National Health and Nutrition Examination I—Epidemiologic Followup Survey

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SYNOPSIS

An epidemiologic followup of the first National Health and Nutrition Examination Survey (NHANES I), being conducted from 1982 to 1984, is expected to provide estimates of the risks of certain health conditions for a sample of the U.S. population and to make it possible to relate these conditions to the nutritional, social, demographic, and behavioral characteristics of the sample. As part of the followup study, the baseline data obtained in NHANES I have been reviewed to define hypotheses and to identify pertinent variables that can be used in studying changes over time and the relationships of these variables to outcome measures. Because the followup study provides cohort data on a large sample of the U.S. population, it presents a unique opportunity for epidemiologists.

AN EPIDEMIOLOGIC FOLLOWUP of the first National Health and Nutrition Examination Survey (NHANES I) has been initiated by the National Institute on Aging (NIA), National Institutes of Health, in collaboration with the National Center for Health Statistics (NCHS), Office of the Assistant Secretary for Health. The purpose is to investigate the relationship of baseline physiological, nutritional, social, psychological, and demographic factors to subsequent morbidity or mortality from specific diseases and conditions. The followup survey is being conducted during the years 1982–84.

The followup study includes participants in the 1971 to 1975 NHANES I, who at the time of that survey were 25 to 74 years of age. The project design provides for a feasibility study, tracing of the participants in NHANES I (after an interval of approximately 10 years), personal interviews with those traced or with a proxy for those who are deceased, weight and blood pressure measurements, collection of diagnostic information from hospital records, and for decedents, determination from death certificates of the dates and causes of death.

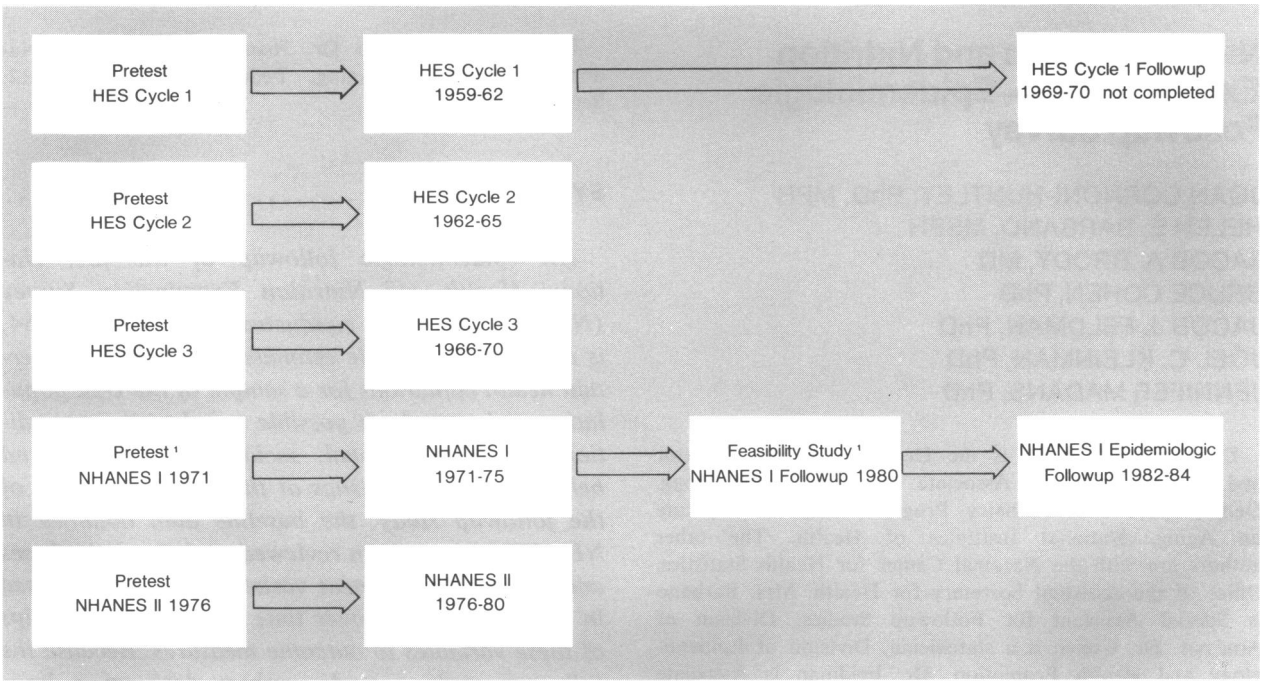
Background

The first National Health and Nutrition Examination Survey was initiated by NCHS in 1970 (*1*). NHANES, an extension of the earlier cycles of the Health Examination Survey (HES), was set up to add measures of the nutritional status of the population to the extensive physical examination in the HES. All the health examination surveys that have been completed are diagramed in figure 1. Cycles 1, 2, and 3 of the HES and NHANES I and II are based on national probability samples of the U.S. noninstitutionalized civilian population (*1–4*).

The NHANES I Epidemiologic Followup Survey is building on the baseline data that were collected in NHANES I, in which extensive health-related information was acquired on a large cohort of people throughout the United States. In NHANES I, prevalence rates were estimated, and associated characteristics were identified for these cross-sectional data.

By determining, through the followup, the health status of the participants and relating it to the previously collected data, it is expected that risk factors

Figure 1. Cycles of the Health Examination Survey (HES) and the National Health and Nutrition Examination Survey (NHANES)



[1] Feasibility Study was a followup of pretest sample.

can be identified that will enhance and broaden the scope of research on cancer, cardiovascular and cerebrovascular diseases, arthritis, dementia, and other chronic conditions. The data gathered will provide hypothesis-generating information, which, in turn, may support the initiation and design of focused studies. The followup study is expected to provide particularly valuable data about the health problems of the increasing number of elderly people in the United States. The followup approach permits identification of predictive factors and can lead to appropriate intervention to prevent or reduce illness and disability.

Planning for the followup began in January 1979 with an interagency agreement between the Epidemiology, Demography, and Biometry Program of the National Institute on Aging and the Division of Analysis of the National Center for Health Statistics. Since that time, the National Cancer Institute, National Heart, Lung, and Blood Institute, National Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases, National Institute of Allergy and Infectious Diseases, National Institute of Neurological and Communicative Disorders and Stroke, National Institute of Alcohol Abuse and Alcoholism, and National Institute of Mental Health have become involved. The primary interest of the staff of the Epidemiology, Demography, and Biometry Program is in the types and patterns of disease of the elderly that are associated with the results of the initial survey as well as with the elderly's dietary habits.

In January 1979, planning sessions began with representatives from all participating Institutes as well as with consultants in nutrition, environmental effects, social and psychological factors, and health services use. Those participating in the planning sessions reviewed the baseline data (that is, the information that had been collected in the original survey) and made suggestions regarding the characteristics of the sample and the structure and specific content of the followup survey. The goal was to design a survey instrument that would complement the original data collection and at the same time meet the specific analytical needs of the collaborating researchers.

The Sample

To match the particular interests of the sponsoring Institutes, the age range in the sample included all persons 25 years and older at the time of the original survey. The age, race, and sex distribution of the original NHANES I sample are shown in table 1. The sample's ages range from 32 to 86 years old

Table 1. Population at initial interview

Age (years)	Males			Females			Total	
	White	Black	Other	White	Black	Other	Number	Percent
25–34	971	144	21	1,996	371	35	3,538	24.6
35–44	806	108	12	1,614	368	34	2,942	20.4
45–54	900	156	9	1,046	162	8	2,281	15.8
55–64	734	103	10	811	142	3	1,803	12.5
65–74	1,504	313	19	1,671	328	8	3,843	26.7
Total:								
Number	4,915	824	71	7,138	1,371	88	14,407	...
Percent	34.1	5.7	0.5	49.6	9.5	0.6	...	100.0

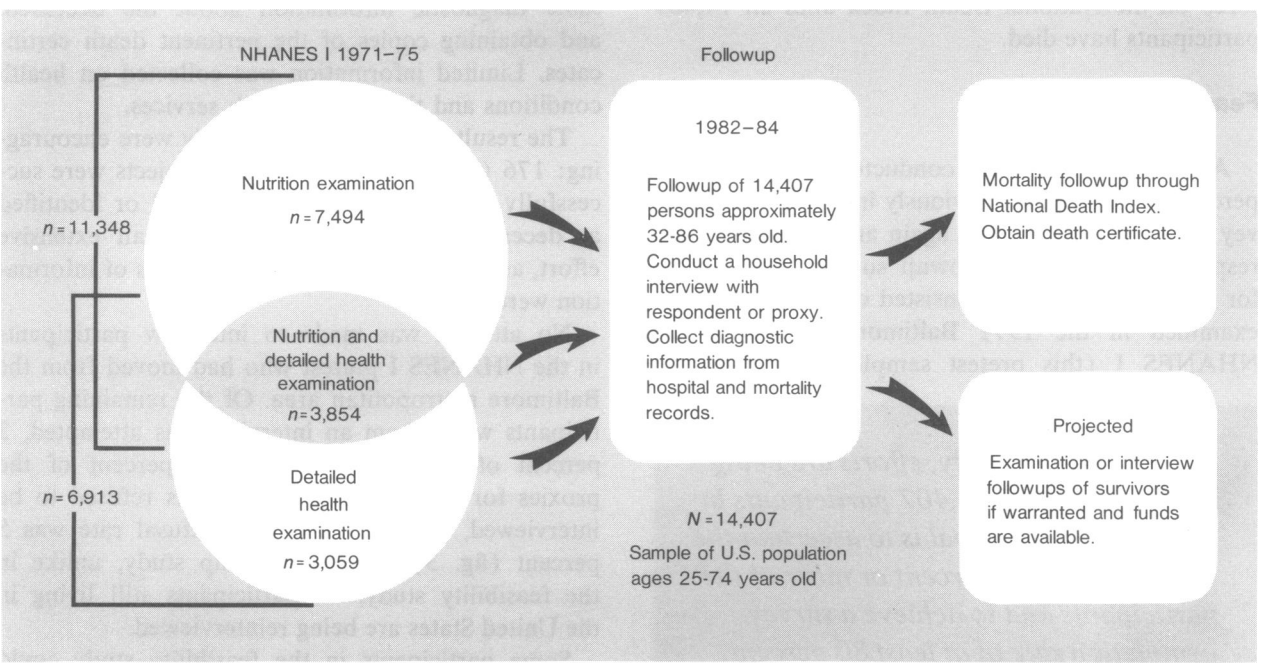
at the time of the followup. The National Institute of Aging is primarily interested in the persons 65 to 86 years of age at the time of the followup.

Because in the original survey, various subsamples received different questionnaires, the number of participants for each area of information varies. For example, the number of participants in NHANES I from whom nutritional information was obtained was approximately 11,348. All NHANES I participants underwent a physical examination, but only 6,913 received a detailed medical examination, and of these, only 1,199 and 1,888 selected respondents were administered the cardiovascular and respiratory supplementary questions (fig. 2).

Structure

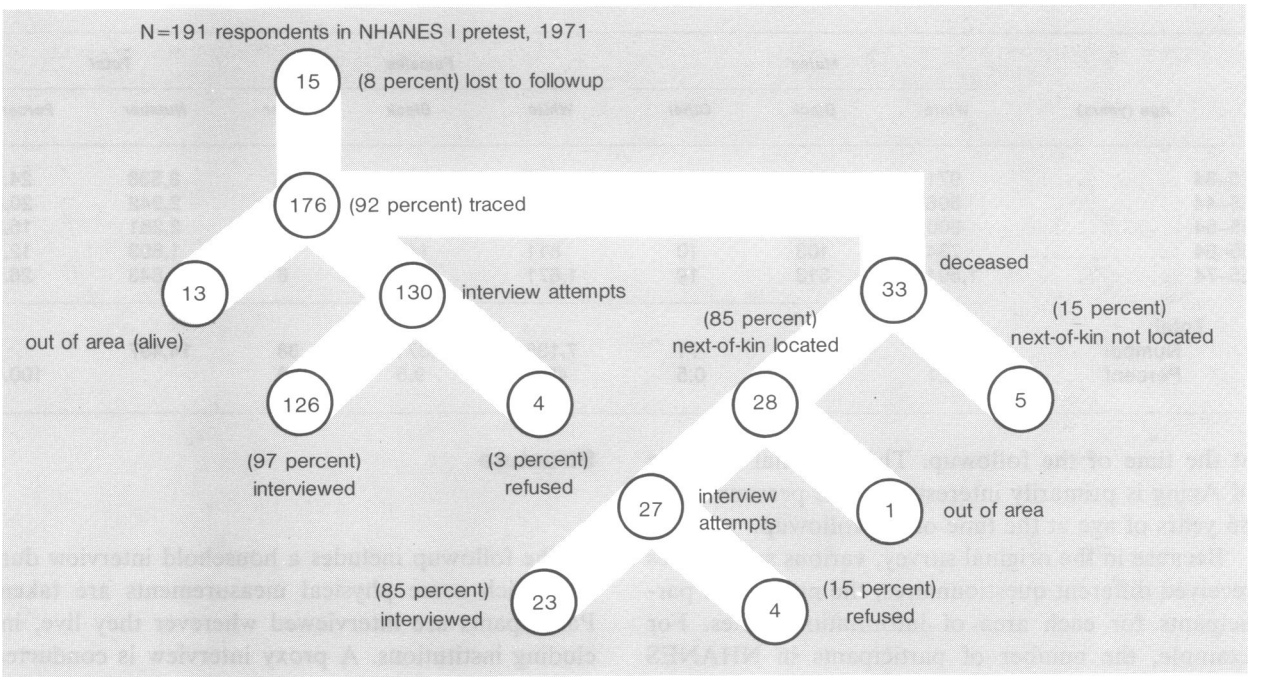
The followup includes a household interview during which some physical measurements are taken. Participants are interviewed wherever they live, including institutions. A proxy interview is conducted for the disabled or deceased. The participants, or the next of kin in the case of a proxy, are asked to sign an authorization to permit a review of past medical records. The hospitals identified on the household interview questionnaire are contacted for information to supplement the medical history reported by the respondent or the proxy.

Figure 2. NHANES I Epidemiologic Followup: flow of study population



NOTE: The capital *N* indicates total population; the lowercase *n* indicates subsamples.

Figure 3. Summary of tracing and interviewing success in Baltimore Feasibility Study, 1980



NOTE: Combined response rate for interviews: (126+23) ÷ (130+27) = 95 percent.

As part of the tracing procedure, a search of all names of participants "lost to followup" is carried out through the States' death certificate records in order to ascertain the participants' vital status. Once this search has been completed in all State vital statistics offices, subsequent mortality will be monitored on the National Death Index until all 14,407 participants have died.

Feasibility Study

A feasibility study was conducted to estimate the percentage of persons previously included in the survey who could be located again and to estimate the response rate to the followup survey. The sample for the feasibility study consisted of the 191 persons examined in the 1971 Baltimore pretest of the NHANES I (this pretest sample is identified in figure 1). The study included locating the respondents (after a 9-year interval), conducting a brief household interview, acquiring a signed authorization to use other medical history sources, abstracting hospital records for diagnostic information about hospitalizations in the interim period, obtaining the same diagnostic information about the deceased, and obtaining copies of the pertinent death certificates. Limited information was collected on health conditions and the use of health services.

In the followup study, efforts are being made to trace all 14,407 participants in NHANES I. The goal is to ascertain the vital status of 95 percent or more of the participants and to achieve a survey completion rate of at least 80 percent.

The results of the feasibility study were encouraging: 176 (92 percent) of the 191 subjects were successfully traced, that is, either located or identified as deceased. The tracing did not entail extensive effort, and only readily available sources of information were used.

No attempt was made to interview participants in the NHANES I pretest who had moved from the Baltimore metropolitan area. Of the remaining participants with whom an interview was attempted, 3 percent of the principals and 15 percent of the proxies for the deceased participants refused to be interviewed, so that the overall refusal rate was 5 percent (fig. 3). In the followup study, unlike in the feasibility study, all participants still living in the United States are being reinterviewed.

Some participants in the feasibility study could not accurately reconstruct the exact dates of their

hospitalizations in the preceding 9-year period. However, the hospitals that the participants or their proxies identified were asked to provide information on all admissions of the participant during the 9-year period. Thus, the required information on hospitalizations was obtained even if the dates identified by the participant or proxy were in error.

In the feasibility study, the overall signed authorization rate for allowing review of health records was 89 percent; 91 percent of the principals and 79 percent of the next of kin willingly signed consent forms to allow such review.

The participants in the followup study will be monitored over an extended period, so that there will be a long enough interval not only to look at the risk factors identified in the NHANES I examination, but also to analyze the data currently being collected and to determine the relationship of these data to subsequent mortality.

Tracing

As mentioned, 92 percent of the participants in the feasibility study were readily located by using only relatively few tracing methods. More intense efforts are being made in the followup to trace all 14,407 participants. The goal in the followup is to ascertain the vital status of 95 percent or more of the participants and to achieve a survey completion rate of at least 80 percent. To achieve this rate, live participants will have to be traced and interviewed, and decedents will need to be traced, death certificates obtained, and interviews completed with proxies whenever possible. In the tracing procedure, information is obtained about the present address of the participant, the participant's telephone number, any name change, and the identity of someone who might know the participant's whereabouts should there be difficulty in contacting him or her for an interview. If the participant is deceased, then the date of death, the State where the death occurred, and the name and address of the next of kin are to be obtained.

Objectives

The objectives of the followup are to study: (*a*) retrospective morbidity and mortality associated with suspected risk factors, (*b*) prospective mortality associated with suspected risk factors, (*c*) changes in the participants' characteristics between NHANES I and the followup survey, and (*d*) progression of chronic disease and functional impairments.

Retrospective morbidity and mortality associated with suspected risk factors. A national population the size of the study sample will provide a unique opportunity to replicate smaller more limited studies of suspected risk factors and subsequent disease. Morbidity and mortality that have occurred since the original survey will be analyzed in association with risk factors such as smoking, cholesterol levels, and weight. Each of the nine participating agencies have put forth hypotheses that they will be studying.

Prospective mortality associated with suspected risk factors. The participants will be monitored over an extended period, so that there will be a long enough interval not only to look at the factors identified in the NHANES I examination, but also to analyze the data currently being collected and to determine the relationship of these data to subsequent mortality. For example, several of the NIH institutes have put forth hypotheses concerning the data on nutrition and vitamin use that are being collected in the followup survey. The repeat blood pressure measures and the weight histories may provide data for testing other hypotheses.

Changes in the participants' characteristics between NHANES I and the followup survey. A person's characteristics and habits have been shown to be related to that person's health. When studying declines in health or institutionalization, data on changes such as from being married to widowhood, from living with others to living alone, and from working to being retired will be analyzed. Personality variables possibly associated with a decline in health have been included in the followup so that these interrelationships can be studied.

Progression of chronic disease and functional impairments. Some chronic diseases need to be studied over time in order to understand their progression. In NHANES I, considerable data were assembled on the prevalence of rheumatoid arthritis and osteoarthritis, both as symptoms perceived by the participants and as signs of arthritis uncovered by detailed

Table 2. Questionnaire topics

Category	Topics
Demographic	Income, education, household composition, ethnicity, occupation, marital status.
Family history	Parents' and siblings' vital status, cancer.
Female medical history	Pregnancy, hormones, births.
Medical history	Heart disease, hypertension, chronic obstructive pulmonary disease, stroke, diabetes, cancer, other chronic disease.
Arthritis	Detailed, site-specific.
Hospitalization	Ten-year history, including nursing homes.
Functional status	Activities of daily living.
Medications	Antihypertensives, aspirin, antacids.
Smoking history	Patterns and current use.
Alcohol history	Patterns and current use.
Psychological status	Depression and general well-being, type A personality.
Other	Dental, hearing, vision, bowels, sleep.
Nutrition	Extensive coverage, food frequency, vitamins.
Weight	History.
Physical activity	Activity level, jogging.

physical examinations and X-rays of the hands, hips, knees, and sacroiliac region. The arthritis supplement used in NHANES I was revised only slightly for the followup questionnaire. Its inclusion in the followup will permit analysis of the progression or remission of arthritis symptoms. Questions on the degree of pain due to arthritis that the participant experiences and on the resulting functional disability are included in the followup questionnaire in order to discover, for example, why functional impairment develops in certain participants with radiological evidence of osteoarthritis (as determined in the NHANES I examination), whereas in others with the same severity of disease, such impairment does not occur.

Data Collection

The questionnaire. An extensive interviewing instrument, which reflects the diverse interests of the participating institutes, is being used in the followup. Most of the scales in the instrument have been used in other studies. Included in the questionnaire are a health history, a female medical history, and a health conditions checklist, as well as sections on nutrition, arthritis, functional impairment, weight, smoking, alcohol consumption, mental status, sleep problems, use of specific medications, physical activity, and socioeconomic characteristics (table 2).

The health history consists of self-reports by the participant about selected conditions. Many of these conditions will be analyzed as outcome measures or risk factors for other disorders. Information is sought on the time of onset of symptoms. Sections on cardiovascular disorders, stroke and neurological symptoms, respiratory disease, and cancer are included in the questionnaire. Standardized questions are used for these sections.

Health conditions were selected for the checklist based on their severity, their prevalence as reported from the NHANES I, and the specific need for this information in the proposed analysis. Reports on hospitalizations that have taken place since the baseline survey are also elicited in connection with the conditions checklist.

Many chronic and persistent problems of the elderly result in functional and cognitive disabilities and extensive use of health care services. In an attempt to understand better the demographic features and predictive factors related to such disorders, information on vision and hearing impairments and on dental problems are obtained.

The status of functional impairment is included as an outcome measurement. The scale being used is a combination of the Fries Functional Disability Scale for Arthritis (*5*) and the Katz Activities of Daily Living Scale (*6*), both of which have been used in population studies of the elderly.

Dietary intake is assessed based on an expanded food–frequency questionnaire prepared specifically for the followup survey. Data from the recent NCHS survey NHANES II were used to establish the food categories. Detailed data on the dietary intake of foods high in vitamin A, vitamin C, fiber, and cholesterol are included, as well as general information on the consumption of foods from the major food groups.

Physical measurements. At the end of the household interview, three consecutive blood pressure readings, the pulse rate, and the weight are obtained. Procedures for all the physical measurements were established in consultation with the staffs of several national research programs and specialized researchers (*7*).

Blood pressure is measured by interviewers trained and certified in accordance with the guidelines of the American Heart Association and the National Heart, Lung, and Blood Institute (*8*). Arm cuffs in child, adult, and large sizes are avail-

able so that the interviewer can select the correct size. At least 30 seconds are to elapse between the three readings, and each time the cuff bladder is to be fully deflated.

To ensure precise and reliable physical measurements, several control methods have been incorporated into the followup survey, such as the use of the dual stethoscope by a supervisor to test the accuracy of the interviewer in the field. Procedures are also specified for a continual check of the equipment.

Morbidity. The outcome measures under consideration in the followup are morbidity, mortality, and institutionalization. Morbidity data for the followup survey are primarily self-reported symptoms, illnesses, and hospitalizations. However, after information is obtained from the participant or next of kin on episodes of hospitalization or institutionalization, a followup is made to health care facilities to obtain additional information. Hospital records not only supplement the participant's self-reports; they may also provide more detailed and medically verified diagnoses.

During the interview, each respondent is queried about any overnight hospitalization since 1970. The name of the hospital, its address, and the approximate date of hospital discharge are also obtained from the participant. Each hospital reported by the participant is contacted for diagnostic information on all admissions of the patient since his participation in NHANES I. Photocopies of hospital admission sheets and discharge notes are requested. In the case of cardiovascular episodes, an electrocardiogram is requested. Medical record information is also requested from other inpatient facilities such as nursing homes. Dates of admission and discharge and the diagnosis (reason for admission) are obtained from all these facilities.

Mortality. Death certificates and hospital records for the NHANES I participants who have died in the approximately 10-year period between the two surveys are obtained. To assist in determining as accurately as possible the cause of death, information about the deceased's last days is obtained by interviewing a proxy respondent concerning the circumstances at the time of the participant's death.

Continued Surveillance of the Population

The cost-effectiveness of the followup survey is enhanced by the availability of the National Death Index (*9*). Once the deaths in the sample population are ascertained in the tracing process, little additional cost will be incurred in using the National Death Index to continue the monitoring of the population's vital status. Information on the cause of death will be readily ascertainable from a copy of the death certificate obtained from the appropriate vital records office. This additional information will be integrated with the NHANES I data base and the information from the followup interview to further enrich the results of the basic longitudinal study.

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