

- Weinstein A, Meenan RF, Guttadauria M, Kaplan SB, Klippel J: Comparison of auranofin, gold sodium thiomalate and placebo in the treatment of rheumatoid arthritis: a controlled clinical trial. *Arthritis Rheum* 1983; 26:1303-1315.
10. Sherrer YS, Block DA, Mitchell DM, Young DY, Fries JF: The development of disability in rheumatoid arthritis. *Arthritis Rheum* 1986; 29:494-500.
11. Sherrer YS, Block DA, Mitchell DM, Roth SH, Wolfe F, Fries JF: Disability in rheumatoid arthritis: Comparison of prognostic factors across three populations: *J Rheumatol* 1987; 14:705-709.
12. Pincus T, Callahan LF: Formal education as a marker for increased mortality and morbidity in rheumatoid arthritis. *J Chronic Dis* 1985; 38:973.

Selection of Elderly Controls Using Random Digit Dialing

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Abstract: The experience of identifying and soliciting elderly male controls, using a nonclustered random digit dialing procedure in a case-control study, is presented. For elderly controls (ages 65-84) 3.5 times more residential telephone numbers were required than for controls encompassing a much broader age range (ages 40-84). This is a function of the proportion of elderly in the population and their lower response to telephone identification. Elderly controls, age 70 and older, also had lower participation rates. (*Am J Public Health* 1988; 78:1487-1488.)

Introduction

The results from random digit dialing varies among studies for many reasons including the sampling frame used, type of location (urban vs rural), geographical area of the country, age and sex of respondents, method of converting initial telephone screening refusals, and number, placement and degree of sensitive questions to determine eligibility.¹⁻⁹ The number of telephone numbers required to obtain controls in pediatric case-control studies has been reported.^{8,9} The elderly have the highest proportion of telephone numbers of any age group in the United States.⁷ However, the effort required to screen for elderly male controls using random digit dialing compared to younger adult males has not been reported. In this paper we present our experience with a random digit dialing procedure to solicit adult males.

Methods

This was a case-control study to explore dietary factors of potential etiologic significance in the occurrence of pancreatic cancer. Cases were ascertained from death certificates because one year survival is less than 15 per cent.¹⁰ Controls, defined as living White males, ages 40-84, who resided in the seven-county Minneapolis-St. Paul metropolitan area, were frequency matched to cases and ascertained by random digit dialing. The interview was conducted with the control's wife (or other relative) since a surrogate was used to obtain information for the cases.

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Initially, cases were divided into five-year age groups so that a similar number of controls could be obtained thus ensuring reasonable comparability on age. An attempt was made to select controls from similar geographic locations within the study area by incorporating the three digit prefix of the cases' telephone numbers into the random digit dialing procedure. The remaining four digits were randomly generated. For each case an initial list of 25 telephone numbers was available. These numbers were called in order and resolved (ineligible, refusal, etc.) before the next number on the list was solicited. Each telephone number was called up to nine times and the calls were evenly distributed among mornings, afternoons, and evenings and weekdays and weekends. If there was no contact after nine calls, the interviewer proceeded to the next telephone number.

An additional variation on random digit dialing was to check each telephone number in a reverse street directory to determine if the number represented a residence or commercial establishment. If a residence, a name was obtained so that the caller could properly address the respondent rather than having to solicit this information as part of the call.

At the initial call information was requested as to whether any males ages 40-84 resided in the household. If there was, a letter was sent which requested their participation. If not, the next number was called until an eligible, willing participant was ascertained. Residences that refused to provide screening information and eligible controls who refused to participate were contacted up to two additional times with letters and follow-up telephone calls. Because of the greater percentage of younger (ages 40-64) men in the population, this group was completed sooner than the older age groups (ages 65-84). Therefore, the age criterion during the enrollment period changed from 40-84 to 65-84. Results from the random digit dialing are presented according to the age groups screened: the initially screened broader age group (40-84) and the narrower, more elderly age group (65-84).

Results

Altogether there were 19,640 telephone calls made to determine the status of 8,936 telephone numbers used in the study (Table 1). The percentage of all telephone numbers called that were residences was similar between the broader age group (52.2 per cent) and the narrower, more elderly age group (55.6 per cent). The mean number of residential telephone numbers required to ascertain a control was 10.3 for the broader age and 34.3 for the more elderly age group. There was a higher percentage of residences that refused to provide the screening information using the broader age screen (6.7 per cent) than the more elderly age screen (5.0 per cent). On average, it took 5.5 hours to identify an eligible control. The following are the percentages (in parentheses) of

TABLE 1—Random Digit Dialing Results

| Outcome | Age Group Screened | | |
|---|--------------------|------------|------------|
| | 40-84 | 65-84 | Total |
| Total number of telephone calls needed to determine outcome | 9,230 | 10,460 | 19,690 |
| Total individual telephone numbers dialed | 4,173 | 4,763 | 8,936 |
| Numbers dialed: | | | |
| Non-working numbers | 1,474 | 1,512 | 2,986 |
| Non-residential numbers | 513 | 613 | 1,126 |
| Residential numbers | 2,186 | 2,638 | 4,824 |
| Ineligible residences | 1,828 | 2,429 | 4,257 |
| Number of refusals and eligibles: | | | |
| Number of residences which initially refused to provide screening information | 260 (11.9)* | 282 (10.7) | 542 (11.2) |
| Number of initially refused residences which never provided screening information | 146 (6.7) | 132 (5.0) | 278 (5.8) |
| Number of eligible residences identified | 212# (9.7) | 77 (2.9) | 289 (6.0) |
| Mean number of telephone numbers per identified eligible residence | 19.7 | 61.9 | 30.9 |
| Mean number of residential telephone numbers per identified eligible residence | 10.3 | 34.3 | 16.7 |

*Percentage of residential numbers in parentheses.
#Fifty-seven per cent were less than 65 years of age.

eligible controls who agreed to participate in the study: less than 60 years of age (80.2), ages 60-64 (82.2), 65-69 (92.6), 70-74 (72.7), 75 and older (69.5).

Discussion

This study demonstrated the greater difficulty in ascertaining only elderly male controls using a non-cluster random digit dialing technique. The non-cluster random digit dialing method has been discussed as straightforward and unbiased³ although it will contain more telephone numbers that belong to nonresidences than does Waksberg's two-stage cluster method.⁹

Approximately 3.5 times as many residences were contacted in order to identify an eligible elderly control compared to a control from the broader age group. Because of the study design, we were unable to analyze separately the elderly controls ascertained through the use of the broader age range criterion. In spite of this limitation, the present study does illustrate the greater difficulty in identifying and soliciting elderly (ages 65-84) controls using random digit dialing. This is probably a function of the lower proportion of elderly in the population and their lower response to telephone identification.⁷ Unfortunately, random digit dialing does not allow for the characterization of those who refuse to provide screening information.

Conceivably, if a cluster random digit dialing procedure was used, it could have reduced the number of calls needed to find the controls. However, there would still have been many more telephone calls necessary to obtain elderly controls. Eligible elderly controls age 70 and older also had a lower study participation rate.

The experience from this study suggests that random digit dialing may not be the most efficient method to identify and solicit elderly controls. An alternative method for soliciting controls among the elderly is through the Health Care Financing Administration which has been used successfully in case-control studies.¹² However, to use these records, the study must be federally funded.

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REFERENCES

1. Glasser GJ, Metzger GD: Random digit dialing as a method of telephone sampling. *J Market Res* 1972; 9:59-64.
2. Tull DS, Albaum GS: Bias in random digit dialed surveys. *Public Opinion Q* 1977; 41:389-395.
3. Kviz F: Random digit dialing and sample bias. *Public Opinion Q* 1978; 42:544-546.
4. Leuthold DA, Scheele R: Patterns of bias in samples based on telephone directories. *Public Opinion Q* 1971; 35:249-257.
5. Hartge P, Brinton LA, Rosenthal JF, Cahill JI, et al: Random digit dialing in selecting a population-based control group. *Am J Epidemiol* 1984; 120:825-833.
6. Harlow BL, Hartge P: Telephone household screening and interviewing. *Am J Epidemiol* 1983; 117:632-633.
7. Thornberry OT, Massey JT: Coverage and response rates in random digit dialed national surveys. *Proc Am Stat Assoc* 1983; 654-659.
8. Robison LL, Daigle A: Control selection using random digit dialing for cases of childhood cancer. *Am J Epidemiol* 1984; 120:164-166.
9. Ward EM, Kramer S, Meadows AT: The efficacy of random digit dialing in selecting matched controls for a case-control study of pediatric cancer. *Am J Epidemiol* 1984; 120:582-591.
10. Ries LG, Pollack ES, Young JL: Cancer patient survival: Surveillance, Epidemiology, and End-Results Program, 1973-79. *JNCI* 1983; 70:693-707.
11. Waksberg J: Sampling methods for random digit dialing. *J Am Stat Assoc* 1978; 73:40-46.
12. McLaughlin JK, Blot WJ, Mandel JS, Schuman LM, et al: A population based case-control study of renal cell carcinoma. *JNCI* 1984; 72:275-284.