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ORIGINAL ARTICLE

The use of chronic disease risk factor surveillance systems for evidence-based decision-making: physical activity and nutrition as examples

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Abstract

Objective To highlight the value of continuous risk factor surveillance systems in providing evidence of the impact of, and to inform health promotion interventions.

Method An ongoing risk factor surveillance system involving telephone interviews with approximately $n = 600$ randomly selected South Australians each month. Trend analysis on physical activity (PA) levels and daily consumption of fruit and vegetables was undertaken.

Results An apparent seasonal trend for fruit consumption and PA was found, with less activity and fruit consumption undertaken in winter months. Overweight/obese adults exercised less than those with normal BMI, and females less than males, although PA rates for both females and overweight/obese adults are rising. There was an increase in vegetable consumption following a major media campaign. Although reported prevalence of the consumption of five or more serves of vegetables daily and the mean number of serves consumed daily has decreased, it is still above pre-campaign rates.

Conclusion Additional information obtained from a risk factor surveillance system, when compared to an annual or point-in-time survey, provides valuable evidence for health professionals interested in measuring and assessing the effectiveness of health promotion interventions.

Keywords Risk factor surveillance system · Physical activity · Nutrition · Health survey · Health promotion

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Introduction

Evidence and evidence-based decision-making have been increasingly called for, and used, in population health, medicine and public health forums (McQueen 2000; Ruffin 2000). Evidence-based decision-making incorporates up-to-date, relevant and appropriate use of evidence that has been derived from a variety of scientific methods (Rychetnik et al. 2004; Tang et al. 2003).

Within the health promotion area, promoting health and well being and preventing illness requires a comprehensive range of evidence. Identification of the specific type, mix and dose of strategies is particularly complex. Information is required on the population as a whole, particular subgroups, the impact of the problem and the potential of various interventions to make a difference. Various types of information and evidence of effectiveness inform both the planning and the evaluation of the suite of specific health promotion actions. For example, information regarding population trends of physical activity (PA) and food intake feed back on the effectiveness of health promotion efforts to prevent chronic diseases such as diabetes and cardiovascular disease. Given these complexities in health promotion, a broad approach to judging the value of evidence of interventions is required (Harris and Sainsbury 2002; Keleher et al. 2007; Nutbeam and Bauman 2006; WHO 2005).

The use of health surveys for health promotion program planning and evaluation has seen the number of health surveys increase and the content become more varied, as the surveys have expanded to include public awareness, knowledge and attitudes. This breadth reflects the extent of determinants impacting on health outcomes and the requirement to intervene beyond the health sector. Notwithstanding, the achievements of health promotion goals depend on achieving behavioural change of individuals within a population. Population level data provides information on determinants as well as offering the opportunity to evaluate the short and long term impacts and effectiveness of health promotion initiatives and to determine whether sub-groups of the population are being impacted on equally. As such, population surveys have a key role in assessing effectiveness of initiatives as well as in identifying the need for further strategy development (Mostashari et al. 2005; Wang et al. 2005).

While health surveys have been used for some time to provide evidence of change, the increased use of ongoing risk factor surveillance systems to provide this evidence has developed considerably in recent years (Holtzman 2003). Time is an important factor in measuring the effectiveness of health promotion policy and program interventions, and risk factor surveillance is a more powerful means of determining program, policy or intervention effectiveness than once-off or annual surveys (Campostrini 2007; Campostrini et al. 2006). Thus, surveillance, as described by McQueen and Puska (2003), provides an even more appropriate evidence base to examine the development and changes in various factors focused on by health promotion. While prevalence provides some information, the introduction of time or seasonality into the analysis provides a broader, more informative and powerful picture (Campostrini 2007).

The aim of this research is to analyse selected data collected by the South Australian Monitoring and Surveillance System (SAMSS) to assess the contribution and value of the ongoing surveillance system in providing evidence for health promoters and health planners. PA and nutrition have been selected as appropriate examples.

Methods

SAMSS is a telephone-based chronic disease and risk factor surveillance system that has been operating in South Australia (SA) since 2002 (Population Research and Outcome Studies Unit 2002). All households in SA with a number listed in the electronic white pages (EWP) are eligible for selection in the sample. A letter introducing the surveillance system is sent to the household of each selected telephone number. It informs people of the purpose of the survey and indicates that they can expect a telephone call within the time frame of the survey. Within each household, the person who had their birthday last, aged zero years and over, is selected for interview. Data are collected every month by a contracted agency and interviews are conducted in English. Proxy interviews are undertaken for respondents aged under the age of 16. Overall, the response rate for SAMSS from July 2002 until June 2007 has generally been between 65 and 70% each month. Each interview takes approximately 15 min.

The Computer Assisted Telephone Interview (CATI) system was used to conduct the interviews. At least ten call backs were made to the telephone number selected to interview household members. Replacement interviews for persons who could not be contacted or interviewed were not permitted.

The data are weighted by age, sex and area of residence to reflect the structure of the population in South Australia to the latest Census or Estimated Residential Population (Australian Bureau of Statistics 2004). Probability of selection in the household was calculated based on the number of people in the household and the number of listings in the White Pages. Weighting is used to correct for disproportionality of the sample with respect to the population of interest. In total, approximately 80% of the total SA households are included in the EWP. The weighting of the data allows for any bias to be compensated for as a result of the 20% non-contacted households or for any gender or age group discrepancies.

Data relating to PA have been collected for respondents aged 16 years and over since July 2003. Respondents are asked to provide the time they have spent undertaking walking, moderate or vigorous PA over the past week. The time is summed, with the time spent undertaking vigorous activity multiplied by a factor of two to account for its greater intensity, in order to provide an indication as to whether respondents are undertaking a sufficient level of PA to provide a health benefit. This is defined as 150 min or more of activity each week (Armstrong et al. 2000). Self-reported height and weight are also collected and for those aged 18 years and over the World Health Organization (WHO) classification is used to determine the proportions (WHO 2000). The PA data in this analysis was limited to respondents aged 18 years and over so that comparisons with BMI could be made.

Since 2002, respondents have also been asked how many serves of fruit and how many serves of vegetables they eat each day. As it is recommended that at least two serves of fruit and five serves of vegetables each day are consumed by adults aged 19 years and over (Commonwealth Department of Health and Family Services 1998; National Health and Medical Research Council 2003), data presented are for adults aged 19 years and over only. Promoting awareness of the recommended number of serves of fruit and vegetables has formed the basis of a major advertising campaign Go for 2&5® that has been conducted in SA and other states in Australia. Phase one of the campaign was from the end of April to the end of June 2005 with mass media consisting of radio advertising in SA (mid-May to end of June) and national television, radio, magazine and outdoor advertising (end of April to end of June). The second phase of the campaign (only in SA) was from the first week in April 2006 to the first week of July 2006. From April 2005 through to July 2006 public relations activities complemented print and other resources (posters, seasonal availability pads, newsletters and recipe books) distributed to media, community organisations, health services and fruit and vegetable retailers). Complementing this are polices and state-wide programs to increase the supply of, and demand for, fruit and vegetables. Examples include a program where students have a set break at school to eat fresh fruit and vegetables and drink water; a policy that all government school canteens must stop selling unhealthy food and sell more healthy foods; and where disadvantaged community members are trained in healthy eating and then teach their peers to adopt healthier eating habits.

Data were analysed using the Statistical Package for the Social Sciences (SPSS version 15.0) and Stata Version 9.2. Descriptive analyses were conducted using χ^2 tests to detect statistically significantly differences ($P < 0.05$) in prevalence. Evolution over time was studied through auto regressive integrated moving average (ARIMA) models. Interrupted time series ARIMA models were used to detect campaign effects. Trends and other effects were estimated through autoregressive models.

Results

Since 2003, the proportion of respondents aged 18 years and over undertaking a sufficient level of PA to confer a health benefit, has ranged between 48.5% (95% CI 47.2–49.9) and 51.9% (95% CI 50.6–53.3) (Table 1). In terms of nutrition, the proportion eating five or more serves of vegetables ranged from 7.0% (95% CI 6.3–7.8) to 11.9% (95% CI 11.1–12.8) and for the proportion eating two or more serves of fruit the estimates ranged from 39.6% (95% CI 38.3–41.0) to 42.9% (95% CI 41.5–44.2) (Table 1).

Time series analysis was then undertaken, using each month's data, to examine initially whether there had been a change in the proportion of respondents undertaking sufficient activity over time. While little difference in overall prevalence is apparent over time (Table 1), examination of the data indicated that there was a lower prevalence of PA in the winter months and a higher prevalence in the summer months, with an overall estimated difference of 1.9% ($P = 0.055$) over time. An AR(1) model was the best fit for this time series ($P = 0.013$) and the model also showed a tendency towards a significant seasonal component ($P < 0.1$) (Fig. 1). To examine the effect of age on these results, the data were analysed separately for those respondents aged 18–69 years and for those 70 years and over (data not shown). There was no significant trend in the prevalence of PA for those aged 70 years and over. For those 18–69, according to the fitted model, 2.6% were more

Table 1 Prevalence of sufficient physical activity (150 min or greater per week) (age 18 years and over), eating five or more serves of vegetables and eating two or more serves of fruit (age 19 years and over)

	n	%	95% CI
Physical activity			
July 2003 to June 2004	2,580	50.1	48.7–51.4
July 2004 to June 2005	2,681	48.5	47.2–49.9
July 2005 to June 2006	2,739	50.5	49.2–51.8
July 2006 to June 2007	2,804	51.9	50.6–53.3
Overall	10,805	50.3	49.6–50.9
Vegetable consumption			
July 2002 to June 2003	323	7.0	6.3–7.8
July 2003 to June 2004	407	8.1	7.3–8.8
July 2004 to June 2005	567	10.5	9.7–11.3
July 2005 to June 2006	642	11.9	11.1–12.8
July 2006 to June 2007	500	9.3	8.6–10.2
Overall	2,439	9.4	9.1–9.8
Fruit consumption			
July 2002 to June 2003	1,956	42.3	40.9–43.7
July 2003 to June 2004	2,000	39.6	38.3–41.0
July 2004 to June 2005	2,230	41.2	39.9–42.5
July 2005 to June 2006	2,310	42.9	41.5–44.2
July 2006 to June 2007	2,242	41.9	40.6–43.3
Overall	10,738	41.6	41.0–42.2

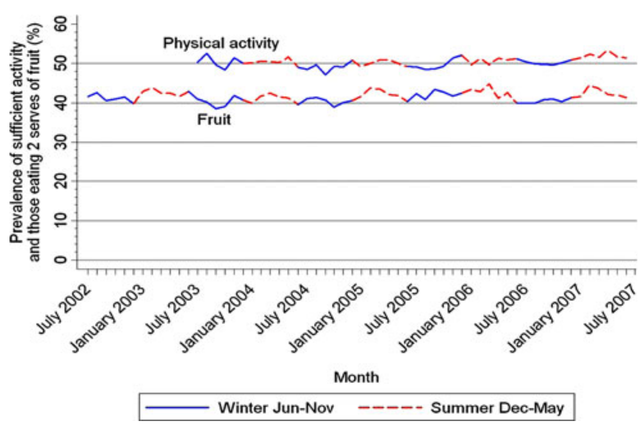


Fig. 1 Seasonal variation of physical activity (ages 18 years and over) and consumption of two serves of fruit (ages 19 years and over), SAMSS

Fig. 2 Physical activity prevalence by sex, SAMSS July 2003 to June 2007, ages 18 years and over

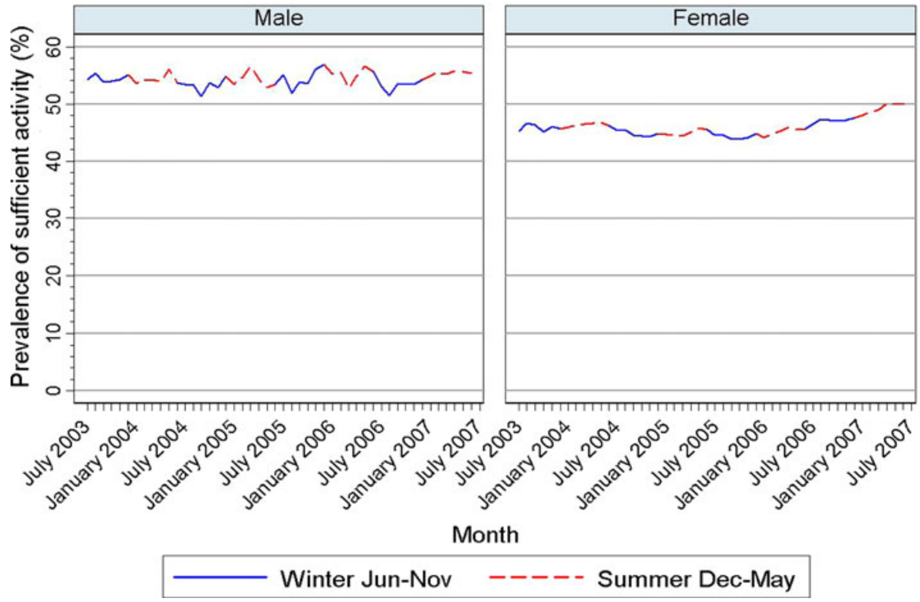
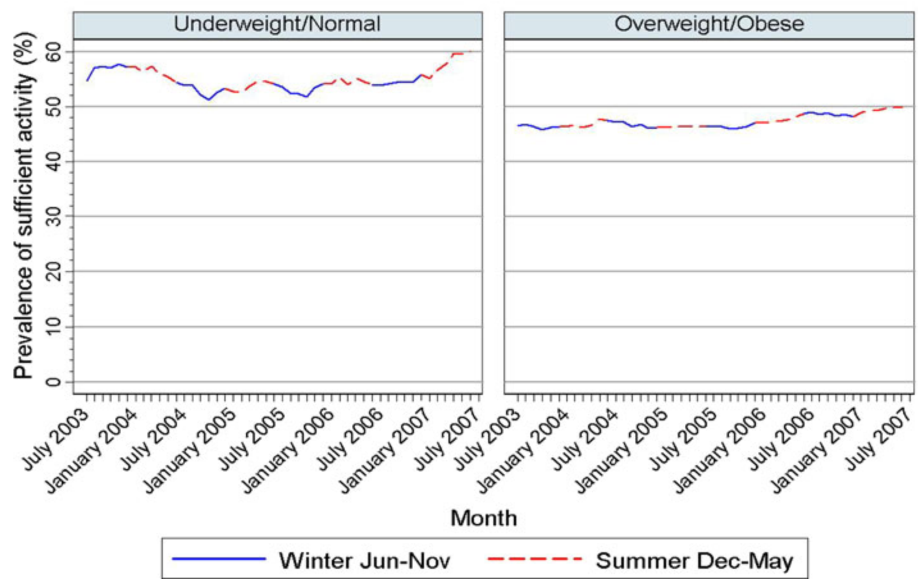


Fig. 3 Physical activity prevalence by BMI, SAMSS July 2003 to June 2007, ages 18 years and over



active in summer than in winter. In addition, for this age group there was a significant increase in the percentage who were sufficiently active (approximately 1% each year).

The data were also examined by sex. For males, the prevalence of PA was higher overall compared to females (with a difference estimated to be 7.8%, $P < 0.001$). For males, once autocorrelation was taken into account, no significant trend was detected but for females there was a significant rising trend, particularly in the later years (Fig. 2). No effect of seasonality was detected.

As adequate PA along side a healthy diet is an important means of preventing and managing overweight and obesity, trends were also stratified by BMI category (underweight/normal and overweight/obese) to examine the effect of PA. There was no statistically significant trend in the prevalence of PA among the normal-underweight population, however, the overall prevalence of PA was statistically significantly higher than those classified as overweight or obese (difference = 7.5%, $P < 0.001$). When considering only those who are overweight or obese, there has been instead a significant increase in the prevalence of sufficient PA over time, particularly in recent years (Fig. 3). For the adults who were overweight or obese, there was a higher proportion undertaking PA in the summer months (difference = 2.9%, $P = 0.01$).

Time series analysis was also undertaken on the data relating to fruit and vegetable consumption. In this case the analysis tested for a significant effect of the campaigns

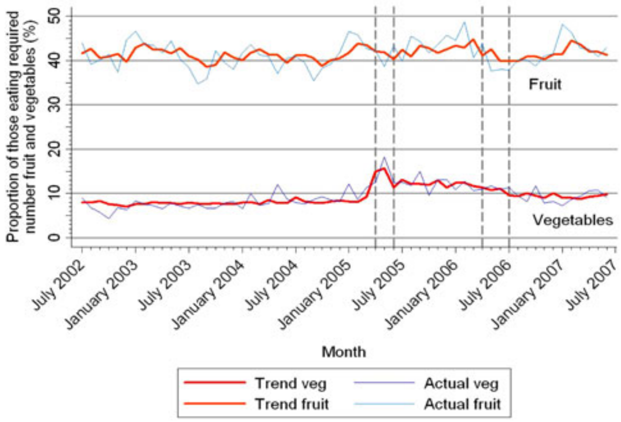


Fig. 4 Prevalence of the consumption of five serves of vegetables per day and two serves of fruit per day, SAMSS July 2002 to June 2007, ages 19 years and over (*vertical line* denotes campaigns in 2005 and 2006)

conducted in 2005 and 2006, in a manner similar to that of Campostrini et al. (2006) and showed that the increased prevalence of the consumption of five serves of vegetables per day increased across 2005 and 2006 in line with major advertising campaigns being conducted in those years (Fig. 4). When the effect of both campaigns were examined in the model, there was no significant effect of the second campaign, but there was a significant effect of the campaign conducted in 2005, with a shift of approximately 5.5% in the prevalence of those consuming five or more serves of vegetables from the commencement of the campaign [AR(2), $P < 0.05$]. Following the end of the campaign in 2005 there was a significant downward shift of approximately 3.3%, which was not regained with the second campaign in 2006. A similar effect occurs when the mean number of serves of vegetables was analysed (data not shown). There was a significant initial increase of approximately 0.2 serves per day corresponding to the beginning of the campaign, which has essentially been maintained since that time [AR(2), $P < 0.05$]. The model does not show a significant presence of seasonality.

Overall, there has been a small but significant shift (approximately 0.5%) in the proportion of South Australians consuming two or more serves of fruit each day as indicated by an AR(1) model ($P < 0.05$). However, the campaigns did not have a significant effect on this increase (Fig. 4). There was a similar picture for the average number of serves of fruit consumed with a significant increase over time of approximately 0.5 of a serves, as determined by an ARIMA model [AR(1), $P < 0.05$] (data not shown). In contrast to the situation with vegetables, the campaigns did not have a significant impact on the increase. Examination of the data indicated that there was a seasonal component associated with the consumption of fruit, with higher fruit consumption occurring in the summer months. An AR(1) model was significant ($P < 0.05$) with a seasonal component also significant ($P < 0.05$) (Fig. 1).

Discussion

This research demonstrates the value of an ongoing risk factor surveillance system in providing meaningful evidence of a health promotion interventions and additional information not normally available via once-off or annual surveys. We were able to demonstrate a tendency for a seasonal trend associated with PA ($P < 0.1$) and a significant effect of season on the consumption of fruit ($P < 0.05$). To the best of our knowledge this has not previously been demonstrated in Australia using these methods. In addition, we have been able to offer some evidence on the impact of a healthy eating campaign and the difference in levels of PA by BMI.

Weaknesses and limitations associated with this study centre on the self-report nature of the information collected and the known biases that may exist as a result of the socially desirable responses leading to a possible overestimation of the actual behaviour. Although we know that from the perspective of studying changes and evolution over time, these biases are of little importance if the hypothesis is accepted that they are likely to remain stable over time. If any biases are kept constant, the time series will not be impacted. Data collected in this surveillance system are indicator-based and, as such, we are able to show that a change in some of these high level indicators is occurring. Whether the change is based on social desirability or actual behavioural change is a limitation of most evaluation processes including this surveillance system. In addition, respondents may have had healthier lifestyle habits than non-responders, resulting in an overestimation of the real proportion of the population undertaking sufficient levels of PA and consuming sufficient fruits and vegetables. The obvious conflict between statistical significance, and what that means in terms of actually changing the habits of the population, is also a limitation and this should be considered in the broader public health context.

The strengths of these analyses are the large representative sample size, and the number of continuous collection points. This has enabled the data to highlight to health promotion experts the short and longer term impact of campaigns, the BMI profile of those who have received the health promoting messages and the importance of time in evaluating population behaviours. These trends provide valuable information because they point out the impact of seasonality on behaviours and better inform decisions about campaign focus and timing. In this instance, we have been able to show the effect of a nutrition campaign, the difficulty in achieving sustainability of the increased consumption of fruit and vegetables and the outcome of the health promotion effort over time. Health promotion decision-makers are interested in both overall annual and point-in-time prevalence estimates as well as the story behind the estimate—who, when and by how much. We have not been able to show that the campaigns directly resulted in population change in behaviours. The purpose of a risk factor surveillance system is to highlight that a change is occurring rather than to analyse every aspect associated with the intervention or outcome.

Health promoters, policy makers, and those in charge of financial allocation for health programs need information to provide the foundation for their decision-making about priorities for action and effective allocation of limited resources. This information needs to be relevant, timely, reliable and coordinated (Adams and Lin 1998; de Bruin et al. 1996; Lopez 2003). Evidence-based decisions need to include cautious analysis of accurate data and verified research findings (Chambers et al. 2002). While the evidence from population surveys and chronic disease and risk factor surveillance systems are influential in policy and planning decisions, it is also recognized that other factors, such as political will and economic and social aspects of the society, also have a (often major) role (Doyle et al. 2005). It is only at the population level that evaluation of the effectiveness of health promotion preventive programs and policy interventions can be assessed to make sure they are addressing all groups within the population (Durch et al. 1997).

In addition, health promotion campaigns are unlikely to make a difference unless they are at sufficient intensity, sustained over time and complemented by a range of community activities and policy changes. There are numerous factors impacting on individuals' decisions about diet and PA including time, cost, safety, support and knowledge. Evidence shows good public health campaigns can make a difference (tobacco, fruit and vegetable) if conducted using good practice. For example, SAMSS data has been analysed to consider fruit and vegetable consumption levels by different age groups and income levels. This has highlighted the need to develop strategies to reach younger people and men, whose consumption of fruit and vegetables is lower than other groups, and disadvantaged groups particularly with respect to fruit.

An important component of evidence-based decision-making is the timely dissemination of the information, such as that gained from a surveillance system, to the decision-makers. Health problems affect human lives and data that explain, alter, inform or educate changes should be available as soon as possible. The collection of population health data via health surveys or surveillance systems is expensive and limited health economic resources are wasted when data collections are inadequately or improperly analysed and disseminated. By the very definition of a surveillance system, transfer of data into information is mandatory but also includes the need for the transfer of information to appropriate users in a timely manner (Remington et al. 1988). The lack of integration or an integrated reporting process is a weakness of many surveillance systems, as is lack of timeliness and often data are collected and analysed only superficially (Dean 1993; Legault et al. 2000). Decision-making is also often based on univariate analysis, dated information and inflexible reporting mechanisms. These analyses have highlighted the value of a flexible, timely, systematic approach as one way to provide evidence, measure effectiveness and detect change associated with population-wide health promotion interventions.

These population level results help evaluate the effectiveness of health promotion intervention and indicate the challenge ahead in achieving behaviour change. The results also point to the impact of seasonality on behaviour, which might better inform decisions about campaign focus and timing. Furthermore, the ongoing data collection allows us to continue to monitor behaviour and thus measure changes which may take considerable time to occur. This surveillance system has highlighted the value of a 'system' approach. Rather than using significant time and resources to implement a yearly or ad hoc survey, this 'system' in its ongoing, consistent form, requires minimal additional resources—the effort is divided over the days and weeks of the year rather than in one big resource-intensive undertaking at the beginning or end of the process.

In conclusion, the additional information obtained from a risk factor surveillance system, when compared to an annual or point-in-time survey, provides valuable evidence for health professionals interested in measuring and assessing the effectiveness of health promotion interventions. The information can also be used to determine the impact of season or other risk factors over time on the variable of interest.

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