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ORIGINAL ARTICLE

Using risk factor surveillance as a basis for mixed-methodology research: an example from Australia using food intake and anthropometric measures

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Abstract
Objectives Risk factor surveillance is an integral part of public health, and can provide a ready-made sample for further research. This study assessed the utility of mixed-methodology research using telephone and postal surveys.
Methods Adult respondents to telephone surveys in South Australia and Western Australia were recruited to a postal survey about food consumption, in particular, relating to fruit and vegetables. Responses to the two surveys were compared.
Results Around 60% of eligible telephone survey respondents participated in the postal survey. There was fair to poor agreement between the results from the two methods for serves of fruit and vegetables consumed. There was excellent agreement between the two methods for self-reported height and weight.
Conclusions The telephone survey was a useful way to recruit people to the postal survey; this could be due to the high level of trust gained through the telephone interview, or social desirability bias. It is difficult to ascertain why different results on fruit and vegetable intake were obtained, but it may be associated with understanding of the parameters of a 'serve', recall bias or the time taken to calculate an answer.

Keywords Mixed-method · Surveillance · Food frequency questionnaire · Method comparison · Fruit and vegetables

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Introduction

Risk factor surveillance has been recognized as an integral part of public health practice, essential for assessing health status and risk, defining priorities, and evaluating programs (Teutsch and Churchill 2000). In some Australian states, including Western Australia (WA) and South Australia (SA), continuous population chronic disease and risk factor surveillance is undertaken and contributes to monitoring of trends, prevalence estimates for health conditions and risk factors, evaluation of health promotion programs, and timely investigation of emerging health issues.

Not only is surveillance useful in itself for monitoring health and its determinants, but also regular surveying of the community provides an opportunity to build upon surveillance data using additional study designs to further investigate areas of interest or need. Risk factor surveillance, by its nature, provides descriptive, rather than explanatory information (Braveman 2003). The risk factor surveillance systems in place in WA and SA offer limited opportunity to investigate a topic in-depth. The surveys, administered by telephone, tend to focus on being simple and short, to encourage higher response rates, ensure efficiency and validity and keep costs relatively low (Taylor et al. 1998). When more detailed investigation into a particular health topic is warranted, the use of another mode of

administration may be more desirable. Surveillance surveys can provide a ready-made and easily accessible resource for further investigations by providing a study recruitment base. Respondents can be asked during the surveillance survey interview if they would be prepared to participate in further research. This provides an instant sample for the next stage of the research, the original survey data as extra contextual information for the new study, and data to enable comparisons to be made between the different methods if some of the survey content is repeated in the second stage.

The follow-on study's alternative method could be, for example, a postal survey, a face-to-face survey, a telephone survey or participation in biomedical tests or physical examinations. Each has its strengths and weaknesses. For example, surveys administered in person can use more complex questions or help respondents with visual aids, but may also make a socially desirable response more likely (Bowling 2005). Self-administered surveys, like postal surveys, allow for more consideration to be given to a response, but postal surveys tend to have a lower response rate than a face-to-face survey and require basic literacy skills (Bowling 2005).

This pilot mixed-methodology study explored the use of telephone and postal surveys to collect information on nutrition in WA and SA. With rising levels of obesity and the potential impact this will have on health services, food and nutrition is a focus of a considerable number of health promotion programs, including the highly successful "Go for 2&5®" campaign in Australia (Pollard 2006). Measuring people's nutritional intake is an important monitoring and evaluation component, but self-report methods for measurement may have limitations such as under or overestimating the foods consumed, or recall bias. Food frequency questionnaires (FFQ) are one of the most common approaches to measuring nutritional intake, and these types of instruments have been widely used (Cade et al. 2002). A review of FFQ found that interviewer administered surveys had slightly better validity and reliability than self-administered surveys, however required considerably more resources (Cade et al. 2002). In the WA and SA surveillance surveys, simple questions about the number of serves of fruit and vegetables consumed are used as indicators of nutritional intake and to evaluate adherence to dietary recommendations.

The aims of this study were twofold: to assess the response rate when recruiting participants to a second stage study; and, to compare the results from the two different methodologies. The FFQ is a particularly good pilot instrument to use when testing response rates, because it is complex in nature and time-consuming to complete. A good response rate to this questionnaire would be a strong indication of the success of using telephone-based surveillance systems as the basis for mixed-methodology studies, when the second stage is a postal survey with traditionally low response rates. In addition, results of the simple fruit and vegetable consumption questions (separate to the FFQ) were compared to assess the reproducibility of these results using two different methods.

Methods

The established chronic disease risk factor surveillance systems in SA and WA were used to recruit subjects into a second stage postal survey over the months of October and November 2006 (Population Research and Outcome Studies Unit 2004; Health Outcomes Assessment Unit 2005). The surveillance surveys use computer assisted telephone interviewing (CATI), and all households with a number listed in the electronic white pages are eligible for selection. WA samples using a stratified random sample with their nine health regions as the strata. The data are weighted to compensate for the relative over sampling within the rural regions, and then age and sex adjusted to the estimated resident population of the year of collection. In SA, the sample is a simple random sample of telephone numbers; data are also weighted to reflect the population. The surveys include questions on demographics, behavioural risk factors, socioeconomic status and health status, as well as some questions about food consumption (how many serves of fruit and vegetables are usually consumed) and height and weight.

These continuous data collection systems collect information on people of all ages, but only respondents 18 years and over were asked, during the CATI interview, if they would participate in the postal survey study. The FFQ in the survey was based on the Australian Health Measurement Survey conducted by Australian Institute of Health and Welfare (2004), with some minor variations. The questionnaire was mailed to participating respondents within a week of the telephone interview, with a return envelope for the survey to be mailed back. A reminder phone call was made if the survey was not returned in 7 days, then another letter sent if it had still not been returned. Respondents were also asked for permission to link the data in the postal survey to the data collected in the original CATI survey.

The FFQ required people to estimate how often they usually ate different foods, as well as the types of foods they ate. There were approximately 110 different food and drink items on the survey. The survey included a section which contained questions on height and weight and fruit and vegetable consumption which were identically worded to those that had already been asked in the telephone survey. The time period covered was the previous 12 months.

The questionnaire took about an hour to complete. Questions about basic demographics, to allow for weighting, were also asked in case permission to use the original telephone survey information was not given.

Results

Overall, 65% of eligible adult respondents to the CATI survey participated in the postal survey. To determine an overall response rate, including both surveys, the sample of eligible people 18+ from the CATI surveys (which included people under 18) had to be estimated. It was assumed that the response rate in the CATI survey for people aged 18+ years was the same as for the sample overall. Using the number of people interviewed aged 18+ to infer back, an estimated eligible CATI population 18+ years was calculated, and the total completed postal survey number compared against this to get an overall response rate. As response rates for younger participants are generally lower than for the sample as a whole, the overall sample response rate used to estimate the total eligible sample aged over 18 years is likely to be an underestimation of the actual response rate in those aged over 18 years.

The response rate of the postal survey itself was 79.8%. Response rates are shown in Table 1.

Overall, 87.1% of respondents agreed to have their postal survey data linked to their CATI data. To ensure the sample reflected the population from which it came, data were weighted according to the sampling strategy used and the age, sex and area composition of the population in each state.

The description of the study population is shown in Table 2. While the unweighted samples were different in composition, partially due to the slightly different sampling methods, the weighted samples from the two states were similar in their demographic composition.

Comparison between telephone and postal survey methods: fruit and vegetable consumption

Respondents were asked in both the telephone and postal surveys how many serves of vegetables and fruit they usually consumed each day. A serve of vegetables was equivalent to half a cup of cooked vegetables or one cup of salad vegetables, and a serve of fruit was equivalent to one medium piece or two small pieces of fruit, or one cup of diced fruit. For the 87% of respondents who permitted data linkage ($n = 1{,}111$), responses in the two surveys were compared. Table 3 shows the results from the two surveys.

The data from each state were combined and the agreement between the postal and telephone surveys calculated. The intraclass correlation coefficient (ICC) for number of serves of fruit was 0.571 (95% CI 0.529–0.611) and for vegetables 0.484 (95% CI 0.437–0.529). This indicates that the agreement between the two surveys was fair to poor for these questions. While the means for fruit consumption presented in Table 3 appear to be quite similar, these figures mask considerable variation in individuals' responses which results in the lack of agreement between the two methods.

Comparison between telephone and postal survey methods: height and weight

In both the telephone and postal survey, respondents were asked to give their height without shoes and their weight, enabling comparison between the two methods. The results are given in Table 4.

Combining data from SA and WA, the ICC between the results of the two surveys was 0.961 (95% CI 0.955–0.965) for height, 0.947 (95% CI 0.940–0.953) for weight, and for BMI calculated from these variables, 0.934 (95% CI 0.925–0.941), showing satisfactory agreement between the two methods, and, therefore, excellent reliability.

Table 1 Response rates to the telephone and postal surveys

	South Australia		Western Australia		Total	
	n	%	*n*	%	*n*	%
CATI response rate (Oct/Nov combined)	1,202/1,727	69.6	929/1,231	75.5	2,131/2,958	72.0
Estimated eligible sample for 18+ using CATI response rate	1,524		1,193		2,717	
Eligible for postal survey (18+ years)	1,061/1,202	88.3	901/929	97.0	1,962/2,131	92.1
Agreed to complete postal survey	832/1,061	78.4	765/901	84.9	1,597/1,962	81.4
Completed postal survey of those who agreed	634/832	76.2	641/765	83.8	1,275/1,597	79.8
Completed postal survey of those eligible from telephone survey	634/1,061	59.8	641/901	71.1	1,275/1,962	64.9
Response rate from original estimated telephone sample 18+	634/1,524	41.6	641/1,193	53.7	1,275/2,717	46.9

CATI computer aided telephone interview

Table 2 Demographic characteristics of respondents to the postal survey

	South Australia		Western Australia		Total	
	unwt *n* (%)	wght *n* (%)	unwt *n* (%)	wght *n* (%)	unwt *n* (%)	wght *n* (%)
Sex						
Male	266 (42.0)	311 (49.1)	204 (31.8)	321 (50.1)	470 (36.9)	633 (49.6)
Female	368 (58.0)	323 (50.9)	437 (68.2)	320 (49.9)	805 (63.1)	642 (50.4)
Age group						
18–44 years	122 (19.24)	298 (47.1)	212 (33.1)	321 (50.1)	334 (26.2)	622 (48.8)
45–64 years	301 (47.48)	208 (32.9)	276 (43.1)	208 (32.4)	577 (45.3)	416 (32.6)
65 years+	211 (33.28)	127 (20.1)	153 (23.9)	112 (17.4)	364 (28.5)	237 (18.6)
Area of residence						
Metropolitan	414 (65.3)	462 (72.9)	321 (50.1)	501 (78.19)	735 (57.6)	968 (75.9)
Country	220 (34.7)	172 (27.1)	320 (49.9)	140 (21.81)	540 (42.4)	307 (24.1)
Total	634 (100)	634 (100)	641 (100)	641 (100)	1,275 (100)	1,275 (100)

The weighting of data can result in rounding discrepancies or totals not adding

unwt unweighted, *wght* weighted to the sampling strategy, age, sex and location profile of each state

Table 3 Serves of fruit and vegetables recorded in two surveys

	Mean number of serves (95% CI)–SA		Mean number of serves (95% CI)–WA	
	Telephone	Postal	Telephone	Postal
Vegetables	3.0 (2.9–3.1)	2.4 (2.3–2.5)	3.2 (3.0–3.3)	2.5 (2.3–2.6)
Fruits	1.8 (1.7–1.9)	1.8 (1.7–1.9)	1.6 (1.5–1.7)	1.6 (1.5–1.7)

Table 4 Height and weight recorded in two surveys

	Mean value and 95% CI, SA		Mean value and 95% CI, WA	
	Telephone	Postal	Telephone	Postal
Height (cm)	170.1 (169.2–171.0)	169.8 (168.8–170.7)	171.4 (170.0–172.8)	171.2 (170.0–172.5)
Weight (kg)	75.7 (74.1–77.2)	75.6 (74.1–77.2)	76.6 (74.7–78.6)	76.7 (74.7–78.6)

Discussion

The response rate for this mixed method research was good and adequate for making estimates about the population from which the samples were drawn. Respondents to the telephone surveillance survey were positive about taking part in the postal survey, with around 80% agreeing in both states. This indicates that the approach is well received. This could be due to the high level of trust created through the surveillance interview, or the effect of social desirability or acquiescence bias, where respondents are more likely to give positive responses or say 'yes' when they are interviewed (as opposed to self-administered surveys) (Bowling 2005). Feedback from the CATI interviewers indicates that most respondents like doing the health survey and feel positive about doing another, and this good experience helps to recruit respondents to the next stage survey.

The response rate of the postal survey itself was 79.8% which represents an excellent response rate for a postal survey, particularly when the subject matter is repetitive and complex. The overall response rate to the postal survey of nearly 65% of eligible CATI respondents is also very acceptable for a postal survey. Overall 87.1% agreed that the data collected on the postal survey could be linked to their original information. Although this is quite high, a higher agreement rate may possibly have been achieved had the consent been an "opt in" rather than an "opt out". Interviewer feedback was solicited as to why this might be and they suggested that some people who signed the questionnaire thought that they were giving consent and not refusing consent to have their data linked. This information would suggest that asking people to "consent" to a "no" was a difficult concept to grasp. Perhaps a simpler, 'do you agree to have your information linked to your responses to the health survey?'—'Yes/No' would have been an easier and fairer question to ask. Further investigation is needed to resolve this issue but it is an important one, as many studies require consent procedures for ethics

approval. It is important to know that people understand the decision that they are making and in this case, such understanding would have improved the quality of the information about food frequency.

The finding of only fair to poor agreement between the answers given in the two survey methodologies about fruit and vegetable consumption is difficult to interpret, although the results are consistent with the results obtained in the field testing studies examining CATI questions for reliability, wording and order effect (Irvine et al. 2004; WA Department of Health and SA Department of Health 2005; WA Department of Health, Victorian Department of Human Services and SA Department of Health 2006). However, for vegetables, the differences were in the opposite direction. Previous reliability testing using telephone interviews for test and retest showed a mean increase in reported number of serves of vegetables on the recall interview, while in this study, with the recall test using a self-administered method, there was a mean decrease in the reported number of serves (Irvine et al. 2004). There is no obvious reason why this should be the case as the argument that the initial interview spurred people to check their intake could be used as an explanation for both changes. Possible explanations include an increased accuracy in the estimates after respondents had completed the much more detailed FFQ; the written definition of a serve made it easier to estimate consumption accurately; the extra time to calculate the number of serves made it more accurate; there may be an increased curiosity or motivation about actual consumption and, therefore, some effort is taken to find out; or, it may be that the lower social desirability associated with a self-administered survey affected the response. The most likely explanation is some combination of a range of factors. Further investigation into this is required, as knowledge about how mixed-methodology surveys affect responses is important, particularly in relation to estimating the extent to which people comply with guidelines related to a healthy lifestyle.

There was excellent agreement between the telephone and postal surveys on BMI, indicating that this is a reliable, although not necessarily valid, measure using either methodology. This is also consistent with CATI field tests (Irvine et al. 2004). Other studies have shown that self-reported height and weight underestimates BMI (Taylor et al. 2006; Hayes et al. 2008). It appears that, at least for adults, the perceived height and weight are features that the respondent is consistent about and does not feel any need or desire to check. Given that obesity is a National Health Priority Area and is regularly monitored, there may be grounds for an education program to encourage adults to regularly check their weight (Australian Institute of Health and Welfare 2009).

The costs associated with recruiting for further studies are minimized when it becomes part of an existing survey system, as was the case in this pilot project. Both SA and WA collect data continuously throughout the year and adding on a recruitment question takes little time, effort or money. The added benefit is that the data collected in the second stage of the study can be linked to that collected in the first stage, provided the respondent gives consent for this to happen. Using surveillance samples provides excellent opportunities for many types of projects, particularly those requiring a quick turn-around like case-control studies.

This project achieved an excellent response rate, an excellent linkage permission rate, relatively unbiased recruitment and a timely response in terms of analysis and reporting for a CATI and postal mixed-methodology method. Further research into the validity and reliability of questions related to food consumption is warranted, and evaluating this should be an ongoing element of surveillance systems. Overall, the study successfully demonstrated that a mixed-methodology approach is not only feasible but has the potential to contribute to closing some of the nation's health-information gaps in a timely and cost effective manner.

References

Australian Institute of Health and Welfare (2004) Australian health measurement survey: report on the pilot test. AIHW Cat No CVD 28. AIHW, Canberra

Australian Institute of Health and Welfare (2009) Health priority areas: obesity, vol 2009. Australian Institute of Health and Welfare

Bowling A (2005) Mode of questionnaire administration can have serious effects on data quality. J Public Health 27:281–291

Braveman PA (2003) Monitoring equity in health and healthcare: a conceptual framework. J Health Popul Nutr 21:181–192

Cade J, Thompson R, Burley V, Warm D (2002) Development, validation and utilisation of food-frequency questionnaires—a review. Public Health Nutr 5:567–587

Hayes AJ, Kortt MA, Clarke PM, Brandrup JD (2008) Estimating equations to correct self-reported height and weight: implications for prevalence of overweight and obesity in Australia. Aust N Z J Public Health 32:542–545

Health Outcomes Assessment Unit (2005) WA Health and Wellbeing Surveillance System (WAHWSS) Design and Methodology. Technical paper series no 1. Epidemiology Branch, WA Department of Health, Perth, Western Australia

Irvine K, Baker D, Eyeson-Annan M (2004) Population Health Monitoring and Surveillance: question development field testing—field test 3 report. NSW Department of Health, Sydney

Pollard C (2006) The Go For 2&5^{R} Campaign—example of a Public Health Early Intervention Strategy. South Aust Public Health Bull 3:18–20

Population Research and Outcome Studies Unit (2004) South Australian Monitoring and Surveillance System (SAMSS) Technical Report. Report 1/04, 2004: Survey Methodology. SA Department of Health Adelaide, South Australia

Taylor A, Wilson D, Wakefield M (1998) Differences in health estimates using telephone and door-to-door survey methods—a hypothetical exercise. Aust N Z J Public Health 22:223–226

Taylor A, Dal Grande E, Gill T, Chittleborough C, Wilson D, Adams R, Grant J, Phillips P, Appleton S, Ruffin R (2006) How valid are self-reported height and weight? A comparison between CATI self-report and clinic measurements using a large cohort study. Aust N Z J Public Health 30:238–246

Teutsch S, Churchill RE (2000) Principles and practice of public health surveillance. Oxford University Press, New York

WA Department of Health, SA Department of Health (2005) Results of field testing three modules of core health questions for inclusion in a nation-wide preventable chronic disease and behavioural risk factor survey module manual

WA Department of Health, Victorian Department of Human Services, SA Department of Health (2006) Results of field testing three modules of core health questions for inclusion in a nation-wide preventable chronic disease and behavioural risk factor survey module manual