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# The Future of Random-Digit-Dial Surveys for Injury Prevention and Violence Research

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**Abstract:** A central issue facing injury prevention research today is how to collect self-reported data on injury and violence from a geographically dispersed public, quickly, cost effectively, and with a reasonable degree of confidence in the quality of the results. Questions about eroding frame coverage, declining participation rates, and increasing potential for bias have raised doubts about the long-term viability of random-digit-dial (RDD) telephone surveys for injury prevention research. So where does the future lie? The four articles in this volume, as well as other research, point down two paths: (1) continued reliance on RDD, or (2) adoption of alternative survey designs. Continued use of RDD methodology will require additional research in the areas of response rate improvement, techniques for enhancing post-survey adjustments, and cost-effective approaches to nonresponse bias analysis. Moving away from a strict reliance on RDD methodology, injury prevention research could adopt mixed-mode approaches (such as combining telephone, mail, and web-based surveys) or make use of address-based sampling frames as a method for reaching sample members currently missed by most RDD approaches. Either way, the future of collecting self-reports of injury and injury prevention data will be more complex and require considerable resources.

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## Introduction

The use of random-digit-dial (RDD) telephone surveys for collection of information on injury prevention and violence is at a crossroads. At issue is how to collect self-reported data on injury and violence, especially sensitive questions, from a geographically dispersed public—quickly, cost effectively, and with a reasonable degree of confidence in the quality of the results, given that many of the standard approaches to data collection are facing serious obstacles. While RDD telephone surveys have served as the primary vehicle for collecting public health information over the past three decades, questions about declining sample frame integrity and falling rates of participation, as well as concerns about bias, raise doubts about the long-term viability of this approach for injury-prevention research.

The reliability and validity of survey estimates depends on minimizing potential data biases. Nonresponse bias, which is a function of both the level of nonresponse and differences between survey participants and nonparticipants on measures of interest, is

viewed as a significant and growing problem in the survey industry.<sup>1,2</sup> Response rates in many household surveys, including two of the largest sources of information on injury and violence—the Behavioral Risk Factor Surveillance System (BRFSS) and the National Crime Victimization Survey (NCVS)—have been declining over time, spurring researchers to explore techniques for increasing survey participation.<sup>3,4</sup> However, when response rate boosting measures are used indiscriminately, the problem of nonresponse error may actually be exacerbated by improving participation in some groups but not others. As a result, such measures may actually increase the distinctions between participants and nonparticipants, thereby increasing the potential for nonresponse bias.<sup>2,5</sup>

Additionally, the nature of nonresponse in RDD studies is changing, becoming less a function of active refusals and more a mix of refusals and numbers where no one is ever reached.<sup>1</sup> The proliferation of call screening devices (e.g., telephone answering machines, caller ID, and privacy managers), advances in personal telephone services (such as cellular telephones, handheld computers, and telephone number portability), and a growing concern over personal privacy have combined to increase the likelihood that a telephone number dialed for a survey is less likely to be answered today compared to the past. Therefore, finding techniques that will improve participation without inadvertently increasing survey bias is a considerable challenge.

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So where does the future lead? The featured theme articles<sup>6-11</sup> in this volume, as well as other research, point down two paths: (1) continued reliance on RDD telephone surveys, or (2) adoption of alternative sampling frames and modes of data collection. If RDD methodology is to remain viable, continued research is essential for developing ways of improving participation rates, methods for post-survey adjustment, and assessment of the validity of estimates. First, methods for improving participation include the use of incentives<sup>8</sup> and improving interviewer training.<sup>10</sup> Research on pre-notification techniques and cultural and language barriers to survey participation are also needed. Second, more work is required on post-survey adjustments to refine the techniques used to ensure that the survey samples properly reflect the population of interest. In addition to standard adjustments, newer techniques should be considered such as adjusting for households with no telephone service, cell phone-only households, and potential early cooperators bias. Furthermore, cost-effective ways of conducting nonresponse bias analysis are needed, such as the approach proposed by Johnson et al.<sup>9</sup>

Alternatively, moving away from a strict reliance on RDD telephone surveys, mixed-mode approaches using combinations of methods (e.g., telephone, mail, and web-based surveys) could be adopted for data collection. As Galesic et al.<sup>7</sup> highlight, there is considerable research on the use of alternative modes, but little work on how modes might be combined to reach and encourage a broader set of respondents to participate. More recent research has examined the use of address-based sampling frames rather than RDD as a method for sampling survey participants.<sup>12-14</sup> Databases such as those available from the U.S. Postal Service (USPS) offer exciting new possibilities for reaching sample members currently missed by most RDD approaches. We consider how these different streams of research might shape the way in which information on injury and violence-related topics is collected.

### **Continued Improvement of RDD Telephone Surveys**

Some studies suggest that low response rates may not necessarily affect survey estimates. For example, reports have demonstrated that for response rates in the 40% to 70% range, the level of nonresponse bias does not appear to change significantly.<sup>4,15</sup> Lacking sufficient theories capable of predicting when high nonresponse rates imply nonresponse bias and when they do not, however, many researchers have taken a cautious approach and continued to seek ways of improving survey participation. This strategy assumes that as response rates increase, the potential for nonresponse bias decreases. This could occur as a result of either reducing the size of the nonresponding group or interviewing a more diverse and representative sample of respon-

dents. Research on maximizing response rates has tended to focus on operational characteristics of survey designs that are within the researcher's ability to control. These include the use of incentive payments, better training of interviewers, use of pre-notification techniques, and better understanding of the cultural and language barriers involved.

### **Incentives**

As discussed by Singer and Bossarte,<sup>8</sup> survey methodologists and practitioners have long recommended that incentives be considered for surveys that target respondents who are difficult to reach.<sup>16,17</sup> Pre-paid incentives are often more effective in improving survey participation than are contingent or promised incentives.<sup>18,19</sup> Use of pre-paid incentives is somewhat problematic with RDD surveys, however, as addresses are typically available for only 40% to 60% of the potentially eligible sample, depending on the type of address-matching strategy employed. Offering incentives to only a particular subgroup (those with identifiable addresses) has the potential to increase differential nonresponse bias, given that characteristics of those with publicly identifiable addresses are often different from those for which addresses cannot be identified.<sup>20</sup>

Moreover, the interviewing context for studies focused on injury and violence is sometimes much different from that of surveys on other topics. Not only is there disclosure of highly personal information, but there may also be risk of physical harm from a violent partner if participation in the survey is revealed. There is also the practical consideration of how to get incentives into the hands of respondents without putting them at risk. Incentives, whether monetary or nonmonetary, often have to be mailed, thereby increasing the potential for harm to some respondents if a violent household member opens the mailed package. Although this does not preclude the use of incentives, it does mean that implementation needs to be considered carefully, including how to convey the offer and how the person will receive the incentive. Understanding the potential effects of incentives in surveys on injury and violence could be improved by research efforts that (1) delineate the role incentives play in the decision to participate in surveys of sensitive topics such as firearm ownership and storage, drinking and driving, child supervision, and exposure to interpersonal violence or the perpetration of violence; and (2) identify the types of incentives and delivery mechanisms that are most effective in improving response but minimizing potential harm to the respondent.

### **Role of Interviewers**

Interviewers vary greatly in their skills and abilities to persuade sample members to participate in a survey. As

O'Brien summarizes,<sup>10</sup> survey participation is thought to be driven primarily by the social environment of the sample member, the sociopsychological attributes of the respondent, the survey design, and interviewer attributes and skills. Increasing the likelihood of a successful interview in any survey requires that interviewers be trained in what they need to say, how to convey the information (e.g., tone of voice, pace of speech, attitude projected), and how to listen effectively to what is said, what is not said, and any other cues given by the respondent during the interview.

Surveys on sensitive topics and violence require stronger interviewing skills than those required for typical interviewing, including better understanding of the subject matter, ready familiarity with potential resources to offer the sample member when appropriate, the ability to quickly and efficiently respond to subtle cues that the respondent may be feeling unsafe, handling refusal cases in a more sensitive manner, and finding ways for interviewers to debrief or talk about potentially upsetting experiences without revealing confidential information. To acquire flexible and effective approaches to gaining respondent cooperation, new as well as experienced interviewers require a learning environment that realistically simulates the experiences that they are likely to have during an actual interview.<sup>21</sup> Repetitive practice in a constructive learning environment can give interviewers more effective decision-making skills and greater confidence during telephone surveys, which can help minimize the amount of on-the-job learning that is necessary. In the survey world, on-the-job learning by new interviewers can result in numerous unsuccessful interview attempts at the start of a study, leading to lower response rates, mid-interview break-offs, lower quality data, delayed schedules, and increased costs.

Additional research is needed to improve understanding of (1) how sample members and interviewers interact over the telephone during surveys on sensitive topics, (2) the methods that are most successful for helping interviewers learn the particular skills required to conduct such interviews, and (3) the most effective ways of allowing interviewers to practice and hone these skills before fielding the survey.

### **Survey Pre-Notification**

Evidence is growing that the use of advance letters in telephone surveys can improve response rates.<sup>20,22,23</sup> However, their effectiveness can be variable, influenced by factors such as topic sensitivity and survey sponsorship.<sup>24–27</sup> The utility of advance letters is also limited by the availability of addresses for sample members. As with incentives, use of advance letters with only the subset of RDD cases with identifiable addresses may increase the potential for nonresponse bias to the degree that differential response increases differences

between respondents and nonrespondents on issues of importance in the survey.

Furthermore, use of advance letters may be problematic for studies of sensitive topics. If the subject matter is particularly sensitive and the letter sufficiently detailed, participation rates could actually decrease. Inappropriate use of advance letters may also place some sample members at risk, particularly if they are victims of intimate partner violence and the violent partner sees the letter. Understanding in this area could be improved by studies that delineate (1) the conditions under which advance letters should and should not be used in injury-related surveys, (2) the most effective means of conveying the sensitive content of the survey without negatively impacting participation, and (3) the effectiveness of advance letters across a range of injury-related topics.

### **Reaching Racial and Ethnic Minority Populations**

The proportion of racial and ethnic minority members who participate in RDD surveys is often lower than the proportion in the overall U.S. population. Reasons for these lower rates may include disproportionate mistrust of the government and research community, cultural barriers, lower rates of literacy and understanding of health issues, high mobility patterns, suboptimal data-collection procedures, and the limited number of languages in which surveys are typically offered.<sup>28–35</sup> There has been considerable growth over the past two decades in the percentage of U.S. residents who speak primarily a language other than English. According to the 2000 census, 47.0 million (18%) of the 262.4 million people aged 5 years or older spoke a language other than English at home.<sup>36</sup> “Linguistic isolation” is defined by the U.S. Census as living in a household in which all members aged 14 years and older speak a non-English language and also speak English less than “very well.”<sup>37</sup> In 2000, approximately 4.5% of the U.S. population could be considered linguistically isolated, with this percentage varying across different ethnic subgroups.<sup>36</sup> Because most telephone surveys are typically conducted in English only, language isolation leads to nonresponse among people who do not speak English. Offering surveys in English and Spanish, however, can reduce to less than 2% the percentage of the U.S. population who would not be able to respond solely due to language.

Injury researchers need to develop survey designs that better address the increasingly complex racial, ethnic, and linguistic mix of the U.S. population. A U.S. Department of Health and Human Services report recommended that “culturally and linguistically appropriate interviewing techniques need to be employed at all times when conducting surveys on racial and ethnic issues.”<sup>38</sup> Researchers need to be cognizant of the customs, values, and beliefs of persons in minority

communities, particularly as they relate to the sharing of personal information, including healthcare practices and health conditions. Researchers also need to consider increasing the number of languages in which a survey is offered, especially in communities where language isolation is high. Moreover, it is important to ensure that the translated questions are culturally equivalent in terms of coherence and appropriateness. Unfortunately these steps are often not easy to implement and can require considerable resources. There is a dearth of research on these issues, particularly as they relate to injury, violence, and other sensitive topics. Some topics, such as sex and violence, may be viewed quite differently across different racial/ethnic communities making cross-cultural comparisons difficult. This is, therefore, fertile ground for injury-prevention research.

### Post-Survey Adjustments and Bias Assessments

In conjunction with survey design features and operational considerations, researchers typically use a host of backend adjustments to minimize potential bias due to noncoverage and nonresponse. Additionally, nonresponse bias analyses are increasingly being used to quantify the level of nonresponse bias in estimates.

#### Post-Survey Adjustments

Most surveys conducted today use a variety of methods to improve the relationship between sample and population distributions, thereby reducing the potential for bias in survey estimates. These adjustments typically focus on reducing potential bias due to under-coverage of the population, particularly if under-coverage is greater in some subgroups of the population than others (e.g., younger adults, racial/ethnic minorities) or to nonresponse by selected sample members. Such adjustments often include the following:

**Base sampling weights.** These weights adjust for the probabilities of selection at both the household and individual level, and typically include adjustments to account for (1) the number of telephone numbers in the sampling frame represented by the sampled number, (2) multiple telephone lines in a household, and (3) within-household selection probabilities in households with multiple eligible respondents.

**Interview nonresponse adjustment.** The base sampling weights are adjusted to more accurately reflect the number of eligible sample members in the target population that each respondent with a completed interview represents.

**Post-stratification to known population totals.** Further adjustment is made to ensure that sample totals equal some external total based on the target population for

characteristics most closely related to the outcome variables of interest.

Because small sample sizes can restrict the utility of post-stratification, other newer adjustment techniques are being used with greater frequency, such as raking (i.e., sample balancing). Raking typically involves proportional adjustment of survey weights to the marginals of one or more control totals and can help reduce nonresponse and noncoverage bias as well as sample variability.<sup>39</sup> The utility for injury research is that raking can be conducted using known distributions of the population for variables more directly related to the topic of interest, provided that similar information is collected from the survey respondents. Ideally, raking should be conducted on variables that exhibit a close association with outcome variables or are strongly related to nonresponse or noncoverage. There are also potential drawbacks, however, if these adjustments increase sample variability by increasing the variability of the final weights. If the larger weights are not capped or trimmed, the sample variance estimates may become quite large.

Other forms of adjustment are also being explored. One is an adjustment for telephone service interruption, intended to help account for the fact that RDD surveys do not reach households without telephones.<sup>40</sup> The adjustment assumes that respondents who experience temporary interruption in telephone service are similar in characteristics and behaviors to those with no telephone service. Researchers have also suggested a similar approach for making adjustments for cell phone-only households, that is, households with a cell phone but no landline telephone.<sup>41</sup> Another approach uses level of effort (typically the number of calls made to a number) to adjust for "early cooperators bias," that is, the potential for those who respond early in a survey to differ significantly on variables of interest from those who respond later in the survey or not at all.<sup>42</sup>

Post-survey adjustments need to be applied with care. For example, in instances where the factors driving nonresponse are correlated with a given survey measure, adjustments may actually increase differential nonresponse bias. More thorough investigation is needed for how these and other approaches might be effectively applied to injury research to ensure the validity and accuracy of estimates produced.

#### Nonresponse Bias Analyses

Analyses of nonresponse bias are increasingly being used to evaluate the quality of survey data.<sup>43</sup> Such analyses typically involve one or more of the following:

- Examination of response rates. While the level of nonresponse does not necessarily translate to bias, large differences in the response rates of subgroups can serve as indicators that potential biases may exist. The approach is limited in that it typically does

not deal with nonresponse adjustments made to reduce the bias, and response rates can be calculated only for those subgroups where the subgroup characteristics are known for both the respondents and nonrespondents.

- Comparison of sample and frame estimates. Sample estimates from survey respondents are compared to the population values computed from the sampling frame. The strength of this approach is that any differences are due solely to sampling and nonresponse error. However, only variables on the sampling frame, such as geographic distribution for RDD surveys, can be used in such comparisons.
- Comparison with external data sources. Survey estimates can also be compared with estimates from other surveys with similar items. Although large differences may indicate potential bias, differences cannot be solely attributed to nonresponse bias because there are many other possible sources of the differences (e.g., coverage disparities, differing field periods, differences in question wording, and context effects).

Increasing nonresponse has made bias analysis an essential component of the research process. As Johnson et al.<sup>9</sup> point out, surveys estimating injury-control risk factors are often particularly vulnerable to nonresponse error, making adjustment and assessment of such error a necessary practice. As bias analyses become more widely used, newer, more refined techniques will likely be established to aid in this effort.

### Moving Beyond RDD

Given the growing number of issues facing RDD survey approaches, it is imperative that researchers explore alternative designs for collecting self-reported information. These designs could include use of alternative or mixed-mode surveys, new frames (e.g., address based) from which to sample potential respondents, or both.

### Mixed Modes

Web surveys and more traditional mail surveys are increasingly being viewed as possible alternatives or complements to telephone data collection. The use of alternative modes may extend the reach of a survey by encouraging participation across a broader mix of the population.<sup>44,45</sup> As Galesic et al.<sup>7</sup> point out, however, using or combining various approaches to data collection has its drawbacks. Varying modes of data collection can produce varying results even when identical questions are asked of the same persons.<sup>44–47</sup> Computer-assisted interviewing can also affect survey responses when compared with noncomputerized methods, particularly within a self-administered setting.<sup>48</sup> Additionally, there may be analytic difficulties that arise from combining data from different modes, particularly if

estimates from the two modes do not agree. In these cases the analyst may have to adjust for over- or under-reporting in a given mode when providing aggregate estimates.

For injury research, multiple modes may be beneficial in some instances, but detrimental in others. The cost-effective mode alternatives to telephone surveys are often self-administered surveys conducted either via mail or web surveys. Because self-administered surveys tend to give higher reports of sensitive behaviors, use of these approaches may actually improve data quality, particularly for surveys on topics such as sexual behavior, perpetration of violence, firearm ownership and storage, drug use, drinking and driving, and child supervision.<sup>49,50</sup> For surveys on topics such as intimate partner violence, however, both mail and web surveys could be problematic. As mentioned earlier, correspondence with a sample participant via the mail may be compromised if the partner opens or sees the mail package. Likewise, a partner may become suspicious if the sample participant is spending a prolonged time on the computer. The partner may have spyware installed on the computer that would capture the information entered by the sample member, potentially increasing her or his risk of harm. Considerable research is still required to determine when, how, and in what combinations these alternative modes might best be used for these types of studies.

### Alternative Sampling Frames

Over the past decade, the integrity of RDD sampling frames has increasingly been called into question. RDD sampling frames have always excluded the portion of the population (approximately 1.7%) who have no type of telephone in their household.<sup>51</sup> Additionally, many survey organizations have adopted “list-assisted” RDD sampling approaches, which exclude telephone numbers (approximately 3% to 4% of all households) in “zero blocks”—that is, banks of 100 telephone numbers with no directory-listed households.<sup>52</sup>

Noncoverage problems have been further exacerbated with the increased use of cellular telephones. Data collected January through June 2005 as part of the National Health Interview Survey study found that approximately 6.7% of households used cell phones only, with this percentage expected to increase over time.<sup>51</sup> Moreover, the demographic characteristics of persons in cell phone-only households differ significantly from those in households with landlines with the former being more likely to live with a roommate, to rent their home, and to be younger (aged 18 to 24 years). Because most RDD samples are typically drawn from area code-exchange combinations assumed to be land-line numbers (including mixed-use exchanges), most cell phone-only households are excluded from RDD sampling frames. A dual-frame approach using

separate frames of landline and cell phone exchanges is one potential solution to the problem of cell phone-only households. While a few studies have been conducted using this approach, the design has a number of obstacles including the inefficiency of the cell-phone sample frame and lack of "gold standard" data for appropriate weighting and post-survey adjustments.<sup>53</sup> When we consider all sources of under-coverage in RDD frames (i.e., households with no telephones, those in zero blocks, and cell phone-only households), the percentage of U.S. households not covered by RDD frames may be as high as 9% to 11%.

Moreover, the geographic specificity of numbers in RDD sampling frames is being eroded with the advent of number portability, whereby people can choose to port their land-line telephone number to a cell phone or vice versa.<sup>54</sup> This allows individuals, within certain limits, to take their number from one geographic area to another; however, from an RDD sampling perspective, the number would remain in its original area code-exchange bank. There is similar concern with the growth of voice-over Internet protocol (VoIP) as a communication medium. While many users of VoIP telephones are accessible using standard RDD methods, a small but growing number are using VoIP for long-distance communications whereby the telephone number may be assigned to one geographic area, but the call terminates at a household outside of that area.

In response to these growing RDD frame integrity issues, researchers are testing new frames from which to sample respondents to develop good-quality, efficient, cost-effective household survey designs. The growth of database technology has allowed for the development and maintenance of large computerized address databases that may provide survey researchers with an inexpensive alternative to RDD for drawing household samples. One potential alternative is the Delivery Sequence File (DSF) used by the USPS. The DSF is a computerized file that contains all delivery-point addresses serviced by the USPS, with the exception of general delivery.<sup>12</sup> The file is readily accessible from most third-party survey sample vendors. The standardized format of the frame also facilitates geocoding of addresses and linkage to other external data sources such as the Census ZIP code tabulation areas (ZCTA) data. These data can then be used to stratify the frame for sampling of target populations.

Initial evaluations of the DSF as a means of reducing the costs associated with enumeration of households in area probability surveys have proven promising.<sup>55,56</sup> The studies show that for a survey of the general population, the DSF offers potential coverage of 97% of the households in the United States, thereby providing a cost-effective and timely sampling frame. Recently, the DSF was used as a sampling frame for a BRFSS pilot study, which found that with three mailings (an initial questionnaire, postcard follow-up, and follow-up ques-

tionnaire mailing), the response rates obtained ranged from 40% to 50%.<sup>12-14</sup> The approach was successful in reaching both cell phone-only households and households with no reported telephone service. Respondents to the mail survey tended to be older and more educated than those interviewed in the RDD version of BRFSS; however, there tended to be relatively few differences in the estimates obtained when the mail and telephone surveys were compared.<sup>14</sup> While use of the DSF appears promising despite some potential limitations, its utility as a sampling frame for conducting surveys on sensitive topics has yet to be examined.

## Conclusion

The future direction of data collection for injury and violence prevention research is unclear. What is certain, however, is that the telephone as a mode of contacting sample members will continue to be a mainstay of survey research efforts for the foreseeable future, even if RDD designs are replaced or augmented. Research on sensitive topics via the telephone, however, will have to be conducted with greater care and forethought to maximize the potential of tools such as incentives and advance letters, while minimizing potential risks. These studies often face additional burdens, including greater training and skill requirements for interviewers and limitations on the types of external information available for making more sophisticated post-survey adjustments. Research in this area would be best served by a multipronged approach. Researchers need to work under the assumptions that RDD surveys will continue to be conducted and that these surveys will benefit from additional research on how to improve participation while simultaneously reducing the potential risks to sample members. In parallel, however, continued research and testing of potential alternative designs are essential for paving the way for future data collection efforts in this area.

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