The Second National Sun Survey: Overview and Methods

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ABSTRACT

The Second National Sun Survey (NSS2) was carried out in 2006 to estimate ultraviolet radiation (UVR) exposure, sun protection and related knowledge, attitudes and beliefs among Canadians. This paper provides a detailed overview of NSS2 methods and discusses the strengths and limitations of the survey. The NSS2 consists of two questionnaires administered to two samples of adults (age 16+ years). The base sample provides in-depth information on UVR exposure, protective behaviours, tanning, and knowledge, attitudes and beliefs about sun safety for adults, as well as some sun behaviour information for a sample of their children aged 1-12 years. The shorter comparison sample facilitates direct comparison with the 1996 first national sun survey. Data were collected using computer-assisted telephone interviewing, and sample weights were computed for all respondents for estimation and analysis of both adult and child data. Base sample interviews were completed for 7,121 adults, of whom 1,437 reported on the sun behaviour of one of their children, and the comparison sample yielded 2,115 interviews. Response rates were 63% for both surveys. The NSS2 provides in-depth and up-to-date UVR exposure information among Canadians. The results of this survey will aid health promotion experts and policy-makers in developing effective programs to minimize UVR exposure. A public use data file and training in statistical analysis of the NSS2 has been made available to data analysts from across Canada. Key strengths and limitations identified in this survey will inform the development and implementation of future sun surveys.

Key words: Survey methods; ultraviolet radiation exposure; skin neoplasms

La traduction du résumé se trouve à la fin de l'article.

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Skin cancer, including basal cell carcinoma, squamous cell carcinoma and melanoma, is the most common cancer in Canada and is primarily attributable to ultraviolet radiation exposure (UVR).^{1,2} Reducing UVR exposure among Canadians would reduce the incidence and overall health burden of these largely preventable cancers. Developing health promotion and awareness programs to reduce UVR exposure requires up-to-date information about how much time people spend in the sun, their use of sun protection and their knowledge, attitudes and beliefs (KAB) concerning sun exposure, sun protection and tanning. The objectives of the Second National Sun Survey (NSS2) were to estimate levels of UVR exposure and related indicators among Canadians during the summer of 2006, building upon the first national sun survey (NSS1) conducted in 1996.³ This paper provides an overview of NSS2 methods, including questionnaire development and contents, sampling, data collection, weighting and estimation, as well as a discussion of survey strengths, limitations and recommendations for future sun surveys.

METHODS

Questionnaire development and contents

NSS2 content was developed collaboratively by the National Sun Safety Committee* and the Institute for Social Research (ISR).† Using the NSS1 as a starting point, existing questions were modified and new questions were developed, including several KAB questions regarding sun safety. Questions that were changed significantly or newly developed were pilot tested using structured telephone interviews (n=184) and two focus group discussions (n=17) with convenience samples drawn from the geographic area

surrounding ISR. Other key modifications included increased sample size, increased number of analytic geographic regions, separate weekend and weekday sun exposure, revised sun exposure response categories and an improved child sampling strategy. For many questionnaire design changes, split ballot experiments were implemented to permit later evaluation of the impact of these changes.

* Members of the National Sun Safety Committee (now the National Skin Cancer Prevention Committee) were Joel Claveau (Hôtel-Dieu de Québec), Yves Deslauriers (Health Canada), Angus Fergusson (Environment Canada), Lynn From (Women's College Hospital), Loraine Marrett (Cancer Care Ontario), David McLean (British Columbia Cancer Agency), Natalie Parry (Canadian Cancer Society), Patti Payne (Canadian Cancer Society, Ontario Division), Judith Purcell (Cancer Care Nova Scotia), Pascale Reinhardt (Health Canada), Marc Rhainds (Institut national de santé publique du Québec), Jason Rivers (University of British Columbia), Cheryl Rosen (Toronto Western Hospital), Monica Schwann (Alberta Cancer Board), Jean Shoveller (University of British Columbia), Marni Wiseman (CancerCare Manitoba), Mary Louise Yarema (Toronto Public Health).

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Conflict of Interest: None to declare.

Table 1. Overview of the Second National Sun Survey (NSS2) Base Sample Questionnaire Contents

Section (number of items)		Overview of Contents
A	Knowledge, attitudes and beliefs (18)	Respondents' attitudes, knowledge and beliefs about tanning, sunscreen use, sun protective habits and behaviour in the sun.
B	Outdoor workers (6)	Sun exposure and sun protection behaviours of respondents who worked outdoors during June, July or August 2006.
C	Adult sun exposure (8)	Respondents' time spent in the sun and sun protective habits. Note: Only respondents who spent 30 minutes or more in the sun on a typical day between 11 a.m. and 4 p.m. were asked the sun protection questions.
D	Sunscreen use (4)	Respondents' sunscreen use and what sun protection factor they used. Note: Only respondents who spent 30 minutes or more in the sun on a typical day between 11 a.m. and 4 p.m. and wore sunscreen were asked these questions.
E	Seek suntans (2)	Respondents' tanning attempts.
F	Sunburns (4)	Respondents' sunburns and their frequency, and activities when sustaining sunburns.
G	Vacations (summer and winter) (10)	Respondents' sun exposure while on vacation.
H	Tanning equipment (13)	Respondents' use of tanning equipment and reasons for use.
I	Child sun exposure (16)	Sun exposure, protective behaviours and sunburns of one child aged 1-12 living in the household.
K	UV index (3)	Respondents' familiarity with the UV index.
L	Sun sensitivity (4)	Respondents' skin reaction to sun exposure and skin cancer history.
M	Demographics (6)	Respondents' race, education, employment status, country of birth and household income.

The final NSS2 consisted of two questionnaires administered independently to two distinct samples of adult respondents: the base sample questionnaire and the comparison sample questionnaire. The base sample questionnaire was designed to estimate sun exposure, protective behaviours, use of tanning equipment and KAB about sun safety in adults aged 16 years or older, as well as sun exposure and protective behaviours in children aged 1 to 12 years. Table 1 provides an overview of the base sample questionnaire. Additional pretesting of the newly developed NSS2 questionnaires was conducted by ISR before data collection. The comparison sample questionnaire was designed to permit direct comparison of UVR exposure and behaviours in adults aged 16 or older between the NSS1 and NSS2 for Canada as a whole. It comprised a key set of NSS1 questions.

Sampling

The target population consisted of all persons 16 years or older living in Canada, with the following exceptions: residents of the Canadian territories, full-time residents of institutions (nursing homes, penal institutions, group homes, etc.: 1.7% of Canadians living in the provinces), residents not fluent in one of Canada's official languages (1.7% of Canadians living in the provinces) and residents without any telephone service (1.2% of Canadian households in the provinces).⁴⁻⁶

As noted earlier, two distinct samples of adults were identified. The base sample was allocated across the following six Canadian regions: Atlantic Canada, consisting of Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick; Quebec; Ontario; Manitoba/Saskatchewan; Alberta; and British Columbia. As with the NSS1, the NSS2 comparison sample was distributed across the following five regions: Atlantic Canada (n=292), Quebec (n=494), Ontario (n=600), Manitoba/Saskatchewan/Alberta (n=403) and British Columbia (n=326).

For both NSS2 samples, sampling was carried out by provincial strata using a two-stage probability selection process: household selection followed by respondent selection. For household selection, residential telephone numbers were used as a surrogate for households, and a modified form of random digit dialing was used to select numbers. Selected households were sent an introductory

letter before the first call attempt, and at first contact the eligibility of the household was assessed (i.e., whether the household contained at least one adult from the target population). For households with more than one eligible adult, the person with the next birthday was selected to participate. Base sample respondents were also asked whether they were the legal guardian of one or more children aged 1 to 12 years; if yes, they were asked to answer a series of questions reporting on the sun exposure and sun protective behaviours of the child with the next birthday.

Data collection

Data collection was completed using computer-assisted telephone interviewing with the Computer-Assisted Survey Methods Program (Berkeley, CA) from August 2 to November 22, 2006. ISR undertook the majority of interviews, although Jolicoeur & Associates – a survey house in Quebec – conducted 18% of the base sample interviews and 23% of the comparison sample interviews, restricted to participants in Quebec, Ontario and New Brunswick. Both survey houses conducted interviews in English and French. Call attempts were made during both daytime and evening hours, and on weekdays and weekend days. Over two thirds of the interviews were completed within the first four call attempts, 175 interviews were completed on the twentieth or more call attempt, and over 1,000 interviews were completed with households that initially refused to participate. The majority of base sample interviews (over 70%) were completed within 13 to 19 minutes and the majority of comparison sample interviews within 9 to 12 minutes. Approximately 10% of interviews conducted by ISR were monitored by supervisors to establish consistency of interviewing and data entry. Interim data files of 100 and 1,230 completed interviews were evaluated for additional quality control.

Data editing and imputation

Data editing included ensuring that the data were consistent with skip patterns, re-coding open-ended responses and imputing values for variables essential for survey weighting, such as age group, household size and number of telephones per household. For example, to assign an age group to all respondents based on time of interview and year of birth, year of birth was imputed for the

Table 2. Overview of NSS2 Base Sample Participant Characteristics

Characteristic	N	Percent*
Region		
Atlantic Canada: NL, PE, NS, NB	1321	18.6
Quebec	1296	18.2
Ontario	1375	19.3
Manitoba/Saskatchewan	1008	14.2
Alberta	1054	14.8
British Columbia	1067	15.0
Age (years)		
16-24	753	14.9
25-44	2372	35.7
45-64	2667	33.0
≥65	1329	16.4
Sex		
Males	2949	49.0
Hair colour		
Red	277	3.5
Blonde	1220	16.4
Light brown	2080	28.9
Dark brown	2603	36.0
Black	814	15.2
Ethnicity		
Caucasian/white	6512	88.0
Birth place		
Canada	6134	83.1
Education		
Less than high school	1120	16.7
Completed high school	1823	25.5
Some post-secondary or post-secondary certificate/diploma	2194	31.2
University degree	1886	26.6
Employment		
Employed (full-time, part-time, seasonal)	4473	64.4
Student	422	8.7
Retired	1676	20.2
Not in labour force	518	6.8
Household income†		
<\$20,000	658	9.5
\$20,000-\$39,999	1175	18.4
\$40,000-\$59,999	1161	18.9
\$60,000-\$79,999	938	17.6
\$80,000-\$99,999	626	12.2
\$100,000-\$139,999	662	14.1
≥\$140,000	436	9.4
Outdoor workers		
Respondents who worked outdoors	1490	22.4
Summer vacation		
Respondents who took a summer vacation	3801	54.5
Winter vacation		
Respondents who traveled to a sunny climate during the winter	1268	18.4
Parent/guardian of child aged 1-12 years		
Respondents who reported on a child's sun behaviours	1437	21.9
Children by age		
1-5 years	543	35.9
6-12 years	894	64.1
Children by sex		
Boys	757	52.7

* Respondents who did not know or refused to respond were excluded from all proportion calculations. Unless otherwise indicated, % missing was <2%.

† 22% did not provide household income information.

131 base sample respondents who refused to provide the information. This imputation was based on the age distribution of the remaining sample according to sex, employment and parental status.

Weighting and estimation

To generate population estimates for both children and adult parameters, sample weights were computed for all survey respondents. Weighting was based on the probability of household selection within sampling strata, proportion of non-responding households, number of telephone lines per household and number of adults/children per household. Weights were also post-stratified to match the regional, sex and age distribution of the target popu-

lations according to the 2006 census estimates (post 2001 census adjusted).⁷

NSS2 weights are appropriate for estimation and analysis using procedures for complex survey data, such as those available in SAS (SAS Institute, Cary, NC) and STATA (StataCorp., College Station, TX). As with reporting guidelines for the NSS1,³ estimates based on fewer than 10 respondents or with a coefficient of variation greater than 33.3% were not released, and estimates based on 10 or more respondents with a coefficient of variation between 16.6% and 33.3% were flagged to be interpreted with caution because of marginal precision.

RESULTS

Response rates

In total 7,121 and 2,115 adults were interviewed for the base and comparison samples, respectively, and 1,437 adults in the base sample reported on the behaviour of one of their children. To achieve a base sample of 7,121 respondents, 15,425 telephone numbers were sampled, and of these 3,947 were determined to be ineligible as a result of either household characteristics (e.g., language barrier, ill health) or the telephone number being non-residential or not in service. Of the remaining 11,478 telephone numbers, 7,121 yielded a completed interview, 3,911 reached an individual who refused to be interviewed or asked to be called back, and 446 were repeatedly called but no contact was made. For the purpose of response rate calculations, there are various ways of considering the eligibility of households with which no contact is made.⁸ By assuming that these 446 numbers have the same proportion of eligible households found among numbers successfully contacted (11,032/14,979 = 74%), 328 of these numbers would be considered eligible households. This yields a total of 11,360 eligible houses for a response rate of 63%. By treating all 446 "ring no answer" numbers as eligible, the response rate would be 62%, and by treating all of them as ineligible, the response rate would be 64.5%. The latter method was used when reporting a response rate of 69% for the NSS1.³ The response rate for the comparison sample was 63% when applying the eligibility proportion to households with which contact was made, with a range from 62% to 68% for the other two scenarios, respectively.

Item non-response

Respondent refusals occurred on 51 of the 94 survey items, with the highest number of refusals occurring on the household income question (n=973). Item non-response also occurred on 37 of 94 survey items when skip patterns were introduced in an attempt to retain respondents who reported that they never spend time in the sun or who felt that the questions did not apply to them because of the colour of their skin. For certain analyses, it has been possible to impute answers for some of the missing data, after additional tests to validate these imputations.

Sample representativeness

Compared with 2006 Canadian census estimates, the unweighted NSS2 base sample had a higher proportion of females (59% versus 51%) and older respondents (38% versus 33% aged 45 to 64 years and 19% versus 16% aged 65 or older). Participant characteristics with proportions adjusted with survey weights are shown in

Table 2. Age, sex and region characteristics for the weighted sample were distributed as in the general population because they were weighted to do so. Comparing selected other characteristics of the sample, after weighting, with the target population⁹⁻¹¹ revealed that adults with the following characteristics were over-represented in the NSS2 base sample:

- Caucasians/whites (88% of NSS2 base sample versus 85% according to the 2006 census);
- Canadian-born (83% of sample versus 76% of population); and
- having a university degree (27% of sample versus 18% of population).

Residents relying on cellphone use only are also typically under-represented in telephone surveys; however, approximately 5.3% of NSS2 base sample respondents reported living in a cellphone-only household, and it is believed that approximately 5% of Canadian households had cellphone service only in 2006.⁶

DISCUSSION

The NSS2 provides in-depth and up-to-date data on UVR exposure, sun protection and related KAB among Canadians. The survey content and structure were designed by experts in the field with the advantage of building upon the previously conducted NSS1. As a result, many of the questions are improved, and the scope of the survey content is much broader than that of the NSS1. This, combined with the larger sample, should permit a wider range of analyses. The response rate is comparable with that of the NSS1, despite the general decline in survey response rates noted elsewhere.¹² The earlier start of data collection (August rather than September) should permit evaluation of and reduce recall bias, which generally increases as more time passes between exposure and reporting of sun behaviour.¹³ The reporting of time in the sun for weekends and weekdays separately yields a more detailed description of sun exposure than questions referring only to leisure time in the sun, and the reference to peak sun hours from 11 a.m. to 4 p.m. ensures that there is a more consistent reference period across respondents.

Future sun surveys may also be able to build on the limitations noted in the NSS2. For example, additional strategies to accommodate respondents who feel that questions are irrelevant because of their skin colour or their limited sun exposure could be developed. Also, respondent feedback identified that some questions were "double-barreled" in that they asked respondents to agree/disagree with more than one statement at once; a closer examination of this, as well as other respondent feedback, is warranted.

To facilitate data analysis and broad dissemination of results, an NSS2 base sample public use data file was distributed to analysts across Canada, who were provided with training on the data file specifically and on survey analysis more generally during two workshops held September 2007 and March 2008.¹⁴ This public use data file and an accompanying *Data User Guide* are available upon request from the study's principal investigator, Loraine Marrett.

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RÉSUMÉ

La Deuxième Enquête nationale sur l'exposition au soleil (EES2), menée en 2006, visait à estimer l'exposition aux rayons ultraviolets (UV), l'utilisation d'une protection solaire et les connaissances, les attitudes et les croyances connexes chez les Canadiens. Dans cet article, nous décrivons en détail les méthodes de l'EES2 et nous expliquons les forces et les contraintes de l'enquête. L'EES2 comportait deux questionnaires administrés à deux échantillons d'adultes (16 ans et plus). L'échantillon de base a permis de recueillir des informations approfondies sur l'exposition aux rayons UV, les comportements de protection, le bronzage, les connaissances, attitudes et croyances concernant la protection solaire chez les adultes, ainsi que certaines informations sur les comportements au soleil d'un échantillon d'enfants des répondants âgés de 1 à 12 ans. L'échantillon de comparaison, moins nombreux, a permis de faire des comparaisons directes avec les résultats de l'EES1, menée en 1996. Les données ont été recueillies dans le cadre d'entrevues téléphoniques assistées par ordinateur, et l'on a obtenu le poids de chaque répondant afin d'estimer et d'analyser les données des adultes et des enfants. L'échantillon de base comprenait 7 121 adultes, dont 1 437 ont fourni des renseignements sur le comportement de protection d'un de leurs enfants; l'échantillon de comparaison comprenait 2 115 personnes. Le taux de réponse était de 63 % pour les deux enquêtes. L'EES2 fournit des informations approfondies et à jour sur l'exposition des Canadiens aux rayons UV. Ses résultats aideront les spécialistes et les décideurs en promotion de la santé à élaborer des programmes efficaces pour réduire l'exposition aux rayons UV. Un fichier de données à usage public et une formation en analyse statistique de l'EES2 ont été offerts à des analystes de données venus de tout le Canada. Les principales forces et contraintes de cette enquête viendront étayer l'élaboration et la mise en œuvre des futures enquêtes sur l'exposition au soleil.

Mots clés : méthodes d'enquête; exposition aux rayons ultraviolets; tumeurs de la peau