Reported Participation in Case-Control Studies: Changes over Time

Sara H. Olson

There is concern that participation in case-control studies has declined. To address this question, the author and colleagues reviewed data from 82 US and Canadian case-control studies published in epidemiologic journals during two periods: 1988–1990 and 1997–January 1999. The median year of data collection, which ranged from 1972 to 1996, was the primary independent variable. Reported response among both cases and controls remained constant over this time period. The regression coefficients ($\beta$) were small: For each year, there was a change of 0.15 percentage points for cases ($p = 0.56$) and −0.16 percentage points for controls ($p = 0.54$). Possible confounders included the location where the study had been conducted and, for cases, the disease under study (cancer vs. others). After adjustment for these factors in case groups, there was still no association between year of data collection and response: For each year, there was a change of −0.20 percentage points ($p = 0.43$). After adjustment of results for study location among controls, there was a moderate decline over time: For each year, there was a change of −0.44 percentage points ($p = 0.12$). Overall, reported response in more recent studies was similar to that in earlier studies; for control groups, this may reflect changes in locations where the studies were conducted. *Am J Epidemiol* 2001;154:574–81.

case-control studies; data collection; epidemiologic methods

The proportion of eligible subjects who agree to take part in a case-control study is of continuing concern to epidemiologists, because low participation raises the possibility of selection bias. There is a general concern that participation has declined in recent years, both in epidemiologic studies (1, 2) and in other types of surveys (3, 4). Societal factors, such as increased numbers of households in which all adults are employed, increased marketing by telephone and targeted mailings, and the availability of devices (such as answering machines and caller identification services) that can be used to screen telephone calls, make a decline in participation seem likely. The purpose of this study was to examine reported response in case-control studies over time in order to address the hypothesis that response has declined.

**MATERIALS AND METHODS**

In 1992, as part of a study on response bias among controls selected by random digit dialing (5), my colleagues and I reviewed response in studies published in the *American Journal of Epidemiology* between 1988 and 1990. We recently updated this information with studies published between January 1997 and January 1999 in the *American Journal of Epidemiology, Epidemiology,* and *Cancer Epidemiology, Biomarkers and Prevention.* The two additional journals, which began publication in 1990 and 1991, respectively, were included because they have become important journals for the presentation of findings from this type of study. For both time periods, a case-control study was included if: 1) the study had been conducted in the United States or Canada; 2) information had been obtained from interviews conducted in person or on the telephone; 3) controls had not undergone a clinical examination before being approached; 4) participants had been contacted specifically for that study; 5) the study contained at least 50 cases; and 6) response was reported separately for cases and controls. Data were obtained from 82 studies. We were able to include data on cases from all studies and data on controls from 69 of the studies. The studies analyzed included 38 published in 1988–1990 and 44 published in 1997–1999. The latter group included 24 studies from the *American Journal of Epidemiology,* 11 from *Cancer Epidemiology, Biomarkers and Prevention,* and nine from *Epidemiology.* The median year of data collection ranged from 1972 to 1996.

References 6–93 were used as sources of data for this analysis; for some studies, more than one source was used. A table providing details on the studies, including the disease under consideration, the sources of cases and controls, the median year of data collection, and the percentages of cases and controls who participated, is available on the *Journal*'s website (www.jhsphs.edu/Publications/JEPI/olson.htm).

The outcome variable—the proportion of potential participants who responded—is not always easily determined from information provided in published reports (94). Most of the studies included here reported proportions of cases and controls interviewed among those who were eligible or
reported data from which this could be calculated. Other studies (7, 8, 29, 36, 78, 80, 84) reported response for cases and/or controls based on the number of persons “contacted.” It was not possible to recalculate the proportion who responded among those eligible in these studies, either because there were insufficient data to do so or because there was no clear definition of eligibility. We conducted our analyses both with and without the inclusion of such studies. Since no differences were found, results are presented with those studies included. Several studies used more than one source of controls. For some of them, an overall response proportion was provided, while for others (9, 13, 18, 40, 56, 60, 75), we calculated weighted averages of the results from each source.

For studies using random digit dialing to locate controls, calculation of the proportion who respond should take account of response to both the initial screening telephone call and the subsequent interview (94, 95). For the 21 studies that used only random digit dialing to locate eligible controls, we combined information from both phases of control selection, although for some of these studies we calculated this from the data given. For studies that used random digit dialing in combination with other sources of controls, we used the proportion provided in the published paper; however, it was often unclear whether the overall response reported included both phases of random digit dialing (14, 24, 25, 39, 47, 56, 58, 69, 74, 78). We repeated the analyses leaving out those studies, but since there was no change in the results, the studies were included. We also examined separately responses in the telephone screening phase of random digit dialing for the 28 studies that reported this. This included all of the studies that used random digit dialing alone except one (38), plus eight other studies that used random digit dialing in combination with other methods (9, 13, 24, 40, 58, 60, 75, 83).

The primary independent variable was the median year of data collection for each study. Most studies reported the period in which data collection took place, while some reported only the period in which eligible cases were diagnosed. We calculated the median date from the period of data collection whenever possible. When the median fell between two calendar years, we used the lower year plus “.5.”

Case groups were classified as population-based or hospital-based. There were 53 studies using population-based cases, 26 using hospital-based cases, and three (72, 74, 78) that used other sources (health maintenance organizations or combinations of sources). Note that the distinction is not always clear, since many studies that are population-based identify cases at hospitals and check them against registries, and some studies designated as hospital-based may include a very large proportion of cases in a given geographic area. Case groups were classified as “population-based” if they were so described by the authors or if it was clear that all incident cases in a geographic area were eligible.

Various sources of controls were used in these studies. The main sources were random digit dialing (n = 21) and hospitals (n = 11). Thirty-seven studies used other sources of controls, including lists of driver’s license holders, Health Care Financing Administration beneficiaries, town residents, and birth certificates, as well as neighborhood controls. Many studies used combinations of sources.

We used regression analyses to characterize the association between the median year of data collection for each study (the independent variable) and the proportion of persons who responded (the outcome measure). We carried out separate univariate regression analyses for cases in all studies, for controls in all studies, and for subgroups of cases and controls from different sources.

We considered several factors that might be related to response and that might have varied over time in this group of studies. For cases and controls, these included the age and gender of study participants, the number of study participants, and the location where the study had been conducted. For cases, other factors included the disease being studied, whether the study included interviews with proxy respondents, and whether deceased cases were considered eligible. We used multivariate regression analyses to adjust for possible confounders, separately for cases and controls.

RESULTS

Figures 1 and 2 show, for cases and controls, respectively, plots of the reported response according to median year of data collection. No trend over time is apparent for either cases or controls. The mean percentage of persons who participated, from all studies, was 76.1 percent (standard deviation 11.9) for cases and 71.5 percent (standard deviation 11.5) for controls. The range was the same for both cases and controls: from 40 percent to 97 percent.

Table 1 shows the mean percentages of persons who participated, for case and control groups in total and according to source(s) of cases and controls, and the association between median year of data collection and participation. The beta coefficients were obtained from univariate regression analyses carried out separately for each group of cases and controls shown. For case groups in all studies, there was a change of 0.15 percentage points (95 percent confidence interval CI): –0.34, 0.63) in reported participation for each year (p = 0.56); for control groups, there was a change of –0.16 percentage points (95 percent CI: –0.68, 0.35) for each year (p = 0.54). For cases and controls from various sources, there was little apparent trend over time, except for controls from hospitals, for which there was a decline of 1.68 percentage points (95 percent CI: –3.54, 0.18) per year (p = 0.07).

Table 2 shows response for cases and controls according to study characteristics that might be related to response. For case groups, the proportion who participated was 8.1 percentage points lower for studies of cancer than for studies of other diseases (p < 0.01). For both cases and controls, the location of the study influenced response: Studies conducted in California had the highest mean proportion participating, followed by the state of Washington, while participation in New York State was lower, although differences are likely to have been due to chance because of the small sample sizes. For controls, larger studies (with greater numbers of subjects) had, on average, higher response, with a difference of...
7.4 percentage points ($p < 0.05$) between the largest and smallest studies. For the other measures, differences were small and probably reflect chance variation. There were no differences in response among either cases or controls by journal (data not shown).

Both the diseases that were studied and the places where the studies were conducted changed over time; therefore, these two factors might have been confounders of the relation between year of data collection and response. Recent studies were more likely to be studies of diseases other than cancer. The studies from New York tended to have been conducted earlier than those from California (1973–1989 compared with 1984–1994), while those from Washington were intermediate (1978–1992).

We used multiple regression analysis to further examine the relation between year of data collection and response, with separate models for cases and controls (table 3). For cases, the change in reported response was $-0.20$ percentage points (95 percent CI: $-0.71, 0.31$) per year after adjustment for the cases' disease and study location ($p = 0.43$). For controls, the change in reported response was $-0.44$ percentage points (95 percent CI: $-1.00, 0.12$) per year after adjustment for location ($p = 0.12$). The addition of other variables included in table 2 did not change these results (data not shown).
We examined changes in response over time among controls in 13 studies conducted by the Weiss/Daling Studies unit at the Fred Hutchinson Cancer Research Center (Seattle, Washington) (L. Voigt, Fred Hutchinson Cancer Research Center, personal communication, 2000). These studies were all conducted in the same location, western Washington State, using the same methodology. In these studies, random digit dialing was used to screen for eligible controls, and in-person interviews were conducted. The median year of data collection ranged from 1989 to 1996. The mean overall percentage of persons who participated was 71.5 percent (94.6 percent for the screening phase of random digit dialing and 75.5 percent for the subsequent interview). We used regression models to characterize the relation between time and response, with separate models for overall response, response in the screening phase of random digit dialing, and response in the subsequent interview phase. Overall response changed little over the time period: –0.23 percentage points (95 percent CI: –2.08, 1.62) per year \( (p = 0.79) \). Response in the screening phase declined over time \( (β = –0.32, 95 \text{ percent CI: } –0.08, –0.55; p = 0.01) \), although it was greater than 92 percent in all studies. There was no change in response to subsequent interviews \( (β = 0.01, 95 \text{ percent CI: } –1.86, 1.88; p = 0.99) \).

**DISCUSSION**

These results indicate that, overall, there has been little change in reported response among cases or controls in recent years. For cases, there was no association between time and response, even after consideration of possible confounding variables. For control groups, for which societal factors would be expected to play a larger role, there was a moderate decline after adjustment for location. If study locations had not changed over time, there would have been a decline of approximately half a percentage point per year in the proportion of controls participating. Data obtained from the Fred Hutchinson Cancer Research Center, where the population studied, methods of contacting potential controls, and methods of calculating response have remained the same, also support the conclusion that there has been little change in overall response over time.

It is not clear why results should differ between California and New York State. Residents of these states are probably similar in terms of socioeconomic status and some aspects of lifestyle. The number of studies from either of these states was too small to allow for conclusions regarding other factors that might have affected response.

Other studies examining changes in response over time have had mixed results. Gorey and Trevisan (2) reported a decline in response in 21 studies of the prevalence of hypertension carried out between 1960 and 1991, with an average of 86 percent participating in the years before 1975 as compared with 69 percent in later years. In South Carolina, Oldendick and Link (96) reported a decline in participation in public-opinion telephone surveys on various issues, from approximately 73 percent in 1990 to 67 percent in 1999. A recent paper by Stang et al. (97), summarizing response in population-based control groups in Germany, found no decline between 1987 and 1995. Groves and Couper (3) examined response trends over time in several large-scale continuing studies, such as the Current Population Survey, the National Crime Survey, the National Health Interview Survey, and the National Election Studies. They concluded that there was an overall trend toward lower participation in recent years but that this result varied among the studies.

**TABLE 1. Mean percentages of persons participating and associations between percentage participating and median year of data collection in a study of response reported from 1972 to 1996**

<table>
<thead>
<tr>
<th>Percentage participating</th>
<th>Regression coefficient (β)</th>
<th>95% confidence interval</th>
<th>( p ) value</th>
<th>No. of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases in all studies†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population-based</td>
<td>76.1</td>
<td>11.9</td>
<td>0.15</td>
<td>–0.34, 0.63</td>
</tr>
<tr>
<td>Hospital-based</td>
<td>75.0</td>
<td>11.6</td>
<td>0.17</td>
<td>–0.39, 0.74</td>
</tr>
<tr>
<td>Controls in all studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random digit dialing</td>
<td></td>
<td></td>
<td>–0.05</td>
<td>–1.25, 1.14</td>
</tr>
<tr>
<td>Overall response‡</td>
<td>71.5</td>
<td>11.5</td>
<td>–0.16</td>
<td>–0.68, 0.35</td>
</tr>
<tr>
<td>Response to telephone screening phase§</td>
<td>67.0</td>
<td>8.8</td>
<td>0.46</td>
<td>–0.34, 1.27</td>
</tr>
<tr>
<td>Hospital</td>
<td>88.0</td>
<td>6.8</td>
<td>0.37</td>
<td>–0.13, 0.86</td>
</tr>
<tr>
<td>All other sources¶</td>
<td>72.6</td>
<td>12.2</td>
<td>–0.20</td>
<td>–0.89, 0.48</td>
</tr>
</tbody>
</table>

* SD, standard deviation.
† Includes three studies with sources of cases other than population-based or hospital-based cases.
‡ Includes results of both the telephone screening phase and the subsequent interview in studies that used only random digit dialing to locate controls.
§ Includes all studies using random digit dialing that provided information on response to telephone screening.
¶ Other sources of controls include lists (e.g., lists of town residents, birth certificates), neighborhoods, random digit dialing plus Health Care Financing Administration data, driver’s licenses plus Health Care Financing Administration data, and other combinations of sources.
TABLE 2. Mean percentages of persons participating according to factors that might affect participation in a study of response reported from 1972 to 1996

<table>
<thead>
<tr>
<th>Age (years) of oldest subjects‡</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>≤50</td>
<td>78.3</td>
<td>13.6</td>
<td>15</td>
<td>69.6</td>
</tr>
<tr>
<td>≤75</td>
<td>77.4</td>
<td>7.2</td>
<td>28</td>
<td>72.1</td>
</tr>
<tr>
<td>&gt;75</td>
<td>73.9</td>
<td>14.5</td>
<td>34</td>
<td>71.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender of subjects</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Women only</td>
<td>73.9</td>
<td>10.8</td>
<td>39</td>
<td>71.1</td>
</tr>
<tr>
<td>Men only</td>
<td>78.5</td>
<td>15.9</td>
<td>11</td>
<td>73.4</td>
</tr>
<tr>
<td>Both</td>
<td>77.8</td>
<td>11.6</td>
<td>32</td>
<td>71.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size of study§</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>74.1</td>
<td>14.7</td>
<td>27</td>
<td>67.9*</td>
</tr>
<tr>
<td>Medium</td>
<td>76.1</td>
<td>12.1</td>
<td>28</td>
<td>71.3</td>
</tr>
<tr>
<td>Large</td>
<td>78.0</td>
<td>8.0</td>
<td>27</td>
<td>75.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location of study</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>80.1</td>
<td>7.7</td>
<td>9</td>
<td>74.1</td>
</tr>
<tr>
<td>Washington State</td>
<td>74.6</td>
<td>10.4</td>
<td>13</td>
<td>71.3</td>
</tr>
<tr>
<td>New York State</td>
<td>65.7</td>
<td>20.9</td>
<td>6</td>
<td>63.8</td>
</tr>
<tr>
<td>Other states or provinces</td>
<td>75.0</td>
<td>11.7</td>
<td>31</td>
<td>70.1</td>
</tr>
<tr>
<td>More than one state or province</td>
<td>79.4</td>
<td>10.2</td>
<td>23</td>
<td>74.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cases’ disease</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>73.9**</td>
<td>11.9</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>82.0</td>
<td>9.9</td>
<td>22</td>
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<table>
<thead>
<tr>
<th>Deceased cases considered eligible</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>74.5</td>
<td>12.3</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>79.7</td>
<td>8.8</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Not stated</td>
<td>76.4</td>
<td>13.0</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proxies used for cases</th>
<th>Cases</th>
<th></th>
<th>Controls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>79.1</td>
<td>9.6</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Parents used</td>
<td>79.8</td>
<td>9.7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>73.6</td>
<td>13.0</td>
<td>47</td>
<td></td>
</tr>
</tbody>
</table>

* p < 0.05 for studies with large numbers of controls versus those with small numbers of controls; **p < 0.01.
† SD, standard deviation.
‡ Excludes five studies that did not report ages of subjects. Studies in which parents were interviewed were included in the youngest age category.
§ Divided into tertiles separately for cases and controls. For cases, small studies had 85–277 subjects; medium, 279–538; and large, 540–6,888. For controls, small studies had 76–391 subjects; medium, 399–844; and large, 899–9,341.

TABLE 3. Unadjusted and adjusted associations between percentages of persons participating and median year of data collection in case and control groups in a study of response reported from 1972 to 1996

<table>
<thead>
<tr>
<th>Regression coefficient (β) for median year of data collection</th>
<th>Case groups</th>
<th></th>
<th>Control groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>β</td>
<td>95% confidence interval</td>
<td>p value</td>
<td>β</td>
</tr>
<tr>
<td>Unadjusted</td>
<td>0.15</td>
<td>–0.34, 0.63</td>
<td>0.56</td>
<td>–0.16</td>
</tr>
<tr>
<td>Adjusted*</td>
<td>–0.20</td>
<td>–0.71, 0.31</td>
<td>0.43</td>
<td>–0.44</td>
</tr>
</tbody>
</table>

* The model for case groups was adjusted for location and disease; the model for control groups was adjusted for location. Variables were entered as defined in table 3.
Limitations of this analysis include the relatively small number of studies, particularly for analysis of subgroups. There are other journals regularly publishing results of case-control studies that we did not include. Publication bias may have led to the exclusion from our report of studies for which response was lower. In addition, studies that were excluded because response was not reported may have had lower response than those studies included. Summarizing data on response from published reports is difficult because of inconsistencies in how response is reported and calculated. However, results were unchanged when we repeated our analyses after excluding studies that calculated response based on persons contacted rather than those eligible and studies for which it was not clear whether response included the screening phase of random digit dialing.

It may be that epidemiologists have gained experience in conducting case-control studies that has led to maintenance of response in spite of societal changes. This may be reflected in the changes in study localities to places with higher response and the higher levels of response for studies with the largest numbers of controls. Efforts to locate hard-to-reach potential respondents or to persuade them to take part, perhaps through the use of financial incentives, may have increased over the years. For example, Ezzati-Rice et al. (98) reported that several special efforts were made to increase response in the Third National Health and Nutrition Examination Survey, and Moorman et al. (99) reported improved response when interviewers and potential cases and controls were concordant with regard to race.

Another consideration in interpreting these results is that methods of calculating and reporting response may have changed over time. Slattery et al. (94) identified several ways of defining response and showed that large differences can be found using different methods. A survey of epidemiologists in that report found little consistency in how response was calculated and general agreement that gaining cooperation was more difficult than it had been in the past. Epidemiologists may feel pressured to report favorable response to make papers more likely to be published and to obtain funding for future projects.

Response to surveys is affected by both societal factors beyond the control of investigators and study-specific factors that can be controlled to some extent. A forum for exchange of information on factors possibly related to participation that can be controlled by investigators (100) would eventually lead to higher-quality studies. It is not possible to address the issue of participation in case-control studies without an understanding of the magnitude of the problem and its sources. A consistent and complete method of reporting response in case-control studies would help investigators identify the extent and nature of problems with nonresponse.

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REFERENCES


