



The efficacy of respondent-driven sampling for the health assessment of minority populations



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ABSTRACT

Background: Respondent driven sampling (RDS) is a relatively new network sampling technique typically employed for hard-to-reach populations. Like snowball sampling, initial respondents or “seeds” recruit additional respondents from their network of friends. Under certain assumptions, the method promises to produce a sample independent from the biases that may have been introduced by the non-random choice of “seeds.” We conducted a survey on health communication in Guam’s general population using the RDS method, the first survey that has utilized this methodology in Guam. It was conducted in hopes of identifying a cost-efficient non-probability sampling strategy that could generate reasonable population estimates for both minority and general populations.

Methods: RDS data was collected in Guam in 2013 (n = 511) and population estimates were compared with 2012 BRFSS data (n = 2031) and the 2010 census data. The estimates were calculated using the unweighted RDS sample and the weighted sample using RDS inference methods and compared with known population characteristics.

Results: The sample size was reached in 23 days, providing evidence that the RDS method is a viable, cost-effective data collection method, which can provide reasonable population estimates. However, the results also suggest that the RDS inference methods used to reduce bias, based on self-reported estimates of network sizes, may not always work. Caution is needed when interpreting RDS study findings.

Conclusions: For a more diverse sample, data collection should not be conducted in just one location. Fewer questions about network estimates should be asked, and more careful consideration should be given to the kind of incentives offered to participants.

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1. Introduction

Despite overall health improvement, significant health disparities persist in minority populations [1]. Efforts to reduce these disparities are hindered by a lack of good surveillance data. Obtaining probability samples representing various minority populations through the preferred method of random digit dialing (RDD) is not only cost-prohibitive, but also ineffective in reaching

many minority groups. Widely used for national surveillance studies such as the Behavioral Risk Factor Surveillance Survey (BRFSS), RDD is impractical for populations of small size (hidden populations), which do not have a proper sampling frame [3].

The lack of scientific surveillance data has serious consequences. It makes designing effective programs for underserved populations nearly impossible and limits government or private funding opportunities for health programs and interventions. Thus, a cost-effective means of obtaining reliable data for minority populations is essential.

In this study we propose respondent-driven sampling (RDS) as an efficient, cost-saving alternative to RDD. Using data collected

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with the RDS method in Guam, we compare the resulting data with the BRFSS data collected by RDD.

1.1. Background

Guam's multiethnic population offers a unique opportunity to learn about the health information needs and practices of Americans of Pacific Island ancestry, a largely underserved and underrepresented segment of the national population. A United States territory in the western Pacific with an area of 212 square miles and a population over 170,000 as of 2016, Guam is composed of numerous cultural groups and languages [4] including Chamorros, Filipinos, and other Pacific Islanders. Good data on Americans of Pacific Islander ancestry (API), which critical for developing effective health campaigns, establishing baseline information, measuring the impact of these campaigns, and comparing local with national and international patterns in health behaviors, is very limited. This makes Guam's population ideal for testing the respondent-driven sampling (RDS) methodology, since RDS targets hard-to-reach or hidden populations.

Data which provide a more precise and culturally accurate picture of the community is important for developing more effective cancer prevention and control programs that are tailored to the target population. While API comprise only 4% of the U.S. population, it is one of the fastest-growing groups in America (2010 U.S. Census). Yet, there is limited data on API, among whom the incidence of certain cancers and certain noncommunicable diseases (NCDs) are higher than the national average [5,6]. Moreover, the labels for the distinct groups which fall under the API umbrella term continue to evolve in national data. The terms "Guamanian" and "Samoan" were only included with "Hawaiian" on U.S. census forms since 1980.

Data for Guam is further complicated by the presence of citizens from the Federated States of Micronesia (FSM), who can live and work in U.S. territory by virtue of the Compact of Free Association (COFA) with the United States. In the 2010 Census, 10% of the Guam population were FSM residents, while another 9.4% reported that they were "mixed." Given these population complexities in Guam and its diverse cultural and linguistic backgrounds, acquiring a good probability sample of Guam residents poses unique challenges in terms of cost [2]. Consequently, communication interventions designed to address health disparities may be based on no data or data which do not capture an accurate picture of the target population.

Since it is substantially cheaper than probability sampling methods such as RDD, if RDS can successfully generate a sample that is statistically representative of the various ethnic groups in Guam, it will be a significant step in satisfying the needs for good

health data. We intend to investigate if RDS method can produce stable estimates for key health outcomes comparable to those from BRFSS data collected through the more expensive RDD method.

1.2. Respondent-driven sampling

Respondent-driven sampling (RDS) is a fairly new form of chain referral sampling developed by Douglas Heckathorn [3,7], which uses chain-referrals that progress through a series of recruitment waves until equilibrium (when composition of the ultimate sample is independent of the initial sample) is reached. This advanced method of sampling combines "snowball sampling" with the employment of mathematical modeling, stochastic Markov chain modeling, that weights the sample to compensate for the non-random sample collection.

RDS differs from snowball sampling, in several important ways. First, while snowball sampling only gives incentives for participation, RDS has a dual incentive system: for participating as well as for recruiting others into the study. Second, RDS asks subjects to actually recruit their peers into the study, compared to simply identifying them. This helps in two ways: individuals who might be reluctant to give a researcher the name of a peer might, nonetheless, recruit that peer. In addition, people, who might refuse to participate when approached by a researcher, will agree to a peer's invitation. This system creates larger personal networks to recruit from, instead of relying on subjects with smaller networks. However, the limit placed on the number of recruits, typically three per individual, ensures that recruitment is not biased by reliance on a few individuals who are more effective recruiters. Most importantly, RDS can produce unbiased population estimates, unlike snowball sampling. It does so by taking into the account that study participants were not recruited randomly and uses statistical weights based on the participants' network size (i.e., the number of people that the participants know who would be eligible for the study) and recruitment patterns (who recruited whom). As recruitment continues across waves, equilibrium that results in a sample independent of the characteristics of the initial seeds can be attained.

In this study, the RDS recruiting method was used among members of Guam's general population to assess if this method can be used to obtain a statistically representative population based sample comparable to that obtained through RDD.

2. Materials and methods

Data used for this study were collected during a period of twenty-three (23 days) from February 1 to March 6, 2013 by the Guam Cancer Research Center. All adults (18+ years old) from the

Table 1
Seeds' Characteristics.

Seed Number	Age	Gender	Ethnicity	Village	Reported Network size (N3)	Number of recruits	Number of waves	Total number of recruits
1	36	Female	Palauan	Mangilao	5	3	8	132
2	58	Male	Pohnpeian	Talofoto	2	1	4	11
3	39	Female	Chamorro	Talofoto	500	1	3	11
4	21	Female	Chuukese	Mangilao	20	3	2	7
5	24	Male	Filipino	Barrigada	30	3	13	259
6	47	Female	Filipino	Dededo	20	1	1	1
7	23	Female	Chamorro	Yona	10	0	0	0
8	23	Female	Filipino	Yigo	8	0	0	0
9	57	Male	Filipino	Yigo	15	3	8	68
10	61	Male	Filipino	Merizo	10	0	0	0
11	63	Male	Chamorro	Dededo	5	1	2	2
12	28	Male	Chamorro	Yona	30	1	1	1
13	37	Female	Chamorro	Yona	10	1	1	3
14	55	Female	Chamorro	Agana Heights	5	1	1	2

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