Chapter 3
Survey operations

Data collection

Interviewing for the 1984 Supplement on Aging (SOA) was conducted by the U.S. Bureau of the Census, Field Division, in the standard face-to-face interviewing procedure for conducting the National Health Interview Survey (NHIS). (See reference 1 for a description of the NHIS procedures.) The SOA was administered in the 1984 NHIS sample households after the NHIS basic questions were asked of the household respondent about all the household members. Because the rule for the SOA was self-response if possible, sometimes the original respondent continued with the SOA and sometimes the respondent for the SOA was another person who had not participated in the household interview.

The interview period for the 1984 NHIS and SOA was January 9, 1984, through January 6, 1985, with interviewing conducted weekly throughout the year. Appendixes I and II contain the questionnaires used.

Interviewer training

NHIS interviewer training is conducted by the U.S. Bureau of the Census, Field Division, and consists of two types:

- Initial training, which is the basic NHIS training for interviewers newly assigned to NHIS either from other U.S. Bureau of the Census surveys or as new employees. It is conducted periodically as the Bureau's Field Division acquires new NHIS interviewers.
- Group training, which is training conducted in weeklong classroom training sessions on the current year's special procedures and questions, including supplements. It is conducted for interviewers who have been working as NHIS interviewers for at least the past year. It is conducted at the beginning of the NHIS data collection year in January and again midway through the year.

In addition to classroom training, NHIS interviewer training includes home study, self-instruction exercises, and observed practice interviewing. Detailed interviewer instruction manuals are prepared for both the NHIS basic questionnaire and for the supplements.

For group training sessions covering a supplement or special topic questions, a training package is specially written by the U.S. Bureau of the Census. Specifications for the training and guidance for emphases in the classroom session and home study segments are provided by the staff of the Survey Planning and Development Branch, Division of Health Interview Statistics,

who participated in the development of the supplement (appendix VIII).

Training on the SOA for experienced interviewers consisted of 1½ days of group classroom sessions in January. Additionally, portions of a 2-hour home study in March, a 3-hour home study in June, and the 1-day July group training were devoted to the SOA. Trained supervisors also trained interviewers as needed during the year. NCHS staff attended both the January and the July group training.

In addition to the training for experienced NHIS interviewers, the initial training—that is, the basic training on NHIS for new interviewers—was modified to accommodate the complex SOA. Historically, the initial training for NHIS interviewers takes about a full week and includes only 1½ days for any supplement to be covered. This basic training package was modified, and additional time was given for training new interviewers on the SOA. The procedures and concepts included in the SOA were more complex than usual, and they required thorough knowledge of the NHIS conventions and concepts to administer.

Data collection

A total of 16,697 sample persons in the 39,996 households responding to the 1984 NHIS were selected for the SOA interview. The SOA interviews were completed for 96.7 percent of the sample, or 16,148 persons. Self-response, which was the primary respondent rule, accounted for 89.8 percent and proxy response, for 6.9 percent; 3.3 percent did not respond to the SOA. Less than 1 percent were partial interviews. Thus, the effective response rate was 96.7 (the SOA response rate) × 96.4 (the NHIS household interview response rate) = 93.2 percent.

Data in table C summarize these results by quarter and show the breakdown of personal visit and telephone callback interviews.

Weekly monitoring of response rates for each of the census regional offices and the national total was conducted throughout the interviewing. The nonresponse rate at the outset of interviewing was 4.25 percent, and it increased to 5.88 percent for the first quarter. Reasons for nonresponse were analyzed from the interviewer memoranda that are required to explain noninterviews and from supervisors' monitoring interviewers with high noninterview rates. The problems of the combined length of the basic questionnaire and the SOA and the initial opinion of the interviewers that the basic questionnaire was more im-

Table C. Response rates for the Supplement on Aging (SOA), by quarter and type of response

Item	1984 total	Jan.– Mar.	Apr.– June	July– Sept.	Oct.– Dec.
Number of persons selected for SOA	16,697	4,152	4,247	4,197	4,101
	Percent of sample persons				
Nonresponse	3.3	5.9	2.8	2.3	2.3
Refused	2.7	4.7	2.5	2.2	1.7
Absent[1]	0.2	0.4	0.1	0.1	0.2
Incapable[1]	0.1	0.2	0.1	0.0	0.1
Other	0.3	0.6	0.1	0.1	0.3
Total SOA response[2]	96.7	94.1	97.2	97.7	97.7
Self-response	89.8	89.5	90.5	89.5	89.5
No callback	83.5	83.2	83.8	83.3	84.0
Personal callback	3.5	3.8	4.1	3.2	2.4
Telephone callback	2.8	2.5	2.6	0.0	3.1
Proxy response	6.9	4.7	6.7	8.2	7.8
No callback	5.3	3.6	5.0	6.4	6.1
Personal callback	0.9	0.7	1.2	0.9	0.8
Telephone callback	0.7	0.4	0.5	0.9	0.9
Number of persons responding to SOA	16,148	3,909	4,129	4,101	4,009

[1]Outcome dispositions of "Temporarily absent" and "Mentally or physically incapable" were assigned only if there was no proxy respondent available.
[2]Because administrative data are used in this table, rates shown differ slightly from those in table D.

portant than the SOA (performance ratings were based on completed basic interviews only) were addressed.

Special procedures were implemented to reduce nonresponse. Procedures were implemented during the first quarter of the interviewing, and review of the problems and general instruction on nonresponse reduction was conducted in the July training sessions.

The procedure changes were:

- Changing the callback rule to accept proxy response after the second personal visit or the first telephone callback. This reduced the antagonism of initially willing proxies who were told at the early callback they could not be interviewed and then were asked for an interview at a later callback.
- Issuing a warning to interviewers not to take proxies simply to avoid refusals.
- Instructing interviewers to suggest calling back to continue, particularly for conducting the SOA, in situations where respondent fatigue was apparent.
- Stressing the importance of a smooth, inconspicuous transition from the NHIS basic interview to the SOA (they were separate questionnaires) and the technique of politely suggesting that a second SOA sample person might want to leave the room and return later as tools for keeping the refusal rate to a minimum.

The impact of providing special procedures to reduce nonresponse was apparent in the second quarter (April–June). The results, shown by quarter in table C, indicate that there was some increase in proxy interviews after the first quarter, but callback interviewing did not increase as much or as consistently with the new procedures. Self-response remained at about the same level throughout the interviewing periods.

An intense effort to reduce nonresponse was made by the U.S. Bureau of the Census field staff following the implementation of measures to address this problem. A lower nonresponse rate was achieved with implementation of the special proce-

dures and was maintained for the balance of the year, producing the SOA's final 3.29 percent noninterview rate. (For a discussion of issues in nonresponse applicable to the population of the SOA, see references 35 and 36.)

Quality control: Data collection

Quality control procedures are followed in data collection, data preparation and coding, and in data editing stages of the survey operations. Additionally, the quality of the data itself is assessed through reinterviewing.

Quality control procedures

The interviewer training program and the field quality control procedures are described in detail in other publications.[1,14] Only a brief summary of the field quality control measures that applied to the NHIS basic interview and the SOA is presented here.

Observation of interviewers is an important procedure in the field. Each NHIS interviewer is observed in a group of households in his or her assignment by an interviewer supervisor or senior interviewer. An observation report is used to document the interviewer's performance. There are three types of observations:

- *Initial* observations are conducted on each interviewer newly assigned to NHIS for 2 days on his or her first interviewing assignment, for 1 day on the second assignment, and for part of a day on the first listing-of-addresses assignment. (An interviewing assignment is 1 week of sample, and it is to be completed within 2 weeks.)
- *Systematic* observations are conducted by supervisors on all interviewers. One-half of the experienced interviewers are observed each quarter, with the halves being rotated throughout the four quarters. Systematic observation is made on newly assigned interviewers during the first quarter following their initial assignment.

- *Special-needs* observations are made by supervisors when they determine through the field edit of completed questionnaires and other field monitoring that an interviewer might need more training.

Another quality control activity that is conducted both in field and in data preparation stages of the survey is the performance of several types of edits. Field edits are the initial edits conducted on the survey data. The three field edits are as follows:

- Interviewers are responsible for performing an edit of all work, prior to submitting it to the census regional office, including checks for completeness, consistency, and legibility of entries.
- The regional office staff performs further edit checks of the questionnaires submitted by the interviewers. Specifications are prepared by the staff of the Survey Planning and Development Branch of DHIS and the Health Surveys Branch staff of the U.S. Bureau of the Census (appendix VIII) for these regional office edits that determine the percent of work edited and the specific questionnaire content to be edited.
- If edit results or observation reports indicate errors, such as omissions or inconsistencies, additional editing of the individual interviewer's work is done by the census regional office staff.

Specifications for conducting these field edits require that the work of experienced interviewers receive more editing at the beginning of the data collection year when new items (or supplements) are first administered. As the year progresses, the percent of experienced interviewer work receiving field edit is reduced. For interviewers newly working on NHIS, the first four assignments are always edited by the regional office staff.

Reinterviewing

Approximately 5 percent of all interviews are designated for reinterview. The reinterview serves as a check on interviewer performance and as a measure of the reliability and accuracy of the NHIS and SOA data.

The content of the reinterview is determined by the DHIS Survey Planning and Development Branch staff and, in 1984, included questions from both the NHIS basic questionnaire and the SOA. (See appendix IV for the content of the SOA reinterview.) For each household designated for reinterview, the subset of questions is asked (by telephone) by the interviewing supervisor within 2 weeks of the original interview. Responses are entered on a form specially designed for reinterviewing. Interviewers are not informed which households are reinterview households.

The reinterview sample is divided into two parts: an 80-percent subsample and a 20-percent subsample. In the larger subsample, the supervisor carries out reconciliation of the reinterview results with the original interview results. In the smaller subsample, no reconciliation of differences is made. In the analysis of the reinterview data, the degree of inconsistency is determined by computer on the processed reinterview questionnaires.

Quality control: Data processing and editing

Specifications for clerical editing and coding of the SOA data by the data preparation staff of NCHS were prepared by the Survey Planning and Development Branch design group, Division of Health Interview Statistics (appendix VIII).

Among the specifications for clerically editing and coding the SOA were:

- Cross-checks of identification information about the SOA sample person and other household data with the basic NHIS information.
- Codes and coding procedures for verbatim responses, such as codes for the equipment used in performing activities of daily living and for the relationships of contact persons with the sample persons.
- Edits of condition data entered from the NHIS basic questionnaire to the SOA.
- Edits of the sample recording and selection.
- Preparation of noninterview records.

Quality control of the coding of questionnaire information consists of recoding 10 percent of all questionnaires by two independent coders. Comparison of all three coding results are analyzed to determine if any coder exceeds the acceptable error level of no more than 5 percent of the coded items. Indication of coding errors requires the supervisor to conduct retraining or to review the code development with the questionnaire design staff to determine suitability of the codes.

The quality of the machine keying is maintained by a 100-percent independent key verification of all items in the questionnaires. After the data are on tape, a third type of edit, computer edits, is performed in the preparation of the final data tapes.

The computer edit checks for inconsistencies and invalid responses, provides algorithms for imputation, and generates recodes. The specifications for these computer edits are provided by data analysts of the Illness and Disability Branch, Division of Health Interview Statistics, who attend the pretests and the interviewer training and who work in conjunction with the DHIS questionnaire design specialists to ascertain the intent and meaning of the questions (appendix VIII).

The specifications for computer edits for the SOA included over 350 decision logic tables designed to perform automated tasks for checking the quality of the SOA data, checking its consistency with the NHIS basic questionnaire information, and developing recodes useful in analytic processing of the final user files.

The SOA data tapes contain the SOA interview information with the following record structure:

- A file of person records containing, for each person for whom an interview was completed, all items in the NHIS basic questionnaire that are on the person file, weights, all items in the SOA questionnaire (except the items used to permit matching to the National Death Index), special recodes, and selected condition and utilization information.
- A file of condition records, with identifiers that permit linkage to the person records, containing all conditions

mentioned in the SOA interview plus any condition for the individual that is related to a "limited activities" status from the basic NHIS questions. (Codes: Unable to perform major activity, Limited in amount or kind of major activity, Limitation in other activities, and Not limited, in position 71 on the SOA public-use person data tape.)

The detail of the content, coding, and structures of these two SOA data record types is contained in the public-use data tape documentation.

Among the computer editing of the SOA data and the preparation of the final files, the following two specific edits are of note because they make the data easier to use:

- The first of these is the addition to the SOA condition record, which contains reference to data on activities of daily living (ADL's) and on individual activities of daily living (IADL's), of special condition information that was reported for the SOA sample person with the ADL or IADL trouble. The special information is abbreviated data on the condition, or conditions, given in the interview as the source of trouble when performing the ADL or IADL. Included in the special ADL or IADL related condition information is the condition serial number, the International Classification of Diseases (ICD) code,[37] an acute or chronic code, hospitalization information, how long the person had the condition, and the date of the last doctor visit for the condition.

- The second is the inclusion in the condition record file information obtained from the basic interview about the SOA sample person that indicates whether the sample person has any limitation of activity and what condition causes that limitation.

Chapter 4
Analysis of SOA data

Estimation

Weights

The National Health Interview Survey (NHIS) is designed to produce estimates for the civilian noninstitutionalized population residing in the United States. Therefore, the data must have weights to inflate the sample numbers to the national estimates. These weights are on all public-use data tapes.

When creating the weights, the 52 weeks of data collection in a year are viewed as the consolidation of four quarters of 13 weeks each. Each quarter is a national sample and the quarter is the fundamental unit for weighting.

The basic weight for each quarter is the product of four factors

- The inverse of the probability of selection at each stage of selection (PSU, segment, household).
- A noninterview adjustment at the segment level.
- A first-stage ratio adjustment.
- A poststratification adjustment to 60 age-race-sex population totals that are provided by the U.S. Bureau of the Census for each quarter.

(A more complete discussion can be found in reference 1.)

The weights for the basic NHIS were not sufficient for the SOA, however, for two reasons:

- The sample for people ages 55–64 years was only a half sample.
- There was, as described in chapter 3, an additional nonresponse on the SOA.

Therefore, the NHIS weights for each quarter were multiplied by an additional factor to poststratify the SOA to the NHIS basic data using the 16 poststratification cells for people ages 55 years and over shown in figure 2. This was the equivalent of repeating the fourth factor for the SOA. The result is that the national estimates, when the weights on the SOA tape

| | Black | | Other | |
Age	Male	Female	Male	Female
55–59 years				
60–64 years				
65–74 years				
75 years and over				

Figure 2. Poststratification cells for the Supplement on Aging

are used, are precisely the same for each of the specified age-sex-race cells as they are when estimated from the NHIS basic data tape. As shown in table D, response rates were lower for people under 65 years of age than for people age 65 years and over, and they were lower in the first than in subsequent quarters. However, as shown in table E, the estimated population in each quarter and in each age, sex, and race group is the same when derived from either the basic NHIS or the SOA despite the difference in the number in the sample.

The differences in the weights on the SOA tape are transparent to the user. The weights for persons ages 65 years and over are similar to those on the basic tape because only the additional nonresponse had to be taken into account. The weights for persons ages 55–64 years are approximately twice as large as those on the basic tape or for people ages 65 years and over because of the half sample in the SOA for people in that age group (appendix VI, table I).

The user who links data from the NHIS basic data files to the SOA files should remember to use the weights on the SOA files instead of those on the basic data tapes.

Point estimates

National estimates for most data can be made by using the appropriate weight as a multiplier for each record. The basic unit for the weights is a quarter, and the files are constructed so that estimates can be made for any quarter. If only one quarter of data is used, the final basic weight will produce the national estimate of the population for that quarter by any characteristic, and the weights for events will produce the national estimates of the number of events that occurred during the quarter. If two quarters of data are used, the population estimates must be averaged, but the events are summed so that all events occurring during the 6 months are counted. If four quarters (the full year of the SOA) are used, the populations are averaged over the four quarters, and the events are summed to give a count of all events occurring during the year. The weights that average the populations and sum the events are on the data tapes.

Analyses could be done using only the final basic weight for the quarter in tape location 201–209 and the 6.5 weight in tape location 228–236. (Because the data are based on a 2-week recall period and there are 13 weeks in a quarter, each event must be multiplied by 6.5 to estimate the number of such events in 13 weeks.) However, there are also weights that average the population if more than one quarter of data is used and there are weights formed by multiplying the frequency count of events by the weight that is appropriate for the recall period.

Table D. Number of persons in the National Health Interview Survey (NHIS) and Supplement on Aging (SOA) samples and Supplement on Aging response rates, by selected characteristics

Characteristic	NHIS	SOA	SOA response rate
			Number in sample
Total[1]	21,746	16,148	0.96
55–64[1] years	9,852	4,651	0.94
65 YEARS AND OVER			
Total	11,894	11,497	0.97
Age			
65–74 years	7,344	7,093	0.96
75–84 years	3,698	3,578	0.97
85 years and over	852	826	0.97
Quarter			
Jan.–Mar.	2,887	2,717	0.94
Apr.–June	3,095	3,002	0.97
July–Sept.	2,961	2,895	0.98
Oct.–Dec.	2,951	2,883	0.98
Sex			
Male	4,829	4,643	0.96
Female	7,065	6,854	0.97
Race			
Other than black	11,002	10,642	0.97
Black	892	855	0.96
Family in household			
Alone	3,726	3,655	0.98
Unrelated person only	137	134	0.98
Spouse only	6,408	6,162	0.96
Other relatives	1,623	1,546	0.95
Health status			
Excellent	1,876	1,816	0.97
Very good	2,400	2,335	0.97
Good	3,727	3,602	0.97
Fair	2,497	2,419	0.97
Poor	1,334	1,274	0.96
Unknown	60	51	0.85
Limitation of activity			
Unable to perform major activity	1,285	1,229	0.96
Major activity, limited	1,659	1,619	0.98
Outside activity, limited	1,707	1,667	0.98
No limitation	7,243	6,982	0.96
Hospital episodes			
0	9,535	9,234	0.97
1	1,659	1,593	0.96
2 or more	700	670	0.96

[1]Response rates assume that one-half of the NHIS people ages 55–64 years were selected for the Supplement on Aging.

The estimates and tape locations of appropriate weights are

Estimate	Tape location
1. Population by any characteristic	
One quarter of data	201–209
6 months of data	210–218
1 year of data	219–227

Table E. Sample numbers and population estimates for persons ages 55 years and over, by selected characteristics: National Health Interview Survey (NHIS) and Supplement on Aging (SOA), 1984

Characteristic	NHIS	SOA	NHIS	SOA
	Sample number in units		Population estimate in thousands	
Total	21,746	16,148	48,485	48,485
Age				
55–64 years	9,852	4,651	22,053	22,052
65–74 years	7,344	7,093	16,287	16,288
75–84 years	3,698	3,578	8,252	8,249
85 years and over	852	826	1,893	1,897
Quarter				
Jan.–Mar.	5,365	3,909	12,071	12,071
Apr.–June	5,493	4,129	12,101	12,101
July–Sept.	5,522	4,101	12,136	12,136
Oct.–Dec.	5,366	4,009	12,178	12,177
Sex				
Male	9,405	6,793	21,073	21,072
Female	12,341	9,355	27,412	27,413
Race				
Other than black	20,042	14,931	44,234	44,255
Black	1,704	1,217	4,159	4,159
Family in household				
Alone	5,066	4,289	11,312	11,414
Unrelated person only	255	188	589	582
Spouse only	13,860	9,712	30,887	30,997
Other relative	2,565	1,959	5,698	5,492
Health status[1]				
Excellent	4,035	2,826	9,010	8,954
Very good	4,628	3,369	10,393	10,342
Good	6,760	5,030	15,051	15,068
Fair	4,053	3,188	8,953	9,103
Poor	2,161	1,665	4,835	4,820
Limitation of activity				
Unable to perform major activity	2,403	1,755	5,367	5,329
Major activity, limited	2,789	2,169	6,168	6,260
Outside activity, limited	2,345	1,985	5,202	5,321
No limitation	14,209	10,239	31,749	31,576
Hospital episodes				
0	18,159	13,297	40,522	40,534
1	2,572	2,018	5,706	5,651
2 or more	1,015	833	2,257	2,299

[1]Responses of "don't know" are not shown separately.

NOTE: Sample numbers should not be used to compute response rates because of the half sample for ages 55–64 years.

Estimate—Con.	Tape location—Con.
2. 12-month recall	
Hospital episodes	327–335
Hospital days:	
Quarter	300–308
Semiannual	309–317
Annual	318–326
Doctor visits:	
Quarter	273–281
Semiannual	282–290
Annual	291–299

Estimate—Con.   *Tape location*—Con.

3. 2-week recall

Restricted activity days	237–245
Bed disability days	246–254
Work-loss days	255–263

The frequency of the 12-month and 2-week recall events has already been multiplied by the appropriate factor, and the weight given above is a variable-specific weight. This enables the user to obtain precisely the same estimates that appear in NHIS publications without making assumptions about what to do about persons for whom some part of the information is unknown. For example, these weights take care of cases where the week of the doctor visit is unknown and cases where it is known that the person had days in bed but the number of days is unknown. When using these weights, *do not* use the variable itself as a multiplier; if the variable is used, the variable component will be squared. It is suggested that users compare their estimates with the estimates published by NCHS to verify the use of the correct weights.

Weights where the frequency has already been multiplied by the appropriate weight are those in tape locations 237–335, and they are labeled with the variable name.

Alternatively, the user can create a new weight by multiplying the frequency of the variable by the appropriate weight. This is the only approach for variables such as the number of hospital discharges and their associated days or the number of acute conditions. These variable-specific weights are not on the SOA tapes because the staff of the Division of Health Interview Statistics uses the hospital or condition tapes to make estimates, and the weights are on those tapes for the basic NHIS.

Because the recall period for hospital discharges and the associated days is 6 months, the semiannual weight in tape locations 210–218 should be used. Multiplying the number of discharges in tape locations 132–133 by the weight will produce the annual estimated number of discharges.

A 2-week recall is used for acute conditions. Therefore, the correct weight is the 6.5 weight.

Tape locations for weights and frequency counts are

	Tape location	
Estimate	*Weight*	*Frequency*
1. 12-month recall		
Hospital episodes	219–227	122–123
Hospital days	219–227	124–126
2. 6-month recall		
Hospital discharges	210–218	132–133
Discharge days	210–218	134–136
3. 2-week recall		
Restricted activity days	228–236	98–99
Bed-disability days	228–236	100–101
Work-loss days	228–236	102–103
Acute conditions	228–236	118–119
Doctor contacts	228–236	120–121

Examples of national estimates

To obtain the national estimate of the population in any quarter, select the quarter using tape location 5, and multiply each record in the quarter by the weight in tape locations 201–209.

To obtain the national estimate of the number of people in the year, multiply each record in the entire file by the weight in tape locations 219–227.

These are the weights used for estimates for the number of people by any population characteristics, such as age, race, sex, people limited in activity, people with one or more limitations in activities of daily living, people with one or more children, people married or widowed, or people living in a retirement complex.

To obtain the national estimate of the number of bed days in any quarter, select the quarter using tape location 5 and accumulate the weights in tape locations 246–254. Alternatively, multiply each record by the 6.5 weight in tape locations 228–236 *and* by the frequency of bed days in 2 weeks in tape locations 100–101.

To obtain the national estimate of the number of bed days in the year, multiply each record in the entire file by the same weight, the one in tape locations 246–254. Alternatively, multiply by the 6.5 weight *and* the frequency.

Using the weight in tape locations 237–245 will produce the number of restricted activity days for a quarter if only a quarter of data is used, for 6 months if 6 months is used, or for the year if all records are used. The alternative is the same as that given above for bed days except that the frequency count is in tape locations 98–99. In each case, national estimates are produced, but the user can examine seasonal variation in the items with a 2-week recall period.

Examples using the SAS[38] are given in appendix VII.

Variances

Because of the complex sample design of the NHIS, there is clustering in primary sampling units (PSU's), in segments, and in households. The clustering, which is done to reduce costs and make such national surveys possible, usually results in variances that are larger than those that would have been obtained if the NHIS had been based on a simple random sample.

This clustered design produces problems for many users who are accustomed to using programs, such as the SAS[38] and Statistical Package for the Social Sciences (SPSS),[39] that assume simple random sampling for all variance estimates used for confidence intervals or tests of significance.

There are a number of alternative ways of dealing with incorporating the variances in design-based analysis.

Curves of relative standard errors

The Division of Health Interview Statistics uses curves of relative standard errors for all analyses in Series 10 publications.[1] The curves for 1984 are in *Vital and Health Statistics, Current Estimates 1984.*[14]

These curves in that report can be used without modification for data on persons ages 65 years and over. They must be adjusted for persons ages 55–64 years because of the half sample. The relative standard errors for data for people ages 55–64 years can be adjusted reasonably well by multiplying by the square root of 2, that is, approximately 1.4.

In using these curves, one must assume that covariances are zero. Such an assumption will result in an overestimate if the variables are positively correlated and an underestimate if they are negatively correlated.

Design effects

The analyst can use design effects to adjust the results from analyses that were based on the assumption of simple random sampling. The design effect is defined as the variance from the complex sample divided by the variance of a simple random sample *of the same size*. For standard errors the square root of the design effect is used.

Some selected design effects for data on the SOA are given in appendix VI, table II. They are relatively small. Most are less than 1.5, which means that the standard error would be about 23 percent larger than if the SOA had been based on a simple random sample of the same size. That is, the complex sample design did not markedly increase the variance estimates that would have been obtained under simple random sampling. The relatively small design effects occur because, in general, older people do not tend to cluster. They tend to be distributed throughout communities rather than living in one particular area, and they tend to live alone or with only one other person. Moreover, they tend to have chronic conditions, and their disability is associated with chronic conditions. There is relatively less geographic or household clustering of chronic conditions than of acute conditions. Thus, there is little clustering in PSU's, segments, or households.

There may also be a social effect that counteracts potential household clustering. Two older people who are both disabled may not live together because of inability to care for one another.

The user should not assume that design effects are always small. Some design effects are relatively large for the SOA variables. In the NHIS they are large for many of the characteristics of children. People with small children tend to live in recently constructed housing and, therefore, there is geographic clustering. They tend to have more than one child and, therefore, there is household clustering, especially if the analyst is using a large age group such as school-aged children. Also, acute conditions are more common among children and, given that many acute conditions (and the disability days associated with them) are communicable diseases, acute conditions will cluster more than the chronic conditions (and disability days associated with them) that are characteristic of older people.

Calculating variances

There are several approaches currently used to calculate variances for data from samples with complex sample designs. They are:

- Taylor linearization.
- Balanced half sample replication (BRR).
- Jackknife procedures.
- Bootstrap procedures.

There is an extensive survey research literature on these approaches that should be investigated by the interested user.[40,41] (A good place to begin is with the Proceedings of the Survey Research Section of the American Statistical Association.) However, the general reader needs only to know that

- They are asymptotically similar.
- The first three have been used in publications from the National Center for Health Statistics.
- There are only a few widely available software programs to use any of them.

The general user who does not have access to someone to write variance programs is confined to one of the commercially available programs. There are, as far as the authors know, only three supported software packages. They are:

- The packages available through the Research Triangle Institute (RTI). All run under SAS and use standard SAS statements. There are three programs, SESUDAAN, SURREGR, and RATIOEST.[42-44] They are separate packages that perform different functions. All are based on Taylor series approximations.
- The programs available through the University of Michigan. These run under OSIRIS and use OSIRIS statements.[45] They are all incorporated in the complete OSIRIS package. Some, such as PSALMS, are based on Taylor series approximations and some, such as REPERR, are based on half-sample replication.
- The program, SUPERCARP, available through the University of Iowa.[46] This program also uses the Taylor series approximation.

SUPERCARP, called PC CARP, is also available for microcomputers.[46] The others are not available for microcomputers.

There are a number of other programs in use by specific research organizations or Federal agencies. Some of them have advantages that the commercially available programs may not have. For example, the BRR program of the National Center for Health Statistics takes poststratification into account.

A recent study on ease of use[47] indicates that the programs from the Research Triangle Institute (RTI) take fewer input statements from the programmer, and they take less computer time than the OSIRIS or SUPERCARP programs or the BRR program developed at the NCHS.

They also run under SAS, which many people have available; have generally good regression programs;[43] and are statistically well designed.

Therefore, the users should evaluate what is available, the environment in which they operate, and choose the program that is easiest to use under that environment.

The examples in this report are based on the RTI programs in the SAS environment because

- They are available at the National Center for Health Statistics. This includes the availability of the program GENCAT that can be used for categorical data analysis.
- They offer the possibility of downloading a variance-covariance matrix to a personal computer and using PC SAS[48] for final analysis.

Considerations of sample design

The NHIS sample design in use in 1984 consisted of 376 primary sampling units (PSU's),[1] one in each stratum. All variance programs assume that there were two PSU's in each stratum. It was necessary, therefore, to create pseudo-PSU's and strata for the calculation of variances. The 298 pseudo-PSU's are in tape locations 187–189 on the SOA public-use data tapes. The user should form pseudostrata by pairing adjacent pseudo-PSU's. For example, PSU's 1 and 2 form stratum 1, PSU's 3 and 4 form stratum 2, and so forth.

The SAS statements for forming the strata are in appendix VII.

A serious problem for the analyst who wishes to estimate variances or covariances is that, because the NHIS is essentially a self-weighting sample and because the population of the United States is not equally distributed among geographic areas, there are PSU's that have no sample persons in particular subdomains of interest. There are, for example, 61 pseudo-PSU's that have no one in the sample who is 85 years or over (appendix VI, table III). There are PSU's that have no black males ages 65 years and over, and there are certainly PSU's that have no one with the characteristic of interest for other analyses.

One method of dealing with this problem is to collapse PSU's and strata, that is, to combine them so that each PSU has at least one sample person with the characteristic of interest.

If the analysis of interest is focused on only one population characteristic for which there is a problem, such as an analysis of data about people ages 85 and over, the analyst can investigate the distribution of the sample by pseudo-PSU's and combine only those where it is necessary. This will preserve as much of the sample design as feasible. If the analysis uses several such characteristics, more combining may be needed. This should be done with great care to preserve the sample structure.

There is, as far as the authors know, little published literature on the impact of extensive combining of strata, but some investigation at the NCHS suggests that the effect on the variances may be minimal.

Strategies for analysis

After the analyst feels comfortable with the structure of the data file and the way the questions have been translated into variables on the tape, the analysis of the SOA data can be approached in three stages. First. investigate the data without weights as if they were derived from a simple random sample. Second, incorporate the weights to make national estimates. And finally, incorporate both weights and the complex sample design. The three stages are shown in figure 3.

Relationship between the questionnaire and the data

The National Health Interview Survey (NHIS) is a complicated survey, and the variables on the public-use data tape reflect that complexity. It is a good idea for the user to check the variables on the SOA tape against the questions on the

| Stage | Type of analysis | Inclusion of | |
		Sample weights	Complex sample design
1	Preliminary	No	No
2	Weighted	Yes	No
3	Final	Yes	Yes

Figure 3.   Stages for the analysis of data from a survey with a complex sample design

questionnaire to learn how the questions were translated into data.

There are many skip patterns on the questionnaire, that is, the answer to one question leads the interviewer to one of several choices for the next question. An answer of "No" or "Don't Know" frequently results in subsequent questions on the topic being skipped. Because the questions were not asked, the entry on the tape is a blank. The blank means that the question was not asked because it was not relevant; it does not mean that the data are missing.

For example, if the answer to the first question for each activity of daily living (ADL) about whether the person has any difficulty was "No," "Doesn't do for another reason," or "Don't Know," all of the rest of the questions about that ADL were skipped, and the interviewer started with the next ADL. The entries on the data tape for the subsequent questions relating to that ADL are blanks.

There are many other such examples. Questions about children were asked only if there were children. Questions about retirement were asked only if the person had ever worked. The questions in the section on Health Opinions in SOA Section T were asked only of self-respondents.

The number of the question that is the source of the data is on the public-use tape to make it easy to refer to the questionnaire for the specific question. However, if there was a question that determined whether the question of interest was asked, it is earlier on the questionnaire. Sometimes it is a checkbox that the interviewer marked on the basis of a much earlier question. It is advisable to search for such questions and checkboxes, especially if there appear to be many blank responses.

Preliminary analysis

Although the SOA was designed to make national estimates, much preliminary investigation can be done on the basis of the sample counts. The National Health Interview Survey is essentially a self-weighting survey;[49] there was no oversampling in 1984, and there was no subsampling on the SOA except for the half sample of people ages 55–64 years.

Preliminary, exploratory analysis at this stage has many advantages. There is a great deal of information on the SOA and many variables and possible combinations of variables. Computer programs for simultaneously examining a number of variables under the assumption of simple random sampling are widely available. Using these programs, the user can examine a lot of information, rank the variables in importance according to some predetermined, usually relaxed criterion, and retain only those which may statistically differentiate in later analysis.

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The preliminary analysis using sample counts also informs the user about the sample size in each cell; this information is essential for making decisions about the final analysis.

At this stage, estimates of the number of events have little meaning. Because of the recall periods used for some of the NHIS questions, the user must be extremely careful in interpreting data unless a weight is used. For example, 2-week recall questions are used to make estimates of the number of events during a 13-week quarter. The number of, say, contacts with a doctor in the past 2 weeks must be multiplied by 6.5 to produce that quarterly estimate and then summed over the four quarters to produce the annual estimate.

It can be seen from table I of appendix VI that, except at the extremes of the distribution, there is not much variation in the population weights among people ages 55–64 years or among people ages 65 years and over. Therefore, relationships among the variables relating to characteristics of persons can be investigated with a fair degree of certainty that those relationships will hold for the national estimates as long as there is a control for the half sample for ages 55–64 years. Because variance from a sample with a complex design are, on the average, larger than those for a simple random sample of the same size, relationships that are not significant at this stage are not likely to be significant when the complex design is taken into account.

Weighted analysis

Although most computer packages have an option for including weights, the user has to be careful to use the weight that is appropriate for each variable. The weights that are on the public-use data tapes were discussed in some detail previously in this section, and examples of their use are given in appendix VII. Using them is essential if the analyst wishes to make inferences about the population of the United States.

Analysts using standard computer packages and weighted data need to remember that most programs assume that the weighted population estimate is the sample size when they calculate the test statistics. Therefore, when weights are used, the statistical levels are no longer valid.

Final analysis

The final analysis should incorporate both the weights and the complex sample design. The weights are needed to make the point estimates for the population of inference. The complex sample design should be incorporated so that the statistical inferences will be appropriate.

More detailed discussion of these strategies for analyses can be found in Series 2, No. 92 and Series 1, No. 19 of *Vital and Health Statistics*.[49,50]

Chapter 5
Differences between data files from the 1984 NHIS Basic Questionnaire and the Supplement on Aging

Weights

The weights on the Supplement on Aging (SOA) files differ from those on tapes from the basic NHIS as discussed in chapter 4.

The SOA was poststratified to the National Health Interview Survey (NHIS) for the 16 cells (4 age $\times$ 2 sex $\times$ 2 race) used for poststratification of the NHIS. Therefore, population estimates for those 16 cells are the same except for rounding.

The weights for persons ages 65 and over are slightly larger on the SOA files than on the files from the basic questionnaire. The weights for persons ages 55–64 are slightly more than twice as large.

Respondents

NHIS basic respondent rule

The basic NHIS interview is conducted with an adult member of the household who is knowledgeable about the health of the household members. This individual is usually an adult female household member.

In addition to this basic respondent rule, the NHIS procedure allows for participation in the NHIS basic interview by other household members present at the time of the interview.

Generally, the NHIS basic interview is conducted with one individual as the household respondent.

The basic NHIS interview also has a reference person designated among the household members. This individual is one of the household members who owns or rents the dwelling unit. The reference person is designated primarily as the basis for enumerating household membership; relationships for household members are given in relation to the reference person.

In households where there was an SOA sample person, the basic NHIS information was collected from persons other than the SOA sample person in 17.1 percent of the interviews.

SOA respondent rule

For the SOA, self-response by the selected sample person was the respondent rule. The selected sample person was sought for interview by callback, if necessary. An attempt was made to interview the sample person alone; a suggestion was made that a second sample person might wish to leave and be interviewed after the first. Similarly, it was suggested that other household members might not wish to be present. However, the practical situation, particularly in SOA households with two or more eligible sample persons of older ages, was such that both sample persons were usually present during interviews.

The SOA response rule allowed for proxy response in those instances where sample persons were mentally or physically unable to respond for themselves or when the sample person was absent during the period of data collection. Of the SOA interviews, 8.5 percent were conducted with a proxy respondent. There was a difference in the percent who responded for themselves after the first quarter for the reasons discussed in chapter 3, Data collection. SOA data users should note that younger people and people without limitations in ADL's and IADL's were likely to answer the questions for themselves (table F).

A cross-classification of self-response and proxy response to the SOA by self-response and proxy response to the basic NHIS interview is shown in table G.

Conditions

Condition lists

In the NHIS, six condition lists (one for each body system) are printed on the questionnaire. One list of the six is used for each household. Therefore, the effective sample used to estimate the prevalence of chronic conditions is only one-sixth of the 42,000 households.

In contrast, only one list of chronic conditions was used in the SOA.

The condition list used for the SOA was a compilation of conditions from the six condition lists in the NHIS basic questionnaire that are most prevalent among people ages 55 year or over. The interviewer read the entire list aloud. The respondent had to answer whether or not the sample person had each condition on the list. This differed from the NHIS basic interview wherein only one of the six lists is administered in each household.

This use of one list should result in more reliable estimates of prevalence for persons ages 55 years and over from the SOA than from the NHIS basic data. It also yields the ability to investigate multiple conditions.

Conditions in the SOA, as in the NHIS basic questionnaire, were also derived from responses to questions in addition to those on the condition list, such as cause of trouble with the ADL's and IADL's.

Conditions on the condition file

Only conditions mentioned in response to questions on the SOA are on the SOA condition tape, with one exception. The exception is that conditions mentioned in response to limitation

Table F. Number and percent of self-responses to the Supplement on Aging and number of proxy responses, by selected demographic and health characteristics

Characteristic	Type of response			
	Total	Self-response	Proxy response	Self-response
	Number of interviews			Percent
Total	16,148	14,783	1,365	91.5
Quarter				
Jan.–Mar.	3,909	3,631	278	92.9
Apr.–June	4,129	3,792	337	91.8
July–Sept.	4,101	3,719	368	90.7
Oct.–Dec.	4,009	3,641	368	90.8
Age				
55–64 years.	4,651	4,284	367	92.1
65–74 years.	7,093	6,643	450	93.7
75–84 years.	3,578	3,250	328	90.8
85 years and over . . .	826	606	220	73.4
Sex				
Male	6,793	6,030	763	88.8
Female	9,355	8,753	602	93.6
Living arrangement				
Alone	4,289	4,206	83	98.1
With others	11,859	10,577	1,282	89.2
Number of ADL's[1] with difficulty				
0	12,893	12,159	824	93.7
1	1,317	1,187	130	90.1
2	646	553	93	85.6
3	403	343	60	85.1
4 or more	799	541	258	67.7
Receives help with 1 or more ADL's[1]				
0	14,853	13,901	952	93.6
1	526	430	96	81.7
2	255	178	77	69.8
3 or more	514	274	240	53.3
Number of IADL's[2] with difficulty				
0	12,360	11,622	738	94.0
1	2,113	1,964	149	92.9
2	586	522	64	89.1
3	325	261	64	80.3
4 or more	764	414	350	54.2
Receives help with 1 or more IADL's[2]				
0	13,040	12,270	770	94.1
1	1,689	1,557	132	92.2
2	484	417	67	86.2
3 or more	935	539	396	57.6

[1]Activities of daily living.
[2]Instrumental activities of daily living.

Table G. Number and percent of self-responses to the Supplement on Aging (SOA) and number of proxy responses, by type of response to the National Health Interview Survey (NHIS) basic questionnaire

Type of response to NHIS basic questionnaire	Type of response to SOA			
	Total	Self-response	Proxy response	Self-response
	Number of interviews			Percent
Total	16,148	14,783	1,365	91.5
Self	13,301	12,953	349	97.4
Entirely	12,296	12,066	230	98.1
Partly	1,005	887	118	88.3
Not recorded	86	61	25	70.9
Proxy.	2,761	1,769	992	64.1
Percent self-response	82.4	87.6	25.5	80.2
Entirely	76.1	81.6	16.8	74.7

on the SOA condition file. The user who wishes to use them will have to match to the basic NHIS questionnaire condition file.

A count of the number of acute conditions is on the SOA person file in tape locations 118–119. There will generally not be records on the SOA condition file for these conditions.

Family relationship and number of persons

Family relationship

There are two differences in the information about relationships in the SOA and the NHIS basic interview. These differences are:

- The relationships of household members in the SOA are relationships to the SOA sample person.
- The relationships in the SOA are relationships for *all* household members, not only family members of the SOA sample person.

In the NHIS basic interview, family membership and relationships are determined in relation to the reference person. As indicated previously, this individual is an adult member of the household who owns or rents the dwelling unit. Membership and relationship designations are listed only among those persons related by blood, marriage, or adoption. Members of the household who are not related to the reference person (individuals for whom a separate basic NHIS questionnaire is used) constitute a separate family group from those in the initial questionnaire. Consequently, the relationships of these individuals are determined in relation to the reference person in the second (or subsequent) family group.

In contrast, in the SOA the relationships of *all* household members are shown to the SOA sample person regardless of who owns or rents the dwelling unit (that is, the NHIS reference person). This relationship information in the SOA was obtained from the SOA respondent, who was usually the SOA sample person. All household members were listed and relationship to the SOA sample person indicated.

Because the family composition is determined in the NHIS basic interview in a way that could exclude possible household members who are closely associated with or even responsible for the SOA sample person, the SOA interview relisted family

of activity questions in the NHIS basic interview are also on the SOA condition file. As a result, almost all conditions on the SOA tape are chronic conditions. Acute conditions mentioned in response to NHIS basic questions about restriction of activity or physician visits within the previous 2 weeks are not

members, added unrelated household members to the list, and, consequently, showed relationships of all household members, both family and unrelated, to the SOA sample person.

Number of persons in the family

The number of persons in the family living in the household, the individual's marital status, and several other such items that can be derived from either the basic NHIS questions or SOA questions do not agree perfectly.

There are several reasons

- The NHIS is a survey of the civilian noninstitutionalized population. If a person listed as living in the household is found to be a member of the Armed Forces on active duty or currently in an institution such as a nursing home, that person is deleted from the NHIS basic household roster. On the basic NHIS, family size and family relationships are coded as if that person does not live in the household. On the SOA, where a much more extensive list of questions about relationships was asked, such a person was retained on the list of household members for relationship coding to the SOA sample persons; and relationships given are the respondents' answers. The codes to indicate relationship on the SOA were the same codes used for coding relationships in the basic NHIS.

- The respondents to the basic household interview and the SOA were not always the same person. A higher proportion of the respondents to the SOA were self-respondents. They could, and in some cases did, give different answers.
- Despite editing and verification, there are interviewer and coder errors on the NHIS. Most are caught and resolved; a few probably remain.

The differences in family size are small (only 2 percent of the person records differ, and almost all of those by only 1 percent), but the analyst should know that they exist and decide which to use. The decision may depend on the analysis of interest.

In general, it is believed that the SOA responses are more accurate. The SOA respondent may know about a marriage long ago that the basic NHIS household respondent did not know about. Conversely, an extremely old person answering the SOA could have been confused or misunderstood the question. This possibility was minimized by using proxy respondents.

For consistency with other data from the NHIS, the NCHS staff uses family size and whether the person was living alone as they are reported on the basic NHIS questionnaire. In any analysis, data from the basic questionnaire should be used for control variables if the analyst wishes to make comparison with other NHIS data.

Chapter 6
Prospective studies

The Supplement on Aging (SOA) was designed as a baseline study for the Longitudinal Study of Aging (LSOA). Specific information was included in the questionnaire to enable followup of the sample persons (appendix II). This included

- Questions asking for the name, address, and telephone number of a person who would know where the sample person would be in the future if the sample person was not available at the 1984 location.
- Questions that provided information necessary to perform matches with the National Death Index.

In addition, the sample persons were informed at the time of the 1984 interview of the intention to recontact them in the future.

NCHS is conducting the LSOA in conjunction with the National Institute on Aging. The study includes, in addition to the information secured from matches with the National Death Index, reinterviews with those sample persons, or their proxies, who were living in 1986 and will include those alive in 1988.

Followup through the National Death Index

The National Death Index (NDI) is a central, computerized index of death record information compiled from magnetic tapes submitted under contractual arrangements to the National Center for Health Statistics (NCHS) by the State vital statistics offices. These tapes (beginning with deaths occurring in 1979) contain a standard set of identifying data for each decedent. The data are used in searches of the NDI to identify and locate death records filed in the United States. The NDI enables investigators conducting statistical studies to determine if persons in their studies may have died; if so, the Index provides the names of the States where the deaths occurred, the corresponding death certificate numbers, and the dates of death. The NDI user can then make the necessary arrangements with the appropriate State offices to procure copies of death certificates or specific statistical information such as cause of death.[34]

The NDI is designed primarily to facilitate prospective studies in medical and health research by reducing the time, expense, and effort involved in State file searches. In the past, investigators conducting such studies have often found it necessary to contact all or most State vital statistics offices, asking each to search its files to see if a death record had been filed for any individual in the entire study group. Studies of this type are frequently very large, including thousands of subjects, because the risk under investigation may be small on a per individual

basis. Furthermore, State vital statistics offices cannot always promptly undertake large file searches because of staff limitations. The NDI provides a convenient computerized source for such searches.

Deaths included in the NDI file begin with those occurring in 1979. The data base management system in which the data are stored is updated annually. All State data for a given calendar year are received, processed, and added to the national file approximately 12 to 18 months after the end of the calendar year.

Through matching this file annually, the occurrence of deaths among the SOA sample people will be discovered. This information will provide an important update of the data available in the baseline study, enabling analyses of a number of variables from both the SOA and the NDI. For example, cause of death can be related to conditions and other health status information or to hospital stays or doctor visits indicated in the 12 months prior to the 1984 SOA interview.

The followup of the SOA sample through matching with the NDI will be an important aspect of the longitudinal data on the older population.

Other aspects of the Longitudinal Study of Aging

The initial followup of the LSOA is designed to provide critically needed information on the paths from health through functional disability to institutionalization and death by monitoring changes in living arrangements and functional capacity on a continuing basis. These two factors, living arrangements and functional status, have been identified as the prime risks for institutionalization. If intervention programs are to be designed to reduce institutionalization, the progression from independent living to that status must be studied.

The purpose of the Longitudinal Study of Aging is twofold

- To study changes in functional status and living arrangements with the hope of recognizing potential points for intervention to prevent institutionalization and provide alternative forms of care to extremely elderly people.
- To study length of life and death rates by characteristics of the population that are not reported on death certificates, such as education, whether living alone or with others, frequency of contact with family or friends, and other characteristics for which data were collected on the SOA.

During the initial followup in 1986, LSOA information was collected on current living arrangements and functional status and any changes in living arrangements (including institutionalization) and functional status since the previous interview for those people still living in the community. Death will be verified through matching the NDI.

The design of the LSOA consists of

- 'Advance mailing of letters explaining the study to sample persons ages 70 years and over at the time of the SOA.
- Telephone contact and interviewing in 1986 and in 1988 among those ages 70 years and over who are still living and who have telephone numbers or contact persons.
- Mail contact with a self-administered questionnaire in 1986 and 1988 among those ages 70 years and over who are still living and who do not have telephone numbers or contact persons.
- Matches of all SOA sample persons to the NDI for years 1984 through 1990.
- Matches of all SOA sample persons ages 65 years and over at the time of the SOA interview to medicare files to obtain information about hospital usage and cost data.

The LSOA will provide comprehensive data on the SOA sample, indicating changes over a 6-year period.

The number of SOA sample persons ages 70 years and over in 1984 and the number and percent selected for the LSOA reinterview are shown in table H.

Table H. Number and percent of persons in the Longitudinal Study of Aging (LSOA) 1986 initial followup reinterview sample, by age and race

Age and race	SOA[1]	LSOA	Percent in LSOA
	Number of sample persons		
Total	7,541	5,151	68.3
Age in 1984			
70–79 years	5,446	3,061	56.3
80 years and over	2,095	2,090	99.8
Race			
White	6,891	4,535	65.8
All other	650	616	94.8
Black	563	560	99.5
Other	87	56	64.4

[1]Supplement on Aging.

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