An Evaluation of the Social Security Administration Master Beneficiary Record File and the National Death Index In the Ascertainment of Vital Status

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Abstract: To evaluate the relative utility of the Social Security Administration and National Death Index as sources of mortality data, the vital status of 12,866 participants in the Multiple Risk Factor Intervention Trial was identified from these sources and compared to the known mortality experience. The SSA correctly identified 87.8 per cent of the 409 deaths that occurred between 1974 and 1980. Underreporting of deaths by the SSA occurred for participants with certain demographic characteristics, especially marital status. For the years 1979 and 1980, the period for which the SSA and NDI have comparable data, the SSA correctly identified 93.2 per cent and the NDI correctly identified 98.4 per cent of the 191 known deaths. The NDI matching process resulted in a large number of false positive matches. (*Am J Public Health* 1983; 73:1270–1274.)

Introduction

Several recent mortality studies have relied on the Social Security Administration (SSA) to identify deaths in the study population. In these studies SSA data were found to be over 90 per cent complete for white males, with varying degrees of underreporting for blacks, rural residents, residents of the southern part of the United States,[1] females, and persons below retirement age.[1,2]

The National Death Index (NDI) offers an alternative source for tracing deaths.[3] Only recently established, it currently covers the calendar years 1979 and 1980, with 1981 to be available during the first quarter of 1983. The degree of success achieved by initial users of the NDI has not yet been documented; however, preliminary data from a pilot study suggest that a search of the NDI, although demonstrating a promising degree of death coverage, results in a high ratio of false positive to true positive matches.*

A study is currently underway to ascertain from SSA data the vital status of 361,662 men who underwent an initial screening to determine eligibility for the Multiple Risk Factor Intervention Trial (MRFIT). In an effort to evaluate the completeness of follow-up achievable for this select population, the names of the 12,866 men who subsequently participated in the MRFIT were matched against the SSA and NDI files. The comparative performance and usefulness of the two data sources are documented below. The findings have methodologic importance to researchers considering the use of one or both of these methods of follow-up.

Methods

MRFIT

The MRFIT is a multi-center intervention trial for coronary heart disease. Men between the ages of 35 and 57 who were determined to be at increased risk for death from coronary heart disease and free of clinical evidence of heart disease were identified through three screening visits at 22 clinical centers throughout the US. At the end of the third screening visit, participants who consented to the trial were randomized into one of two groups. Details of the design and implementation of the MRFIT can be found elsewhere.[4,5]

The initial screening for the MRFIT was conducted between November 1973 and November 1975. Information collected at the first screen included: first and last name, address, Social Security number, date of birth, race, and whether the screenee had had a previous heart attack, was taking medication for diabetes, or was likely to move 50 miles from the clinical center. Blood pressure was measured, serum cholesterol concentration was determined, and the number of cigarettes smoked per day was recorded.

Of the 361,662 men seen at the primary screen, 12,866 men were subsequently randomized to the trial at the end of the third screening visit. Participants in the trial were closely followed through February 28, 1982. A detailed description of follow-up and mortality results through February 28, 1982 has been published elsewhere.[6]

The MRFIT data are characterized by a high degree of reliability. Each initial screening form was keyed at the clinical center and again at the Coordinating Center, virtually eliminating keying errors. A birth date was obtained for every participant; a Social Security number was obtained for all but five randomized participants. The Social Security number and birth date were ascertained at both the first and third screening visits, and were adjudicated, if possible, whenever discrepancies occurred between the two forms.

Social Security Administration

The data from the Social Security Administration were provided by the Office of Enumeration and Earnings Records. This information is available to researchers at the cost of duplicating the data. The data were taken from the Master Beneficiary Record (MBR), a file maintained by the SSA since 1962. The MBR contains a record for each person entitled to receive retirement, survivors, or disability insurance. Deaths that resulted in lump sum payments only have been recorded on the MBR since 1977, but are not on the MBR for the pre-1977 period.[7]

The data abstracted from the MBR consisted of a 26-character record for each deceased individual. The four data items on each record were: 1) a code indicating the source of the data; 2) the Social Security number; 3) the first 12

*Rogot E, *et al*: On the feasibility of linking Census samples to the National Death Index for epidemiologic studies. Presented at the 110th meeting of the American Public Health Association, Montreal, November 1982.

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characters of the last name of the beneficiary; and 4) the month and year of death. These data for the years 1962 through June 1981 (approximately 26 million records) were duplicated on magnetic tapes and supplied to the user at a cost of $1,015.63.

Three algorithms were employed to identify possible matches with the Social Security data: Social Security number alone; Social Security number and last name; and Social Security number and first two letters of last name. Deaths fitting these criteria and occurring between 1974 and 1980 were examined and compared with mortality data collected in the MRFIT as part of the routine follow-up.

National Death Index

The NDI is a computerized index of death records maintained by the National Center for Health Statistics (NCHS). The data are compiled from death certificates and are obtained under contractual agreements with the State Vital Statistics Offices. Requests for data from the NDI are subject to a review process to ensure that the subsequent use of the information conforms to NCHS confidentiality requirements. Information furnished by the NDI for each possible match consists of the name of the state where a death occurred, the corresponding death certificate number, and the date of death. In addition, an indication is given as to which identifying information supplied by the user matches the corresponding information on the NDI record. The NCHS does not release the NDI record of the person's name, Social Security number, or any other identifying information.

The current cost of using the NDI is $.10 for each user record submitted plus a $100 service charge. Applications for use of the NDI are reviewed quarterly.

The NCHS requires that the user's data be submitted on a magnetic tape conforming to NCHS coding and formatting specifications. The combination of first and last name and Social Security number or first and last name and month and year of birth must be furnished for each user record.[8] To identify a possible match, seven different algorithms are employed using various combinations of last name, first name, Social Security number, month and year of birth, and father's last name (for females). Three of these algorithms could be employed with the MRFIT data available: last name and Social Security number; first name and Social Security number; and month and year of birth and first and last names. Although not used in the search for a match, an indication is provided as to whether the user record matches the NDI record with respect to middle initial, day of birth, age at death, sex, race, marital status, state of residence, and state of birth. This information can be used to assess the quality of each match.

An additional feature of the NDI matching process is the use of a "soundex" system, whereby a name is considered a match if the spelling on the user record approximates the NDI version of the name.

When multiple matches are identified for a user record, the possible matches are printed in a hierarchical fashion, beginning with the record containing the highest number of matching data items. The NDI matching information may be returned to the user either as computer printout or, for large requests, a magnetic tape copy of the same report.

Results

A total of 409 deaths among MRFIT participants were identified between 1974 and 1980 through frequent contact with participants and their families; 191 of the deaths occurred during the years 1979 and 1980. A death certificate was obtained for each deceased participant. The vital status as of February 28, 1982 was confirmed for 99.8 per cent of the MRFIT participants. None of the 25 participants lost to follow-up was identified as deceased by either the NDI or SSA. These men are treated in the analyses as survivors through 1980.

TABLE 1—MRFIT Deaths Identified by Year from Social Security Administration Master Beneficiary Record File and National Death Index

Year of Death	No. of Deaths Occurred	No. of Deaths Identified by SSA (%)	No. of Deaths Identified by NDI (%)	No. of Deaths Identified by SSA & NDI (%)
1974	5	3 (60.0)	—	—
1975	24	15 (62.5)	—	—
1976	55	36 (65.5)	—	—
1977	58	53 (91.4)	—	—
1978	76	71 (93.4)	—	—
1979	83	78 (94.0)	81 (97.6)	76 (91.6)
1980	108	103 (95.4)	107 (99.1)	102 (94.4)
TOTAL	409	359	188	178

A search of the SSA data correctly identified 359 (87.8 per cent) of the 409 MRFIT deaths occurring through 1980. The percentage of deaths covered by the SSA data increased steadily from 60.0 per cent in 1974 to 95.4 per cent in 1980 (Table 1). A particularly large increase occurred between the years 1976 and 1977. The fact that lump sum payments were first included on the MBR in 1977 probably accounts for the difference between the 1976 and 1977 match rates. Deaths resulting in lump sum benefits comprise men who die before retirement and who are not survived by children living at home—a sizable proportion of the MRFIT deaths.

Of the 359 correct matches, 349 matched on last name as well as Social Security number. The remaining ten were found to have last name spelling errors on MRFIT forms (7) or SSA files (3). The date of death recorded by the SSA was found to be in error for four of the 359 men identified; two of these had an error recorded in both the year and month of death.

The SSA file search resulted in incorrectly identifying 18 men as deceased (less than 1 per cent of the 12,457 men who were alive through 1980). Of these 18 "false positives", only one matched on last name as well as Social Security number. This person was later identified as the deceased wife of the MRFIT participant in question. It has not been determined whether the participants who were erroneously identified as dead were recorded with an incorrect Social Security number on the SSA record or the MRFIT record.

The combination of Social Security number and first two letters of the last name was used as a simple algorithm to minimize the number of false positives while still identifying true deaths where a misspelling in the name had occurred. The algorithm worked well in this respect; 358 deaths were correctly identified (only one less than matching with the Social Security number alone) and one participant was incorrectly classified as deceased (the husband of the woman mentioned in the previous paragraph).

Table 2 presents some demographic characteristics of the MRFIT participants who died through 1980, and who were identified by the SSA search. There was a substantial difference between the identified deaths and the deaths missed by the SSA data search according to marital status,

TABLE 2—Demographic Characteristics of Deaths Identified Using the Social Security Administration Master Beneficiary Record File (1974–1980)

Characteristic	Total Deaths	Identified Deaths	Per Cent Identified
Age at Death (years)			
<50	117	105	89.7
50–59	256	219	85.5
≥60	36	35	97.2
Race			
White	369	323	87.5
Black	32	29	90.6
Oriental	2	2	100.0
Other	6	5	83.3
Education			
< High School	96	85	88.5
High School Graduate	220	190	86.4
College Graduate	91	82	90.1
Occupation			
Blue Collar	254	222	87.4
White Collar	151	134	88.7
Marital Status			
Married	346	309*	89.3
Not Married	60	47	78.3
Family Income ($)			
<15,000	142	128	90.1
≥15,000	255	220	86.3
Residence			
Large City or Suburb	254	223	87.8
Medium City	44	41	93.2
Town <25,000 Population	107	91	85.0
Region of US (Census Bureau)			
West	93	80	86.0
North Central	114	107	93.9
Northeast	136	118	86.8
South	66	54	81.8

*.01 < p < .05 Yates corrected chi-square.

with deaths among married men (89.3 per cent) identified more frequently than deaths among non-married men (78.3 per cent). This is not surprising, since married men would more likely be survived by family members eligible for Social Security benefits, and their deaths therefore reported more frequently to the SSA.

As was found in other studies, SSA records of deaths among the oldest MRFIT participants (60 or older) were more complete than among the younger men. Men who died in their fifties were least likely to be recorded on the MBR. It is likely that the age 50-59 subgroup accounts for the greatest proportion of lump sum benefits among MRFIT participants, since the members of this cohort, while below retirement age, are less likely to have school-age children than their younger counterparts.

Other studies have found underreporting for rural and southern residents; similar trends were evident here. In contrast to past studies, death coverage was similar for blacks and whites. Little difference in SSA death coverage was found when participants were classified by level of education, occupation, or income.

In Table 3, the number of known deaths correctly identified by the SSA and NDI are compared. Of the deaths occurring in 1979 and 1980, the period for which the SSA and NDI have comparable data, 100 per cent death coverage was achieved with the combination of the two sources. Using the SSA data alone, 181 of the 191 deaths (94.8 per cent) were identified and five false positives occurred for this two-year period.

Combining the results of the three possible matching algorithms, the NDI correctly identified 188 (98.4 per cent) of the deaths in 1979 and 1980. Only one matching algorithm, last name and Social Security number, is common to both the SSA and NDI. Using this algorithm, the NDI correctly identified 172 (90.1 per cent) deaths.

The NDI algorithm identifying the greatest number of deaths correctly was first and last name and month and year of birth. This process yielded 174 (91.1 per cent) correct matches. With the algorithm using first name and Social Security number, 168 (88.0 per cent) of the known deaths were identified.

Of the total 188 deaths identified by the combined NDI algorithms, two failed to match on the last name. Both discrepancies were found to be due to spelling errors on MRFIT forms. Of the remaining 186 matches, one was identified due to a soundex match on last name rather than a match on the exact spelling.

In contrast to the fairly comparable performance of the NDI and SSA with respect to total number of deaths correctly identified, the number of false positives that occurred differed greatly between the two sources (Table 4). The NDI search resulted in 612 false positive matches. Since multiple matches were possible for a given user record, this actually represented 492 MRFIT participants erroneously identified as deceased (3.9 per cent of the men who survived through 1980). The analyses of these mismatches are based on this number, using the first and therefore most probable match when multiple matches occurred.

Of the 492 false positive matches, two matched on first name and Social Security number; one matched on last name and Social Security number. (This match was determined to

TABLE 3—Comparative Results of the Social Security Administration and National Death Index Matching Algorithms: Identification of Known Deaths

	Matching Algorithm					
	SS No. Alone (%)	SS No. and First 2 Letters Last Name (%)	SS No. and Last Name (%)	SS No. and First Name (%)	First, Last Name and Mo/Yr Birth (%)	Total, all Matching Algorithms (%)
SSA 1973–1980 (N = 409)	359 (87.8)	358 (87.5)	349 (85.3)	N/A	N/A	359 (87.8)
SSA 1979–1980 (N = 191)	181 (94.8)	181 (94.8)	178 (93.2)	N/A	N/A	181 (94.8)
NDI 1979–1980 (N = 191)	N/A	N/A	172 (90.1)	168 (88.0)	174 (91.1)	188 (98.4)

TABLE 4—Comparative Results of the Social Security Administration and National Death Index Matching Algorithms: Number of False Positive Matches

	Matching Algorithm					
	SS No. Alone (%)	SS No. and First 2 Letters Last Name	SS No. and Last Name	SS No. and First Name	First, Last Name and Mo/Yr Birth	Total, All Matching Algorithms
SSA 1973–1980 (N = 12457)	18 (0.14)	1 (0.01)	1[a] (0.01)	N/A	N/A	18 (0.14)
SSA 1979–1980 (N = 12457)	5 (0.04)	0	0	N/A	N/A	5 (0.04)
NDI 1979–1980 (N = 12457)	N/A	N/A	1[a] (0.01)	2 (0.02)	490 (3.93)	492[b] (3.95)

a) Both false positives matching on last name and Social Security number were wives of MRFIT participants.
b) Restricted to the first and therefore most probable match when multiple matches occurred for one MRFIT record.

be the deceased wife of the MRFIT participant in question. This death also matched on first name* and accounted for one of the two incorrect matches on first name and Social Security number.) The remaining 490 false positives matched on first and last names and month and year of birth.

Several different methods were tested to reduce the number of NDI mismatches to a workable number. The false positives that matched on month and year of birth were examined for day of birth match. This eliminated 469 of 490 (95.7 per cent) false positives, while also eliminating three of the 174 (1.7 per cent) true matches identified through this algorithm. Eliminating last name soundex matches resulted in eliminating 279 (56.9 per cent) false positives and one (0.6 per cent) true match. A frequency distribution of the number of NDI data items matching MRFIT records shows that identifying records that match at least eight data items (11 were possible in this study) eliminates 463 (94.1 per cent) of the false positive matches and only one true match. Table 5 summarizes this analysis.

*The first name match was a soundex match on the name John. The soundex system ignores vowels and the letter "h," and considers the letters m and n to be equivalent. Thus, the name John would match the names Jim, Jane, Joan, Jean, June, Jaime, and Jan.

TABLE 5—Number and Per Cent of Matching Data Items for Deaths Identified by the National Death Index

No. Matching Data Items[a]	Correctly Identified Deaths (N = 188)		False Positive Matches (N = 492)	
	No.	Per Cent	No.	Per Cent
11	104[b]	55.3	0	0.0
10	159	84.6	0	0.0
9	183	97.3	0	0.0
8	187	99.5	29	5.9
7	188	100.0	271	55.1
6	188	100.0	438	89.0
5	188	100.0	489	99.4
4	188	100.0	492	100.0

a) Data items include Social Security number, last name, first name, middle initial, year of birth, month of birth, day of birth, marital status, sex, race, and state of last known residence.
b) Because the middle initial or marital status was unknown for some participants, 124 (65.9%) of the correctly identified deaths and none of the false positives matched on all data items submitted to the NDI.

Discussion

The SSA and NDI produced similar results in regard to completeness of death ascertainment for the years 1979 and 1980. However, there are substantial differences in usefulness and efficiency. The specific requirements and resources of a study should be considered when choosing one of these sources for mortality follow-up.

Searching the SSA Master Beneficiary Record (MBR) is an inexpensive method of acquiring vital status data for large-scale studies with computer facilities. Death coverage for middle-aged males is good for deaths occurring since 1976, and, with the exception of marital status, does not vary substantially by demographic characteristics. Few false positives occur relative to the number of deaths correctly identified. The SSA data base is updated monthly, and the information provided to researchers includes deaths occurring up to six months before the request is processed.

For research projects such as the MRFIT, which experienced deaths in a pre-retirement study population, the MBR is not an adequate source of mortality data for the time period prior to 1977.

No identifying characteristics other than the last name, Social Security number, and date of death are furnished from the MBR file. This renders Social Security numbers essential for any matching algorithm. Moreover, since no indication is given as to the place of death, death certificates for the identified matches are not easily located.

A Death Master File is currently being developed by the SSA which will pool death data from a variety of files. Since data will be extracted from an earnings history file (which contains lump sum payment deaths) as well as the MBR, the reporting of younger decedents should be improved. The Death Master File will also contain additional identifying information, such as first name, date of birth, and state of last known residence.

The NDI is the obvious source of vital status information for researchers who do not have access to Social Security numbers, or who have incomplete reporting of Social Security numbers. The completeness and accuracy of death reporting are very good. A high match rate can be achieved if the researcher can provide enough information to satisfy the criteria for multiple matching algorithms. The death certificate number and state of death are provided for each possible match, facilitating the location of death certificates.

Several features of the NDI make it especially well suited for small-scale studies. Since the service is priced on a per-record basis, the cost is low for a small number of cases. Computer facilities are not essential to process the data, since the search is done by the NCHS and the user can request that the results be returned in the format of a very readable printed report.

The greatest deterrent to the use of the NDI for mortality follow-up is the large number of false positives that occur for each correctly identified death—a 5:2 ratio for this data set. The typical user can verify vital status only by obtaining each death certificate listed by the NDI. This renders vital status verification a very time-consuming and costly process.

A lengthy time period exists between the occurrence of deaths and the availability to researchers of these data on the NDI. The 1980 mortality data were not available until March 1982, a delay of 15 months. Although this time lag may decrease as the NDI becomes more firmly established, it is doubtful that the NDI can ever be maintained as current as SSA files.

The soundex system was of limited value in this study. It identified only one of three misspellings in the last name among true deaths while adding 280 false positives. Since the NCHS does not release the NDI version of any data item, there is no way to evaluate how similar a soundex match is to the user record spelling of a name. It is likely that the soundex system would be of greater benefit to researchers who anticipate a high frequency of misspelled names in their data set. The NCHS is currently evaluating the effectiveness of the soundex system and the algorithms used in identifying a possible match.

The development of a probabilistic method to eliminate the high proportion of false positives seems essential when using the NDI as a source of mortality data. A simple but effective means of accomplishing this is to identify records containing a minimum number of matching data items, when additional data such as sex, race, and marital status can be furnished by the user. Examining NDI records which matched at least eight of 11 possible data items resulted in overlooking only one (0.5 per cent) true death while eliminating 463 (94.1 per cent) of the 492 false positives.

The Association for Vital Records and Health Statistics, a national organization of vital registrars and health statisticians, is attempting to establish a national data bank of death certificate information. If implemented, this data bank will provide an additional source of vital status ascertainment.

In summary, it must be pointed out that the MRFIT participants represent a highly selected population. Besides being restricted to middle-aged males at elevated risk of heart disease, the men differ from the general population in other ways which may affect SSA or NDI coverage. For example, the fact that much of the screening for the trial was carried out in industrial populations resulted in a very high employment rate among MRFIT participants. This may account for the generally high SSA coverage rates obtained with this data set, particularly among blacks. MRFIT participants tend to be health-oriented, geographically stable individuals. To what extent the results of this investigation apply to the general US population is not known.

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