protocol for this pilot included a medical and physical examination, clinical laboratory measures, carotid Doppler, bone densitometry, psychophysiological assessment, and cognitive evaluation. We finished the first pilot after examining 442 volunteers. Participants in this sample of convenience were aged 18–92 years (median age 47), and were 99% African American with a median household income of \$7,764; 44% were men. Although the first pilot was successful in recruiting low SES African Americans, it was clear we needed to develop and test recontact and participant retention strategies because we were planning a longitudinal study. Therefore, we conducted a second pilot study from February 2003 through November 2003 to evaluate recontact strategies for this convenience sample. We successfully re-examined approximately 66% of the original cohort. Some notable findings from the pilot were: increased frequency of depressive symptoms; premature increases in intimal medial thickness in the carotid artery; altered frequency of

genetic polymorphisms implicated in cardiovascular disease;¹⁷ decreased muscle strength; altered blood pressure and heart rate variability responses to stress and delays in cardiovascular recovery among African Americans;^{18,19} significant association between symptoms of depression and cardiovascular reactivity; differences in emotion recognition between African Americans and Whites;²⁰ and, the invariant factor structure of the Center for Epidemiologic Studies Depression Scale (CES-D) using confirmatory factor analysis suggesting the equivalency of the CES-D scale in samples with differential demographic characteristics including race and SES.²¹

Study Protocol

The HANDLS study collects baseline data in two separate phases, household recruitment and interview, followed by examination on our MRVs. Detailed descriptions of the procedures are described in the Appendix.

RESULTS

Recruitment and Participant Accrual

We recruited 3,722 participants (Table 1); 2,200 African Americans (59%) and 1,522 Whites (41%), 1,536 (41%) with household incomes below 125% of the poverty level and 2,186 (59%) above the poverty level.

The distribution by race, sex, poverty status, and 5-year age strata shows that we recruited approximately equal numbers of participants in each race by sex group except for Whites with household incomes below 125% of the poverty level. Of those with household incomes below the 125% poverty limit, 32% were White and 68% were African American. Of those above the 125% poverty delimiter, 47% were White and 53% were African American. The mean age of participants was 47.7 years. There were no significant age differences associated with sex or race. Participants below the 125% poverty delimiter were slightly younger than those above the delimiter (47.3 vs 48.0 years; $F[1,3719] = 5.37$, $P < .05$).

Medical Examination

A total of 2,802 (75%) participants completed their baseline examinations (Table 1). Among those who did not complete their examinations, 765 participants (83%) failed to show up for their appointments despite repeated attempts to reschedule their examinations and 156 participants (17%) were unable to complete their examinations due to insufficient time, misunderstood time commitment, time conflicts, inability to complete the examination protocol, uncooperative attitude, or the presence of newly diagnosed, acute or uncontrolled chronic medical conditions such as poorly controlled hypertension requiring immediate medical intervention. Age, race, and sex, but not poverty status, were associated with the likelihood of an examination. Older participants (aged 48–64; OR 1.29, 95% CI = 1.11–1.50), women (OR = 1.32, 95% CI = 1.14, 1.53), and Whites (OR = 1.26, 95% CI = 1.08–1.47) were more likely to complete their examinations. Among those who completed their examinations (Table 1), there were no age differences associated with sex and poverty status, but African Americans were negligibly younger than whites (48.0 vs 48.1; $F[1,2798] = 5.8$, $P < .05$).

DISCUSSION

Using a two-stage procedure for recruiting participants, we recruited a baseline sample for our longitudinal study of the effects of race and SES on health disparities. Although final sampling weights were not available, our area probability sample matched closely the demographics of the neighborhoods from which we recruited participants. Overall, the demographics of Baltimore City from the 2000 US Census identified 32% of the population as White and 64% as African American. The US Census Labor Force and Employment Data (2000) for Baltimore City reported that the median household income was \$30,654 with 21% of city residents living below the poverty line as determined by the US Census Bureau. In 2003, the Health and Human Services (HHS) poverty level was \$18,400 for a family of four. Our 125% poverty level identifying the lower SES segment of the study is \$23,000, \$7,654 below the median income level of city residents. Baltimore is similar to other mid-sized US urban areas in that it has a population with a low median income and a moderately high percentage of residents at or below the poverty line. Contrary to stereotypes about minority participation in clinical research,^{22,23} we were most successful in recruiting low SES African Americans who are highly prevalent in the city. We were less successful in recruiting low SES Whites because they are far less prevalent among Whites residing within the city limits.

The sample distribution suggests that the stereotype about the difficulty of recruiting African American participants is untrue in this circumstance. In fact, it appears as though it is more difficult to recruit higher SES participants than participants with lower SES. Our experience recruiting a biracial socioeconomically diverse urban sample appears to duplicate the recruitment results of a structured sample of conve-

nience from a suburban and rural area¹⁰ as well as another recent study conducted in an urban area.⁷ Although the imbalance in our study between numbers of African Americans and Whites is proportional to their presence in Baltimore City, it appears as though higher SES families are less willing than low socioeconomic families to participate in our research. This means that we have expended more effort in recruiting higher socioeconomic participants. A cluster of factors may explain our accrual. Higher socioeconomic individuals may have less need to participate in clinical research because they probably already have health coverage, and remuneration is proportionately a smaller motivation for higher socioeconomic individuals. Also, individuals who are employed full-time and are likely to be higher socioeconomic status probably have less time available for study participation, even though weekend appointments were available. We await the results of our first follow-up examination to determine whether there is differential attrition by SES.

Our response rates for screening and the interview are somewhat lower than expected but similar to the response rate reported for the Jackson Heart Study (JHS), a study of cardiovascular disease in African Americans in the metropolitan areas of Jackson, Mississippi.²⁴ Though their sampling design and sampling frame are quite different from HANDLS, only 53% of those contacted completed the initial interview and 46% of those contacted completed the clinic exam.²⁵ The JHS is an apt comparison for HANDLS because both have a sequential three-stage recruitment procedure (enumeration of selected households, at-home interview of eligible subjects, and a clinical examination at a different site) and both are multidisciplinary with multiple measures. The HANDLS response rates of 67% for completed household interviews and 75% for completed baseline MRVs examinations are quite similar to those

for the JHS. Atherosclerosis Risk in Communities (ARIC), a prospective study of clinical atherosclerotic disease in four US communities, is also comparable to HANDLS.²⁶ The ARIC study response rate for the home interview was 75% and the response rate for the clinic examination was 60%.²⁷ Subset analysis of the African American population of ARIC shows a response rate for the home interview of 71% for men and 72% for women; however, response rates for the clinic visit were significantly lower at 42% and 49% for African American men and women respectively.

National and international trends in overall response rates show significant declines in participation rates over the past 10 years.²⁸ Survey nonresponse is particularly important for HANDLS because it threatens the sampling validity when the reasons for nonparticipation correlate with survey measures. In a population-based cardiovascular study, nonrespondents were more likely to be cigarette smokers and have more cardiovascular disease, but did not have different rates of hypertension, dietary habits, or drug therapy for hyperlipidemia.²⁹ Other studies have suggested that nonresponders have poorer health, less education and higher mortality rates than responders. Recently, a Danish cohort study found that nonresponders had higher mortality rates as well as higher rates of hospitalization, lower SES, and worse overall health.³⁰ The ARIC study found that White male nonresponders reported poorer general health, had lower SES, higher hospitalization rates, and were more likely to be current smokers.²⁷ A higher percentage of White nonresponders (14%) reported histories of myocardial infarction, diabetes mellitus, and stroke compared to 10% for White responders. African American responders and nonresponders in ARIC were not significantly different in general health status or recent hospitalization rates.²⁷ Surprisingly, African American male nonresponders were less likely to report hypertension than African American

male responders, and African American responders (male and female) were slightly more likely to report a history of myocardial infarction, stroke or diabetes mellitus.²⁷ Overall, in ARIC, the differences between responders and nonresponders were significantly different for the Whites not for African Americans.²⁷

Recognizing the importance of addressing nonresponse prospectively, we examined potential causes of nonresponse and devised strategies to ameliorate it. Anecdotal reports from field interviewers suggested that the factors driving nonresponse include availability of time to participate in the study, the time burden of the study, lack of weekend appointment days, lack of paid time-off, childcare responsibilities, and elder care responsibilities. In response, we revised our procedures to accommodate changes in schedules, decreasing participant time burden, and changing recruitment procedures. We changed the schedule by holding examination sessions on weekends and evenings, and by overbooking to account for no-shows and medically unfit participants. We changed study procedures by shortening the exam, and by dividing the complete examination into two half-day sessions. We also increased compensation after obtaining institution review board approval. We changed recruitment procedures by initiating incentives for field interviewers and by adding a refusal conversion specialist to the field interviewer team.

We used two procedures to examine sources of bias introduced by nonresponse. First, we compared our recruitment demographics to the demographics of Baltimore City and the demographics of the neighborhoods in which recruit participants. Second, we asked eligible individuals who refused participation to complete the SF-12, a brief assessment of health status and an instrument that we also administered to participants as part of the household interview.

The present results have limitations. The present sample may be biased towards poorer health, greater exposure

to poor health behaviors, and greater susceptibility to symptoms of depression. Although the participants examined were demographically representative of their neighborhoods, their interest in participating in this study may reflect their concern about their health risks or their poor health. Sampling weights were not available in these analyses.

The HANDLS study and our methodological approaches to barriers to participation is an attempt to address one of the most pressing problems confronting health disparities research. It is well documented that the failure to consistently evaluate the inclusion of minority and socioeconomically diverse research participants has hampered efforts in clinical research to address disparate health outcomes and conduct successful translational research.^{3,11,31} Including minorities and low SES individuals in non-interventional studies is particularly difficult given the lack of immediate tangible benefits to participants whose motivation is reduced as a result.^{32,33} Given the crises in our health-care system, it is incumbent upon all clinical researchers to redevelop their toolkits to include populations at highest risk for disparate health outcomes.

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APPENDIX (additional material available at <http://handls.nih.gov>)

PHASE 1 – SCREENING, RECRUITMENT, AND HOUSEHOLD INTERVIEW

Based on the sampling design, we produced household listings for identifying the residential dwellings in each neighborhood. Field interviewers performed doorstep interviews, identified eligible persons in each household, selected, at random, one to two eligible persons per household, and invited eligible candidates to participate in HANDLS. Once recruited successfully and consented, participants completed the household survey and 24-hour dietary recall questionnaire concluding with appointments for examinations on the medical research vehicles (MRVs).

Household Survey

The household survey inquired about background and demographic information, racial and cultural identification, educational experience, occupational history, family income, total leisure time physical activity, and a wide range of other information broadly conceived as physiological and psychological chronic exposure. Although, the primary purpose of the household survey was to characterize the demographic composition of the sample, it also provided important confounding factors for use in subsequent analyses. It will serve as baseline selection criteria for analyses of subsequent waves of data (Appendix Table 1).

Table 1. Household interview survey

Measure/Instrument
SF-12 ¹⁵
General Demographic Survey
Education
Occupation
Income
Physical functioning ¹⁶
Demographics – Neighborhood Characteristics 1
Usual source of care ¹⁷
Residence Demographics – Neighborhood Characteristics 2 ¹⁸
Utilization of Care ¹⁷
Neighborhood Characteristics 4 ¹⁸
Health Services – Insurance ¹⁷
Medical mistrust ¹⁹
Psychosocial Factors – Discrimination 4 ²⁰
Psychosocial Factors – Ethnic Identity
Psychosocial Factors – Discrimination 5 ²¹
Psychosocial Factors – Discrimination 1 ²²
Psychosocial Factors – Coping ²³
Psychosocial Factors – Discrimination 2 ²⁴
Religiosity & spirituality
Psychosocial Factors – Discrimination 3 ²¹
Household Composition
Dental Health (NHANES III)

Dietary Recall

We administered the dietary recall battery twice, first in the household and again during the MRV examination using the US Department of Agriculture's (USDA) Automated Multiple Pass Method (AMPM) dietary recall survey. The survey was supplemented by measurement aids and illustrations to assist in estimating accurate quantities of foods and beverages consumed. The USDA 5-step multiple-pass method^{1,2} has been validated as an accurate methodology for assessing intake of protein, carbohydrate, fat and energy in obese and non-obese men and women. The AMPM provided an automated, standardized methodology to collect two 24-hour dietary recalls that engaged the participants, maintained their interest through use of the Food Model Booklet, and prompted more complete recollection of consumed food and beverage. The interview was a 5-step process and highlighted the memory clues imbedded in the process to improve reporting of actual dietary intake by participants.

PHASE 2—MEDICAL RESEARCH VEHICLE EXAMINATION

For the second phase of the participant examination, we performed the following procedures on the MRVs after obtaining informed consent (Appendix Table 2).

Table 2. Clinical Elements of the HANDLS MRV Baseline Examination

Domain	Measure
Medical history	general medical history medication history prescription non-prescription dietary supplements review of symptoms hospitalizations/procedures occupational exposure family history
Physical examination	blood pressure (sitting and standing) anthropometrics height weight waist circumference cardiopulmonary neurologic rheumatologic breast exam
Blood analytes (fasting)	CBC w/diff and plats serum creatinine BUN electrolytes glucose HBA1C PSA RPR iron, TIBC, ferritin, transferrin folate insulin C-reactive protein lipid panel thyroid function hepatic function hepatitis B surface antigen hepatitis C antibody HIV magnesium random albumin random microalbumin random creatinine
Urine analytes	alcohol tobacco marijuana heroin and other opiates cocaine and other stimulants
Health behaviors	

Informed Consent Procedures

Each phase had a separate consent. For phase 1, we provided participants with a booklet describing the entire study protocol. Household interviewers reviewed the protocol, reading the material to participants when necessary. The household interviewers insured that participants understood what was involved, the risks and benefits, and the time commitment required to complete the baseline assessment. For phase 2, participants began their examination visits by viewing a consent video and reviewing the

protocol with MRV staff. The MRV staff obtained informed consent, and they ensured that participants could recall what would happen during the examination and that participants understood the time commitment to complete the examination.

Medical History and Physical Examination

The medical history and physical examination provided the fundamental data upon which the documentation of diagnosable

Table 3. MRV study protocol procedures

Domain	Procedure
Carotid and arterial stiffness	carotid doppler ultrasonography, pulse wave velocity, EKG
Body composition and bone mineral density	dual energy x-ray absorptiometry (DXA)
Physical function and performance	grip strength and lower extremity function test
Nutrition	AMPM dietary recall #2
Autonomic regulation	ambulatory monitoring system
Neuropsychological testing	battery of cognitive functioning tests
Mental health and income screen	audio-administered questionnaire

conditions was based as well as a structured method to record medications, and their frequencies and dosages (Appendix Table 3).

Buccal Mucosa Smears

As part of the medical evaluation, we collected buccal mucosa smears from each consenting participant using the Whatman FTA collection system. The extracted DNA from the buccal smears provided an important additional source of genomic DNA.

Dietary Recall

The USDA AMPM measure was re-administered during the MRV examination.

Cognitive Testing

Extensively trained psychometricians administered a baseline battery of cognitive and neuropsychological³ tests assessing memory, executive function, verbal fluency and knowledge, and spatial ability. In

addition to mental status screening using the Mini-Mental State Examination⁴, we administered the Benton Visual Retention Test (BVRT),⁵ California Verbal Learning Test,⁶ Card Rotations and Identical Pictures from the ETS Kit of Factor-referenced Cognitive Tests,⁷ a 2-item prospective memory task, Wechsler Adult Intelligence Scale Digit Span Forward and Backward,⁸ Clock Drawing, Brief Test of Attention,⁹ Wide Range Achievement Test,¹⁰ Trail Making A and B,¹¹ and animal fluency. We assessed baseline symptoms of depression using the Center for Epidemiological Studies Depression inventory (CES-D).

Audio-assisted Computer Administered Self Interview (ACASI)

Problems with reading comprehension may compromise valid data collection from minority and low SES populations. ACASI technology was deployed successfully to collect sensitive information that participants were unwilling to report during an

Table 4. Audio computer-assisted self-interview (ACASI)

Multigroup Ethnic Identity Measure ²⁵	
Income assessment NHANES III	
Social support	social integration ²⁶ emotional support ²⁷ satisfaction with emotional support ²⁶ instrumental support ²⁶ demands/criticism ²⁷ integration ²⁷ satisfaction with integration ²⁷
Psychiatric screening	obsessive-compulsive disorder – PDSQ ²⁸ psychosis – PDSQ ²⁸ perceived Stress ²⁹ post-traumatic stress disorder checklist – civilian version ³⁰ social phobia – PDSQ ²⁸ generalized Anxiety Disorder – PDSQ ²⁸ alcohol abuse – PRIME-MD ³¹ post traumatic stress disorder – PRIME-MD ³¹ Brief COPE ²⁹
Coping strategies	reactive responding – vigilance scale ³² anger subscale ³³

in-person interview.¹² Using this tool, our participants used headphones connected to a computer to listen and respond to questions that we recorded digitally. Participants entered their responses by pressing a touch screen. Each response option was illuminated as it was read to avoid confusion introduced by reading difficulties. In addition to providing privacy for responding to sensitive questions, this methodology insured that questionnaires were administered consistently without a significant burden of staff time. We deployed ACASI in HANDLS to administer a variety of self-report inventories and questionnaires including a section of the medical history, psychiatric symptom screening, and demographic information (Appendix Table 4).

Autonomic Regulation in Aging Adults

We performed non-invasive heart period and blood pressure recordings using the Portapres ambulatory heart rate and blood pressure monitor. We collected continuous beat-to-beat heart rate and blood pressure data using a finger cuff placed on the participants' non-dominant hands. Participants completed both 3-minute anger recall and happy recall tasks. These tasks asked participants to recall events that made them angry and events that made them happy. Before each task, we recorded a 5-minute baseline. After each task, participants rested for 10 minutes. Participants then stood for 5 minutes (orthostasis) to examine the effects of a mild physical challenge. Participants completed momentary mood scales at different points in the protocol to assess the underlying role of mood on cardiovascular responses.¹³ In addition, we collected typical exercise habits using an activity questionnaire.¹⁴

Intimal-medial Thickness

We performed high-resolution B-mode ultrasonography on the left carotid artery for the evaluation of systolic and diastolic common carotid arterial diameters, carotid arterial flow, intimal-medial thickness, and plaques. We also evaluated the right carotid artery for the presence of plaques.

Pulse Wave Velocity

We non-invasively assessed arterial stiffness by measuring central arterial pulse wave velocity. This validated technique involves positioning of Doppler flow probes over the carotid, brachial and femoral pulses, simul-

taneously recording the waveforms, and gating them to the EKG. We measured the distance between the recording sites externally with a tape measure. We calculated pulse wave velocity between two arterial segments by dividing the distance between the two sites by the time delay for the flow waves between these two sampling sites.

Bone Density and Body Composition

We performed dual energy X-ray absorptiometry (DXA) on total body, lumbar spine, and the hip using a Lunar DPX-IQ (Lunar Corp., Madison, WI). The protocol included site-specific scans of the lumbar spine, right proximal femur, bone area, and bone mineral density. The total body scan measured both body composition and bone mineral density, including bone mineral content, bone area, bone mineral density, total body tissue, fat mass, lean mass, lean mass plus bone mineral content, and percent total fat. Results of the total body scan were presented for the body as a whole as well as for the arms, legs, trunk, head, pelvis, and spine.

Physical Performance Assessment

We performed three physical function assessments, grip strength, chair stand (sit-to-stand test), and single leg stand to measure overall strength, functional capacity and balance. In the grip strength test, we measured strength in both hands with an adjustable, hand-held, hydraulic grip strength dynamometer. In the sit-to-stand test, we assessed lower body strength and functional capacity by measuring the time required to perform 5 and 10 repeated chair stands. In the single leg stand test, we measured ability to balance on one leg. The single leg stand is a sensitive test of standing balance for middle age and older adults.

APPENDIX REFERENCES

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