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1. Introduction

The National Population Health Survey (NPHS) is designed to collect information related to the health of the Canadian population. The first cycle of data collection began in 1994, and will continue every second year thereafter. The survey will collect not only cross-sectional information, but also data from a panel of individuals at two-year intervals.

The target population of the NPHS includes household residents in all provinces, with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some remote areas in Quebec and Ontario. Separate surveys were conducted to cover the Yukon, the Northwest Territories and the Institutions (long term residents of hospitals and residential care facilities) and will be presented at a later stage.

The National Population Health Survey (NPHS) was conducted by Statistics Canada in 1994-1995. This manual has been produced to facilitate the manipulation of the microdata file of the survey results.

Any questions about the data set or its use should be directed to:

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2. Background

In the fall of 1991, the National Health Information Council (NHIC), recommended that an on-going national survey of population health be conducted. This recommendation was based on consideration of the economic and fiscal pressures on the health care system and the commensurate requirement for information with which to improve the health status of the population in Canada. Existing sources of health data are unable to provide a complete picture of the health status of the population and the myriad of factors that have an impact on health.

Commencing in April 1992, Statistics Canada received funding for development of a National Population Health Survey. The survey was designed to be flexible, and to produce valid, reliable and timely data. Also, it was to be responsive to changing requirements, interests and policies.

3. Objectives

The objectives of the NPHS are to:

` aid in the development of public policy by providing measures of the level, trend and distribution of the health status of the population;

` provide data for analytic studies that will assist in understanding the determinants of health;

` collect data on the economic, social, demographic, occupational and environmental correlates of health;

` increase the understanding of the relationship between health status and health care utilization, including alternative as well as traditional services;

` provide information on a panel of people who will be followed over time to reflect the dynamic process of health and illness;

` provide the provinces and territories and other clients with a health survey capacity that will permit supplementation of content or sample;

` allow the possibility of linking survey data to routinely collected administrative data such as vital statistics, environmental measures, community variables, and health services utilization.

4. Survey Content

These objectives provided only a broad direction for the NPHS, particularly concerning the type of information to be collected. Therefore, survey content was selected according to the following criteria:

1) Information should relate to, and help monitor, the health goals and objectives of the provinces and territories. Where health goals have not been established, for example, at the national level, policy and programs could be considered in the selection of survey content.

2) The information should not duplicate data available from other sources.

3) With a view to increasing the understanding of health and its determinants, information collected should provide new knowledge in areas that have not been adequately studied.

4) The survey should focus on behaviours or conditions amenable to prevention, treatment, or intervention.

5) The survey should collect information about conditions that impose the greatest burden, in terms of suffering or cost, on affected individuals, the general population, or the health care system.

6) The survey should collect information on factors related to good health, not just those related to illness.

In each household, some limited information was collected from all household members and one person, aged 12 years and over, in each household was randomly selected for a more in-depth interview. Reflecting these guidelines, the questionnaire included components on health status, use of health services, risk factors and demographic and socio-economic status. For example, health status was measured through questions on self-perception of health, functional ability, chronic conditions, and activity restriction. The use of health services was measured through questions on visits to health care providers, hospital care and drug use. Behavioural risk factors include smoking, alcohol use and physical activity. In addition, a special focus of the first survey was psycho-social factors that may influence health, such as stress, self-esteem and social support. Demographic and socio-economic information included age, sex, education, ethnicity, household income and labour force status. A list of the questions asked are provided in Appendix A.

5. Sample Design

The target population of the NPHS includes household residents in all provinces, with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some remote areas in Quebec and Ontario.

Sample design for the household component

Four factors shaped the design of the household component sample:

- the targeted national and provincial/territorial sample sizes;
- the decision to select one member per household to make up the longitudinal panel;
- the choice of the redesigned Labour Force Survey (LFS) as a vehicle for selecting the sample; and
- the decision to integrate the NPHS with the National Longitudinal Survey of Children (NLSC).

The first three factors resulted, respectively, in the allocation of the sample, the application of a technique (the "rejective method," described later) to improve the sample's representativeness, and the selection of provincial samples outside Quebec.

5.1 Sample Allocation

The NPHS was budgeted for a sample size of 19,600 households. It was further agreed among national and provincial representatives that each province needed a minimum of 1,200 households. Subject to this restriction the provincial sample sizes were obtained by using a well known allocation scheme that balances the reliability requirements at national and regional levels (Kish, 1988). According to this scheme the sample was allocated proportionally to $\sqrt{(0.804W_h^2 + 1/12^2)}$, where W_h is the 1991 Census proportion of households in province h, h=1,..,12. This allocation determined the base sample size for each province. Four provinces chose to increase their allotted sample size through the buy-in of additional units.

Within provinces the sample was initially distributed proportionally to the population size. The provincial buy-in samples and the use of a rejective method, described below, affected the sub-provincial allocations. Ontario and Manitoba's buy-in samples imposed minimum requirements by health regions, while N.B. and B.C. paid for additional sample coverage of certain areas only. In B.C. most of the buy-in requirement was met using telephone interviews from a Random-Digit Dialling (RDD) sample of telephone numbers. In applying the rejective method, sample sizes were inflated by the number of households expected to be screened out of the sample.

Table 1 below gives the sample sizes expected by province. Numbers represent in-scope private occupied dwellings before non-response, which was anticipated to be near 10%.

Table 1: Sample Sizes for the NPHS

Household sample sizes

Province	Original Allocation	Buy-in sample	To interview	Screened out	Total
Nfld	1,220	-	1,221	171	1,392
P.E.I.	1,201	-	1,199	223	1,422
N.S.	1,270	-	1,270	246	1,516
N.B.	1,243	180	1,423	234	1,657
Que.	3,584	-	3,479	-	3,479
Ont.	4,817	2,183	7,001	1,021	8,022
Man.	1,307	493	1,800	324	2,124
Sask	1,287	-	1,288	257	1,545
Alta	1,674	-	1,674	305	1,979
BC (1)	1,996	61	2,057	448	2,505
BC (2)	-	788	788	-	788
TOTAL	19,599	3,705	23,200	3,229	26,429

(1) Excludes RDD portion.
(2) RDD portion.

5.2 The Rejective Approach

The survey content primarily focuses on one member in each sample household who is chosen at random to become the longitudinal panel respondent. The panel underrepresents persons coming from large households, typically parents and children, since they have less chance of being chosen and overrepresents persons coming from small households, often single people or the elderly.

A rejective approach has been adopted to increase the representation of parents and youths in the panel. A portion of the sample is pre-identified for screening. After their member roster is completed, screened households that have no member aged under 25 years drop out of the survey. In order to maintain the required sample sizes, the number of households visited in each province is increased by the anticipated number of households screened out in this way.

The rejective method with an under 25-year old rule was adopted as it performed better than other rejection rules considered. For cost and operational reasons the percentages of screened households was usually limited to 25-30% in Ontario, 37.5-40% in urban areas elsewhere and 25-30% in rural areas. As apartment strata had a high concentration of small households, their sample sizes were reduced instead of applying a rejective method. The rejective approach was also not applied in remote regions because of the high contact costs there, and its use was limited in areas where sample buy-in demands were substantial.

5.3 Sample Selection

The sample design considered for the household component of the NPHS was a stratified two-stage design. In the first stage homogeneous strata are formed and independent samples of clusters are drawn from each stratum. In the second stage dwelling lists are prepared for each cluster and dwellings, or households, are selected from the lists.

In all provinces except Quebec the NPHS used the multi-purpose sampling methodology developed for the redesign of the Labour Force Survey (LFS). That methodology provides general household surveys with clustered samples of dwellings, thus making the design very cost effective for the listing and collection of data.

The basic LFS design is a multi-stage stratified sample of dwellings selected within clusters. Each province is divided into three types of areas (Major Urban Centres, Urban Towns and Rural Areas) from which separate geographic and/or socio-economic strata are formed. In most strata six clusters, usually Census Enumeration Areas (EAs), are selected with Probability Proportional to Size (PPS). In a few cases where the population density is low an additional stage is added by first selecting 2 or 3 large Primary Sampling Units, dividing them into clusters, and drawing a sample of six clusters from each. The number six is used throughout the sample design to allow a one-sixth rotation of the sample every month for the LFS.

The sample of dwellings is obtained after listing operations in sample clusters are completed. As sampling rates are predetermined there are often differences between anticipated and obtained sample counts. Excessive sample yields are corrected by dropping a portion of the originally selected units. This is usually done at aggregated

levels and is called sample stabilisation. Note also that sample sizes are inflated to represent dwellings rather than households as approximately 15% of the dwellings are expected to be vacant or otherwise out-of-scope.

The sample design is set up to yield about 60,000 households. Surveys needing smaller sample sizes usually "reserve" from 1 to 6 rotations per province, a rotation being one-sixth of the total sample. Sample stabilisation is used to maintain the sample at desired levels, as when two rotations are reserved but the sample size needed only represents 1.5 rotations.

Requirements specific to the NPHS led to two modifications to this sampling strategy. The number of "reserves" needed was specified at the stratum level rather than the provincial level in order to meet the specific sub-provincial sample size requirements. It was also required that the number of clusters selected per stratum be a multiple of four for variance estimation and seasonal representativity (this allowed strata to have two or more independent samples of four clusters each - one per collection period). As NPHS usually requested only between 2 and 6 clusters per LFS stratum, similar LFS strata were grouped to form larger NPHS strata with the required number of sample clusters.

As a result of these modifications, the NPHS sample of clusters can be considered as a stratified replicated sample where strata are groups of LFS strata and replicates are typically independent, identically distributed samples of 4 clusters each. There were exceptions, but they are not expected to have a significant impact on survey results.

5.4 Integration of NPHS with the National Longitudinal Survey of Children (NLSC)

The National Longitudinal Survey of Children (NLSC) is a household survey which will follow a sample of about 25,000 children under 12 over time. The two surveys are integrated, meaning that common data for children are collected from both and that the NPHS children's sample will be used in NLSC estimates. In the provinces the NPHS is expected to provide a sample of 4,500 to 5,000 children to the NLSC. To obtain this sample size NPHS households where a child is selected for the panel will have the detailed questionnaire for children administered to all children in his or her family (subject to a maximum of 4).

Scheduling constraints required that children not be selected for the NPHS panel before the third survey collection period (or quarter). This distorted the seasonal representativity of children in the panel and reduced their sample size. To increase the sample yield for children without harming the seasonal representation of other household members in the last two quarters it was decided to reassign part of the NPHS sample from the first two quarters to these quarters. As this decision was made after the sample operations described above, the shift was applied to households within clusters rather than to entire clusters.

Figure 1 illustrates how the sample distribution was revised for the integration. The square on the left represents a cluster assigned to quarter 1 or 2. That on the right represents a cluster assigned to quarter 3 or 4. Households are classified by type into: (I) households with children; (II) other households with youths ("Youth" meaning under 25 years old); and (III) households without children or youths. The sample is divided into an "Adult" sample and a "Children" sample. In "Adult" sample households only persons aged 12 or older can be selected for the panel. Panel membership is restricted to children in "Children" households. If there are no children present, then either the household is screened out or a member (non-child) is selected at random for the panel.

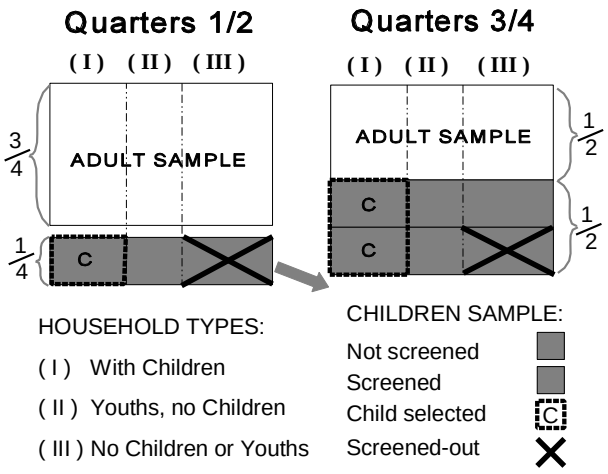

Figure 1: Repartition of the Sample

A quarter of the sample from quarters 1 and 2, and a half from quarters 3 and 4 are designated as "Children" households. "Children" households from quarter 1 or 2 will actually be visited in quarter 3 or 4, respectively. Outside of P.E.I. the rejective method can be applied strictly within the "Children" sample. When the screening rate is at 37.5% all "Children" households are screened. With lower rates some of them will not need to be screened. A 25% screening rate is illustrated in Figure 1. All the "Children" households from quarters 1 and 2 and one-half of those from quarters 3 and 4 are screened. With this method the number of non-children in the panel will be approximately the same in each quarter. However, there will be seasonal differences in sample yields within each household type.

For operational reasons there are no rejections and no shifting of collection periods in LFS apartment strata, high income strata and remote regions. In P.E.I. the number of available interviewers did not permit shifting the collection periods, and screening occurred in all quarters. The "Children" sample in these cases is selected strictly from clusters in quarters 3 and 4, resulting in a seasonal distortion of the sample for non-children. A programming error also caused no 12-year old to be selected for the panel in quarters 1 and 2. Selection probabilities for 12-year old were adjusted in quarters 3 and 4 to compensate this, but the result is that 12 year-old, just like children under 12, are not represented in the panel from the first two quarters.

5.5 Sample Design in Quebec

In Quebec the NPHS sample is selected from dwellings participating in a health survey organized by Santé Québec: the 1992-93 *Enquête sociale et de santé* (ESS). The survey sampled 16,010 dwellings using a two-stage design similar to that of the LFS. The province was divided geographically by crossing 15 Health Regions with four urban density classes (Montreal Census Metropolitan Area, regional capitals, small urban agglomerations and the rural sector). In each area clusters were stratified by socio-economic characteristics and selected using a PPS sample. Selected clusters were enumerated and random samples of their dwellings were drawn: 10 per cluster in major cities, 20 or 30 elsewhere.

Santé Québec provided non-confidential information which allowed the classification of their sample into 4 types of households: one-member households; households with children; other households with youths (persons aged under 25); and the rest (more than one member and no youth or child). A household type was determined by NPHS personnel for the ESS non-respondents.

The NPHS sample size was first allocated among the four urban density classes. To avoid having too much sample in Montreal the allocation was proportional to $\sqrt{(2W_h^2 + 1/4^2)}$, where W_h is the population share for class h, h=1,2,3,4. In each class an attempt was made to obtain a subsample from the ESS which, as far as the selected panel member was concerned, would be proportional to the populations for the 4 household types. This was done by drawing a sufficient number of households from the ESS to give the required yield for households with children (the most underrepresented group), and then removing excess sample from the other three household groups. An initial sample which was almost 50% higher than needed was thus selected. After removing from it 2/3 of the one-member households, 1/2 of the other households with no youths or children, and 1/6 of households with youths but no children, the objective was nearly attained.

Considerations for seasonal representation and variance estimation, and integration with the NLSC, affected the sub-sampling in Quebec as they did elsewhere. ESS strata were thus collapsed to allow the formation of replicates, with the clusters in each replicate covering all four quarters (two quarters are covered per cluster in the rural and small urban sectors as sample sizes are higher there). The sample of households with children was split into an "Adult" sample and a "Children" sample by a 3:2 ratio, the terms having the same meaning as in other provinces. "Children" sample households in quarters 1 and 2 were reassigned to quarters 3 and 4. As NPHS surveys the current occupants of dwellings selected for the ESS, and changes will have occurred in some of those dwellings, the samples of households without children for quarters 3 and 4 are also to be split, by a 2:3 ratio, into an "Adult" and a "Children" sample.

6. Data Collection

6.1 Questionnaire Design and Data Collection Method

The NPHS questions were designed for Computer Assisted Interviewing(CAI), which meant that, as the questions were developed, the associated logical flow into and out of the questions were programmed. This included specifying the type of answer required, the minimum and maximum values, on-line edits associated with the question and what to do in case of item non-response.

With CAI, the interview can be monitored based on answers provided by the respondent. Some valuable controls include directing the skip patterns based on responses or fixing minimum and maximum values . On-screen prompts are shown when an invalid entry is recorded and thus immediate feedback is given to the respondent and/or the interviewer to correct inconsistencies. Other enhancements are the automatic insertion of reference periods based on current dates. Prefilling of text or data based on information gathered during the interview allows the interviewer to proceed without having to search back at previous answers. This type of prefill includes such things as using the correct name or gender within the questions themselves. Allowable ranges/answers based on data collected during the interviewer can also be programmed . In other words the questionnaire can be customized to the respondent - based on data collected at that time.

6.2 Tests

A number of tests were conducted before the main survey was implemented in the field.

Focus groups were held in the development stages of the questionnaires to verify various aspects of their content. The main objectives were to verify the clarity and the quality of the questions, respondent reactions to sections that were felt to be sensitive (mental health, alcohol, etc.), and to obtain approximate times for the length of the different sections.

Two field tests were also conducted. The tests involved four of Statistics Canada's Regional Offices and interviews were carried out by experienced Labour Force Survey interviewers. The main objectives of the two tests were again to observe respondent reaction to the survey, to obtain estimates of time for the various sections, and to see what kind of response rates could be obtained. Verifying response rates was especially important in Quebec where selected respondents had participated in the Santé Québec study a few months before. Field operations and procedures, interviewer training, and the computer programme application (questionnaire on computer) were also tested.

In addition to the field tests, the computer programme application was intensively tested

in house to debug it and to ensure that all possible paths were being correctly followed. Computer application testing was an ongoing operation up until the start of the main survey.

6.3 Interviewing

Collection operations were divided in four quarters (June, August and November 1994, and March 1995) and interviews were conducted by Statistics Canada Labour Force Survey (LFS) interviewers, who are part-time employees hired and trained specifically to carry out the LFS, using the computer-assisted interviewing method.

All respondents were first contacted in person except for a small sample in British Columbia that was conducted by telephone using the RDD approach. Many of the interviews,where started in person, were finished on the telephone either because the selected respondent was not available at the time of the initial visit or because the long interview time prevented the completion of the interview in one contact. The total interview took an average of one hour in each household.

In all dwellings, information about all household members is obtained from a knowledgeable household member - usually the person at home at the time of the interviewer visit. Such 'proxy' reporting, which accounts for approximately 55% of the information collected for this part of the interview, is used to avoid the high cost and extended time requirements that would be involved in repeat visits or calls necessary to obtain information directly from each respondent.

Proxy reporting was allowed for the selected respondent only for reasons of illness or incapacity. Such proxy reporting accounts for 4% of the information collected.

6.4 Supervision and Control

All LFS interviewers are under the supervision of a staff of senior interviewers who are responsible for ensuring that interviewers are familiar with the concepts and procedures of the LFS and its many supplementary surveys, and also for periodically monitoring their interviewers and reviewing their completed documents. The senior interviewers are, in turn, under the supervision of the LFS program managers, located in each of the eight Statistics Canada regional offices.

Some households were re-contacted by Senior Interviewers by telephone after the 3rd and 4th quarters to verify the quality of work of interviewers. At the time of the re-contact, the household composition was verified and an assessment of the interviewer's work was obtained.

6.5 Non-Response to the NPHS

Interviewers are instructed to make all reasonable attempts to obtain NPHS interviews with members of eligible households. For individuals who at first refuse to participate in the NPHS, a letter is sent from the Regional Office to the dwelling address stressing the importance of the survey and the household's cooperation. This is followed by a second call (or visit) from the interviewer. For cases in which the timing of the interviewer's call (or visit) is inconvenient, an appointment is arranged to call back at a more convenient time. For cases in which there is no one home, numerous call backs are made. Under no circumstances are sampled dwellings replaced by other dwellings for reasons of non-response.

Each quarter, after all attempts to obtain interviews have been made, a small number of non-responding households remain.

6.6 Non-response follow-up

Many strategies were put in place to reduce the number of non-response cases. Before interviews started, a maximum recommended assignment size by interviewer was calculated based on test results to allow efficient follow-up of no contact cases (i.e. to avoid over burdening interviewers).

Interviewer procedures included ways of reducing the number of no-contacts by making visits at various times of the day or on the way to or from other dwellings, talking to neighbours or landlords to determine who lives in the dwelling and obtain telephone numbers, etc.

Refusals were followed-up by Senior Interviewers, Project Supervisors or by other Interviewers to try to convince respondents to participate in the survey.

In addition to the two official languages, the questionnaires were translated in Spanish, Portuguese, Chinese, Punjabee and Italian to try to reduce the number of non-interviews due to language problems.

To maximize the response rate, a large number of non-response cases were also followed-up in subsequent quarters.

7. Data Processing

7.1 Data Capture

Because NPHS used CAI, capture was part of the data collection process. The data collected during the interview were recorded directly onto a laptop computer. Each question is represented by a screen on the computer. After the answer to each question is entered, the next question appears automatically on the screen.

7.2 Editing

Some editing usually done at Head Office has been performed on-line in the (CAI) application and are performed during data collection. The editing to deal with out of range values and flow errors were controlled through the use of CAI. These types of errors were controlled by CAI by not allowing invalid values to be entered as responses, and by not allowing incorrect question paths to be followed. For example, CAI ensured that questions that did not apply to the respondent and therefore should not have been answered did not have responses in them. In other situtations, warning messages were invoked, but no corrective action was taken if an interviewer entered contradictory responses between questions. Because no corrective action was taken in such instances, edits were developed to be performed after data collection at Head Office. Inconsistencies were usually corrected by setting one or both of the variables in question to "not stated". No imputation was performed.

7.3 Coding

Several questions allowing write-in responses had the write-in information coded into either new unique categories, or to a listed category if the write-in information duplicated a listed category. Where possible (e.g. occupation, industry, diseases), the coding followed either the standard classification systems as used in the Census of the Population or in other Statistics Canada Surveys such as the Health and Activity Limitation Survey and General Social Survey-cycle 6.

7.4 Creation of Derived Variables

A number of variables on the file have been derived by using items found on the NPHS questionnaires in order to facilitate data analysis. Derived variable names generally start with DV and are followed by characters referring to the question number or subject. In some cases, the derived variables are straightforward and involve collapsing of categories. In other cases, several variables have been combined to create a new variable. Appendix F provides the details on how these variables were derived.

7.5 Weighting

The principle behind estimation in a probability sample such as the NPHS is that each person in the sample "represents", besides himself or herself, several other persons not in the sample. For example, in a simple random 2% sample of the population, each person in the sample represents 50 persons in the population. In the terminology used here, it can be said that each person has a weight of 50.

The weighting phase is a step which calculates, for each person, what their associated weight is. This weight appears on the microdata file, and must be used to derive meaningful estimates from the survey. For example, if the number of individuals who smoke daily (see question SMOK-Q2 in section 9.2) is to be estimated, it is done by selecting the records referring to those individuals in the sample having that characteristic and summing the weights entered on those records.

Details of the method used to calculate these weights are presented in Chapter 11.

7.6 Suppression of Confidential Information

It should be noted that the 'Public Use' microdata files described above differ in a number of important respects from the survey 'master' files held by Statistics Canada. These differences are the result of actions taken to protect the anonymity of individual survey respondents. Users requiring access to information excluded from the microdata files may purchase custom tabulations. Estimates generated will be released to the user, subject to meeting the guidelines for analysis and release outlined in Section 9 of this document.

8. Data Quality

8.1 Response Rates

The calculation of response rates for the NPHS was complicated by two factors which are unique to this survey. The first problem occurred as a result of using the rejective method. Recall that a certain percentage of dwellings were designated as EFR (see Section 5.2 for more details). Households which were ultimately rejected do not contribute to the estimates,but are considered as household respondents since they provided the information that the NPHS requested. The EFR households that did not respond are considered to be non-respondents (as are non-EFR households that did not respond).

Secondly, the integration of the NPHS with the NLSC complicated the calculation of the response rate for the selected persons. Recall that in certain pre-determined dwellings, if at least one child under twelve years old was found, then a child was the selected person and he/she was administered the NLSC questionnaire. In these cases, there was no respondent to the NPHS selected person questionnaire. For this reason, these dwellings are considered to be out of scope for the purpose of calculating the NPHS selected person response rate.

The following is a description of how the Household response rate and the Selected Person response rate were calculated. It should be noted that out of scope dwellings (vacant or abandoned dwellings, dwellings under construction, or households not eligible for the sample) were not used in any of the calculations.

Household response rate

$$\text{HH response rate} = \frac{\text{\# of responding households including rejected households}}{\text{all in-scope households}}$$

A non-rejected responding household had *at least* one general component questionnaire completed for a member of the household. The household response rate at the Canada level for the NPHS was ***88.7%***. At the provincial level, this rate varied from 85.2% in Ontario to 93.2% in Alberta.

Selected person response rate

The selected person response rate can be thought of as the number of health component questionnaires that *were* completed as compared to the number which *should have been* completed.

SP response rate= $\frac{\text{\# of completed health component questionnaires}}{\text{\# of persons eligible to answer the health component questionnaire}}$

where the number of persons eligible to answer the health component is equal to the number of non-rejected responding households, minus the number of dwellings where a child who was less than 12 years old was the selected person.

The selected person response rate for the NPHS was ***96.1%*** at the Canada level, and ranged from 94.7% in Nova Scotia to 97.6% in Saskatchewan.

It should be noted that because of the complications described above, multiplying the two rates together gives a meaningless value. The information that is used to calculate these rates is different in each case, and therefore a combined rate cannot be determined.

Relevant information for Calculation of Response Rates:

Number of respondents at the household level:	20725
Number of respondents at the selected person level:	17626
Number of rejected households:	3447
Number of dwellings where a child was selected:	2383
Number of non-respondents at the household level:	3091
Number of non-respondents at the selected person level:	716
Number of out of scope households:	4512

Calculation of Household response rate:

$$\text{HH Rate} = \frac{20725 + 3447}{20725 + 3447 + 3091} = \frac{24172}{27263} = 88.7\%$$

Calculation of Selected Person response rate:

$$\text{SP Rate} = \frac{17626}{20725 - 2383} = \frac{17626}{18342} = 96.1\%$$

8.2 Survey Errors

The survey produces estimates based on information collected from and about a sample of individuals. Somewhat different estimates might have been obtained if a complete census had been taken using the same questionnaire, interviewers, supervisors, processing methods, etc. as those actually used in the survey. The difference between the estimates obtained from the sample and those resulting from a complete count taken under similar conditions is called the sampling error of the estimate.

Errors which are not related to sampling may occur at almost every phase of a survey operation. Interviewers may misunderstand instructions, respondents may make errors in answering questions, the answers may be incorrectly entered on the questionnaire and errors may be introduced in the processing and tabulation of the data. These are all examples of non-sampling errors.

Over a large number of observations, randomly occurring errors will have little effect on estimates derived from the survey. However, errors occurring systematically will contribute to biases in the survey estimates. Considerable time and effort was made to reduce non-sampling errors in the survey. Quality assurance measures were implemented at each step of the data collection and processing cycle to monitor the quality of the data. These measures included the use of highly skilled interviewers, extensive training of interviewers with respect to the survey procedures and questionnaire, observation of interviewers to detect problems on CAI questionnaire or misunderstanding of instructions, procedures to ensure that data collection errors were minimized.

A major source of non-sampling errors in surveys is the effect of non-response on the survey results. The extent of non-response varies from partial non-response (failure to answer just one or some questions) to total non-response. Partial non-response to NPHS was basically non-existent; once the questionnaire was started, it tended to be completed with very little non-response. Total non-response occurred because the interviewer was either unable to contact the respondent, no member of the household was able to provide the information, or the respondent refused to participate in the survey. Total non-response was handled by adjusting the weight of households who responded to the survey to compensate for those who did not respond.

In most cases, partial non-response to the survey occurred when the respondent did not understand or misinterpreted a question, refused to answer a question, could not recall the requested information, or could not provide non-proxy information.

Since it is an unavoidable fact that estimates from a sample survey are subject to sampling error, sound statistical practice calls for researchers to provide users with some indication of the magnitude of this sampling error. This section of the documentation outlines the

measures of sampling error which Statistics Canada commonly uses and which it urges users producing estimates from this microdata file to use also.

The basis for measuring the potential size of sampling errors is the standard error of the estimates derived from survey results.

However, because of the large variety of estimates that can be produced from a survey, the standard error of an estimate is usually expressed relative to the estimate to which it pertains. This resulting measure, known as the coefficient of variation (C.V) of an estimate, is obtained by dividing the standard error of the estimate by the estimate itself and is expressed as a percentage of the estimate.

For example, suppose that, based upon the survey results, one estimates that 24% of Canadians aged 12 and over are daily cigarettes smokers is found to have standard error of .003. Then the coefficient of variation of the estimate is calculated as:

$$\left(\frac{.003}{.24}\right) \; x \; 100\% \; = \; 1.25\%$$

9. Guidelines For Tabulation, Analysis And Release

This section of the documentation outlines the guidelines to be adhered to by users tabulating, analyzing, publishing or otherwise releasing any data derived from the survey microdata tapes. With the aid of these guidelines, users of microdata should be able to produce figures that are in close agreement with those produced by Statistics Canada and, at the same time, will be able to develop currently unpublished figures in a manner consistent with these established guidelines.

9.1 Rounding Guidelines

In order that estimates for publication or other release derived from these microdata tapes correspond to those produced by Statistics Canada, users are urged to adhere to the following guidelines regarding the rounding of such estimates:

a) Estimates in the main body of a statistical table are to be rounded to the nearest hundred units using the normal rounding technique. In normal rounding, if the first or only digit to be dropped is 0 to 4, the last digit to be retained is not changed. If the first or only digit to be dropped is 5 to 9, the last digit to be retained is raised by one. For example, in normal rounding to the nearest 100, if the last two digits are between 00 and 49, they are changed to 00 and the preceding digit (the hundreds digit) is left unchanged. If the last digits are between 50 and 99 they are changed to 00 and the preceding digit is incremented by 1.

b) Marginal sub-totals and totals in statistical tables are to be derived from their corresponding unrounded components and then are to be rounded themselves to the nearest 100 units using normal rounding.

c) Averages, proportions, rates and percentages are to be computed from unrounded components (i.e. numerators and/or denominators) and then are to be rounded themselves to one decimal using normal rounding. In normal rounding to a single digit, if the final or only digit to be dropped is 0 to 4, the last digit to be retained is not changed. If the first or only digit to be dropped is 5 to 9, the last digit to be retained is increased by 1.

d) Sums and differences of aggregates (or ratios) are to be derived from their corresponding unrounded components and then are to be rounded themselves to the nearest 100 units (or the nearest one decimal) using normal rounding.

e) In instances where, due to technical or other limitations, a rounding technique other than normal rounding is used resulting in estimates to be published or otherwise released which differ from corresponding estimates published by Statistics Canada, users are urged to note the reason for such differences in the publication or release document(s).

f) Under no circumstances are unrounded estimates to be published or otherwise released by users. Unrounded estimates imply greater precision than actually exists.

9.2 Sample Weighting Guidelines for Tabulation

The sample design used for the NPHS was not self-weighting. That is to say, the sampling weights are not identical for all individuals in the sample. When producing simple estimates, including the production of ordinary statistical tables, users must apply the proper sampling weight.

If proper weights are not used, the estimates derived from the microdata tapes cannot be considered to be representative of the survey population, and will not correspond to those produced by Statistics Canada.

Users should also note that some software packages may not allow the generation of estimates that exactly match those available from Statistics Canada, because of their treatment of the weight field.

9.2.1 Definitions of types of estimates: Categorical vs. Quantitative

Before discussing how the NPHS data can be tabulated and analyzed, it is useful to describe the two main types of point estimates of population characteristics which can be generated from the microdata file for the National Population Health Survey.

Categorical Estimates:

Categorical estimates are estimates of the number, or percentage of the surveyed population possessing certain characteristics or falling into some defined category. The number of individuals who smoke daily is an example of such an estimate. An estimate of the number of persons possessing a certain characteristic may also be referred to as an estimate of an aggregate.

Example of Categorical Question:

SMOK-Q2: At the present do/does ... smoke cigarettes daily, occasionally or not at all?

__ Daily
__ Occasionally
__ Not at all

Quantitative Estimates:

Quantitative estimates are estimates of totals or of means, medians and other measures of central tendency of quantities based upon some or all of the members of the surveyed population. They also specifically involve estimates of the form $\hat{X} / \hat{Y}$ where $\hat{X}$ is an estimate of surveyed population quantity total and $\hat{Y}$ is an estimate of the number of persons in the surveyed population contributing to that total quantity.

An example of a quantitative estimate is the average number of cigarettes smoked per day by individuals who smoke daily. The numerator is an estimate of the total number of cigarettes smoked per day by individuals who smoke daily, and its denominator is an estimate of the number of individuals who smoke daily.

Example of Quantitative Question:

SMOK-Q4: How many cigarettes do/does you/he/she smoke each day now?

|_|_| Number of Cigarettes

9.2.2 Tabulation of Categorical Estimates

Estimates of the number of people with a certain characteristic can be obtained from the microdata file by summing the final weights of all records possessing the characteristic(s) of interest. Proportions and ratios of the form $\hat{X} / \hat{Y}$ are obtained by:

a) summing the final weights of records having the characteristic of interest for the numerator ($\hat{X}$),
b) summing the final weights of records having the characteristic of interest for the denominator ($\hat{Y}$), then
c) dividing the numerator estimate by the denominator estimate.

9.2.3 Tabulation of Quantitative Estimates

Estimates of quantities can be obtained from the microdata file by multiplying the value of the variable of interest by the final weight for each record, then summing this quantity over all records of interest. For example, to obtain an estimate of the total number of cigarettes smoked each day by individuals who smoke daily, multiply the value reported in question SMOK-Q4 by the final weight for the record, then sum this value over all records with a response of 'daily' to SMOK-Q2.

To obtain a weighted average of the form $\hat{X} / \hat{Y}$, the numerator ($\hat{X}$) is calculated as for a quantitative estimate and the denominator ($\hat{Y}$) is calculated as for a categorical estimate. For example, to estimate the average number of cigarettes smoked per day by individuals who smoke daily,

a) estimate the total number of cigarettes smoked per day by individuals who smoke daily as described above,
b) estimate the number of individuals who smoke daily by summing the final weights of all records with a response of 'daily' to SMOK-Q2, then
c) divide estimate (a) by estimate (b).

9.3 Guidelines for Statistical Analysis

The National Population Health Survey is based upon a complex design, with stratification and multiple stages of selection, and unequal probabilities of selection of respondents. Using data from such complex surveys presents problems to analysts because the survey design and the selection probabilities affect the estimation and variance calculation procedures that should be used.

While many analysis procedures found in statistical packages allow weights to be used, the meaning or definition of the weight in these procedures differs from that which is appropriate in a sample survey framework, with the result that while in many cases the estimates produced by the packages are correct, the variances that are calculated are almost meaningless.

For many analysis techniques (for example linear regression, logistic regression, analysis of variance), a method exists which can make the application of standard packages more meaningful. If the weights on the records are rescaled so that the average weight is one (1), then the results produced by the standard packages will be more reasonable; they still will not take into account the stratification and clustering of the sample's design, but they will take into account the unequal probabilities of selection. The rescaling can be accomplished by using in the analysis a weight which is equal to the original weight divided by the average of the original weights for the sampled units (people) contributing to the estimator in question.

In order to provide a means of assessing the quality of tabulated estimates, Statistics Canada has produced a set of Approximate Sampling Variability Tables (commonly referred to as "C.V. Tables") for the NPHS. These tables can be used to obtain approximate coefficients of variation for categorical-type estimates and proportions. See Chapter 10 for more details.

9.4 Release Guidelines

Before releasing and/or publishing any estimate from these microdata tapes, users should first determine the number of sampled respondents who contribute to the calculation of the estimate. If this number is less than 30, the weighted estimate should not be released regardless of the value of the coefficient of variation for this estimate. For weighted estimates based on sample sizes of 30 or more, users should determine the coefficient of variation of the rounded estimate and follow the guidelines below.

Sampling Variability Guidelines

Type of Estimate	cv (in %)	Guidelines
1. Unqualified	0.0 - 16.5	Estimates can be considered for general unrestricted release. Requires no special notation.
2. Qualified	16.6 - 25.0	Estimates can be considered for general unrestricted release but should be accompanied by a warning cautioning subsequent users of the high sampling variability associated with the estimates. Such estimates should be identified by the letter Q (or in some other similar fashion).
3. Confidential	25.1 - 33.3	Estimates can be considered for general unrestricted release only when sampling variabilities are obtained using an exact variance calculation procedure. Unless exact variances are obtained, such estimates should be deleted and replaced by dashes (---) in statistical tables.
4. Not for Release	33.4 or greater	Estimates cannot be released in any form under any release OR circumstances. In statistical tables, such estimates should be deleted and replaced by dashes(--)

10. APPROXIMATE SAMPLING VARIABILITY TABLES

In order to supply coefficients of variation which would be applicable to a wide variety of categorical estimates produced from this microdata file and which could be readily accessed by the user, a set of Approximate Sampling Variability Tables has been produced. These "look-up" tables allow the user to obtain an approximate coefficient of variation based on the size of the estimate calculated from the survey data.

The coefficients of variation (C.V) are derived using the variance formula for simple random sampling and incorporating a factor which reflects the multi-stage, clustered nature of the sample design. This factor, known as the design effect, was determined by first calculating design effects for a wide range of characteristics and then choosing from among these a conservative value to be used in the look-up tables which would then apply to the entire set of characteristics.

The four tables below show the design effects, sample sizes and population counts which were used to produce the four sets of Approximate Sampling Variability Tables. The four sets correspond to both the provincial and Canada levels for both household members and selected members, as well as various age groups at the Canada level for both household members and selected members.

Input Data For Provincial and Canada Level Sampling Variability Tables For Household Members (All Ages)

PROVINCE	DESIGN EFFECT	SAMPLE SIZE	POPULATION
Newfoundland	1.39	3,511	573,863
Prince Edward Island	1.28	3,106	132,727
Nova Scotia	1.36	3,071	909,257
New Brunswick	1.34	3,607	742,680
Quebec	1.69	8,461	7,124,848
Ontario	1.67	17,221	10,824,871
Manitoba	2.32	4,744	1,074,307
Saskatchewan	1.33	3,161	969,226
Alberta	1.41	4,487	2,657,513
British Columbia	1.83	7,070	3,608,380
Canada	2.12	58,439	28,617,677

Input Data For Provincial and Canada Level Sampling Variability Tables For Selected Members (Ages 12 and Over)

PROVINCE	DESIGN EFFECT	SAMPLE SIZE	POPULATION
Newfoundland	1.04	918	483,363
Prince Edward Island	0.97	899	109,603
Nova Scotia	1.01	911	763,944
New Brunswick	1.07	1,111	626,303
Quebec	1.22	2,581	6,029,670
Ontario	1.37	5,187	9,050,016
Manitoba	1.61	1,420	890,750
Saskatchewan	1.03	1,005	792,049
Alberta	1.05	1,310	2,166,102
British Columbia	1.54	2,284	3,036,798
Canada	1.64	17,626	23,948,603

Input Data For Canada Level Age Group Sampling Variability Tables For Household Members (All Ages)

AGE GROUP	DESIGN EFFECT	SAMPLE SIZE	POPULATION
0-11	2.03	11,477	4,669,074
12-24	2.13	11,706	5,111,949
25-44	1.79	18,922	9,619,826
45-64	1.84	11,032	5,965,860
65+	1.96	5,302	3,250,967

Input Data For Canada Level Age Group Sampling Variability Tables For Selected Members (Ages 12 and Over)

AGE GROUP	DESIGN EFFECT	SAMPLE SIZE	POPULATION
12-24	1.86	3,242	5,111,949
25-44	1.60	6,790	9,619,826
45-64	1.50	4,451	5,965,860
65+	1.28	3,143	3,250,967

All coefficients of variation in the Approximate Sampling Variability Tables are approximate and, therefore, unofficial. Estimates of actual variance for specific variables may be obtained from Statistics Canada on a cost-recovery basis. The use of actual variance estimates would allow users to release otherwise unreleaseable estimates, i.e. estimates with coefficients of variation in the 'confidential' range.

Remember: If the number of observations on which an estimate is based is less than 30, the weighted estimate should not be released regardless of the value of the coefficient of variation for this estimate. This is because the formulas used for estimating the variance do not hold true for small sample sizes.

10.1 How to use the C.V. tables for Categorical Estimates

The following rules should enable the user to determine the approximate coefficients of variation from the Sampling Variability Tables for estimates of the number, proportion or percentage of the surveyed population possessing a certain characteristic and for ratios and differences between such estimates.

Rule 1: Estimates of Numbers Possessing a Characteristic (Aggregates)

The coefficient of variation depends only on the size of the estimate itself. On the appropriate Sampling Variability Table, locate the estimated number in the left-most column of the table (headed "Numerator of Percentage") and follow the asterisks (if any) across to the first figure encountered. This figure is the approximate coefficient of variation.

Rule 2: Estimates of Proportions or Percentages Possessing a Characteristic

The coefficient of variation of an estimated proportion or percentage depends on both the size of the proportion or percentage and the size of the total upon which the proportion or percentage is based. Estimated proportions or percentages are relatively more reliable than the corresponding estimates of the numerator of the proportion or percentage, when the proportion or percentage is based upon a sub-group of the population. This is due to the fact that the coefficients of variation of the latter type of estimates are based on the largest entry in a row of a particular table, whereas the coefficients of variation of the former type of estimators are based on some entry (not necessarily the largest) in that same row. (Note that in the tables the cv's decline in value reading across a row from left to right). For example, the estimated proportion of individuals who smoke daily out of those who smoke at all is more reliable than the estimated number who smoke daily.

When the proportion or percentage is based upon the total population covered by each specific table, the cv of the proportion or percentage is the same as the cv of the numerator of the proportion or percentage. In this case, Rule 1 can be used.

When the proportion or percentage is based upon a subset of the total population (e.g. those who smoke at all), reference should be made to the proportion or percentage (across the top of the table) and to the numerator of the proportion or percentage (down the left side of the table). The intersection of the appropriate row and column gives the coefficient of variation.

Rule 3: Estimates of Differences Between Aggregates or Percentages

The standard error of a difference between two estimates is approximately equal to the square root of the sum of squares of each standard error considered separately. That is, the standard error of a difference ($\hat{d} = \hat{X}_2 - \hat{X}_1$) is:

$$\sigma_{\hat{d}} = \sqrt{(\hat{X}_1 \alpha_1)^2 + (\hat{X}_2 \alpha_2)^2}$$

where $\hat{X}_1$ is estimate 1, $\hat{X}_2$ is estimate 2, and α_1 and α_2 are the coefficients of variation of $\hat{X}_1$ and $\hat{X}_2$ respectively. The coefficient of variation of $\hat{d}$ is given by $\sigma_{\hat{d}} / \hat{d}$. This formula is accurate for the difference between separate and uncorrelated characteristics, but is only approximate otherwise.

Rule 4: Estimates of Ratios

In the case where the numerator is a subset of the denominator, the ratio should be converted to a percentage and Rule 2 applied. This would apply, for example, to the case where the denominator is the number of individuals who smoke at all and the numerator is the number of individuals who smoke daily out of those who smoke at all.

Consider the case where the numerator is not a subset of the denominator, as for example, the ratio of the number of individuals who smoke daily or occasionally as compared to the number of individuals who do not smoke at all. The standard deviation of the ratio of the estimates is approximately equal to the square root of the sum of squares of each coefficient of variation considered separately multiplied by $\hat{R}$, where $\hat{R}$ is the ratio of the estimates ($\hat{R} = \hat{X}_1 / \hat{X}_2$). That is, the standard error of a ratio is:

$$\sigma_{\hat{R}} = \hat{R}\sqrt{\alpha_1^2 + \alpha_2^2}$$

where α_1 and α_2 are the coefficients of variation of $\hat{X}_1$ and $\hat{X}_2$ respectively.

The coefficient of variation of $\hat{R}$ is given by $\sigma_{\hat{R}} / \hat{R} = \sqrt{\alpha_1^2 + \alpha_2^2}$. The formula will tend to overstate the error, if $\hat{X}_1$ and $\hat{X}_2$ are positively correlated and understate the error if $\hat{X}_1$ and $\hat{X}_2$ are negatively correlated.

Rule 5: Estimates of Differences of Ratios

In this case, Rules 3 and 4 are combined. The cv's for the two ratios are first determined using Rule 4, and then the cv of their difference is found using Rule 3.

10.2 Examples of using the C.V. tables for Categorical Estimates

The following 'real life' examples are included to assist users in applying the foregoing rules.

Example 1 : Estimates of Numbers Possessing a Characteristic (Aggregates)

Suppose that a user estimates that 5,958,122 individuals smoke daily in Canada. How does the user determine the coefficient of variation of this estimate?

1) Refer to the CANADA level cv table for SELECTED MEMBERS.

2) The estimated aggregate (5,958,122) does not appear in the left-hand column (the 'Numerator of Percentage' column), so it is necessary to use the figure closest to it, namely 6,000,000.

3) The coefficient of variation for an estimated aggregate (expressed as a percentage) is found by referring to the first non-asterisk entry on that row, namely, 1.6%.

4) So the approximate coefficient of variation of the estimate is 1.6%. The finding that there were 5,958,122 individuals who smoke daily is publishable with no qualifications.

Example 2 : Estimates of Proportions or Percentages Possessing a Characteristic

Suppose that the user estimates that 5,958,122/8,937,183=66.7% of individuals in Canada who smoke at all smoke daily. How does the user determine the coefficient of variation of this estimate?

1) Refer to the CANADA level cv table for SELECTED MEMBERS.

2) Because the estimate is a percentage which is based on a subset of the total population (i.e., individuals who smoke at all, that is to say, daily or occasionally), it is necessary to use both the percentage (66.7%) and the numerator portion of the percentage (5,958,122) in determining the coefficient of variation.

3) The numerator, 5,958,122, does not appear in the left-hand column (the 'Numerator of Percentage' column) so it is necessary to use the figure closest to it, namely 6,000,000. Similarly, the percentage estimate does not appear as any of the column headings, so it is necessary to use the figure closest to it, 70.0%.

4) The figure at the intersection of the row and column used, namely 1.1% is the coefficient of variation (expressed as a percentage) to be used.

5) So the approximate coefficient of variation of the estimate is 1.1%. The finding that 66.7% of individuals who smoke at all smoke daily can be published with no qualifications.

Example 3 : Estimates of Differences Between Aggregates or Percentages

Suppose that a user estimates that 2,859,899/5,958,122=48% of those who smoke daily smoke 10 or more cigarettes daily (estimate 1) while 3,160,514/4,329,471=73% of those who smoke occasionally or not at all, but at one time smoked daily, smoked 10 or more cigarettes daily at that time (estimate 2). Note that these estimates are based on the results of questions SMOK-Q2, SMOK-Q4, SMOK-Q4A, SMOK-Q5 and SMOK-Q7. How does the user determine the coefficient of variation of the difference between these two estimates?

1) Using the CANADA level cv table for SELECTED MEMBERS in the same manner as described in example 2 gives the cv for estimate 1 as 1.9% (expressed as a percentage), and the cv for estimate 2 as 1.5% (expressed as a percentage).

2) Using rule 3, the standard error of a difference ($\hat{d} = \hat{X}_2 - \hat{X}_1$) is:

$$\sigma_{\hat{d}} = \sqrt{(\hat{X}_1 \alpha_1)^2 + (\hat{X}_2 \alpha_2)^2}$$

where $\hat{X}_1$ is estimate 1, $\hat{X}_2$ is estimate 2, and α_1 and α_2 are the coefficients of variation of $\hat{X}_1$ and $\hat{X}_2$ respectively.

That is, the standard error of the difference $\hat{d} = (.73-.48) = .25$ is:

$$\sigma_{\hat{d}} = \sqrt{[(.48)(.019)]^2 + [(.73)(.015)]^2}$$
$$= .014$$

3) The coefficient of variation of $\hat{d}$ is given by $\sigma_{\hat{d}} / \hat{d} = .014/.25 = 0.056$.

4) So the approximate coefficient of variation of the difference between the estimates is 5.6% (expressed as a percentage). This estimate can be published with no qualifications.

Example 4 : Estimates of Ratios

Suppose that the user estimates that 5,958,122 individuals smoke daily, while 1,732,412 individuals smoke occasionally. The user is interested in comparing the estimate of daily to occasional smokers in the form of a ratio. How does the user determine the coefficient of variation of this estimate?

1) First of all, this estimate is a ratio estimate, where the numerator of the estimate (= $\hat{X}_1$) is the number of individuals who smoke occasionally. The denominator of the estimate (= $\hat{X}_2$) is the number of individuals who smoke daily.

2) Refer to the CANADA level cv table for SELECTED MEMBERS.

3) The numerator of this ratio estimate is 1,732,412. The figure closest to it is 1,500,000. The coefficient of variation for this estimate (expressed as a percentage) is found by referring to the first non-asterisk entry on that row, namely, 3.7%.

4) The denominator of this ratio estimate is 5,958,122. The figure closest to it is 6,000,000. The coefficient of variation for this estimate (expressed as a percentage) is found by referring to the first non-asterisk entry on that row, namely, 1.6%.

5) So the approximate coefficient of variation of the ratio estimate is given by rule 4, which is,

$$\alpha_{\hat{R}} = \sqrt{\alpha_1^2 + \alpha_2^2}$$

where α_1 and α_2 are the coefficients of variation of $\hat{X}_1$ and $\hat{X}_2$ respectively.

That is ,

$$\alpha_{\hat{R}} = \sqrt{(.037)^2 + (.016)^2}$$

$$= 0.040$$

The obtained ratio of occasional to daily smokers is 1,732,412/5,958,122 which is 0.29:1. The coefficient of variation of this estimate is 4.0% (expressed as a percentage), which is releasable with no qualifications.

10.3 How to use the C.V. tables to obtain Confidence Limits

Although coefficients of variation are widely used, a more intuitively meaningful measure of sampling error is the confidence interval of an estimate. A confidence interval constitutes a statement on the level of confidence that the true value for the population lies within a specified range of values. For example a 95% confidence interval can be described as follows:

If sampling of the population is repeated indefinitely, each sample leading to a new confidence interval for an estimate, then in 95% of the samples the interval will cover the true population value.

Using the standard error of an estimate, confidence intervals for estimates may be obtained under the assumption that under repeated sampling of the population, the various estimates obtained for a population characteristic are normally distributed about the true population value. Under this assumption, the chances are about 68 out of 100 that the difference between a sample estimate and the true population value would be less than one standard error, about 95 out of 100 that the difference would be less than two standard errors, and about 99 out 100 that the differences would be less than three standard errors. These different degrees of confidence are referred to as the confidence levels.

Confidence intervals for an estimate, $\hat{X}$, are generally expressed as two numbers, one below the estimate and one above the estimate, as ($\hat{X}$-k, $\hat{X}$+k) where k is determined depending upon the level of confidence desired and the sampling error of the estimate.

Confidence intervals for an estimate can be calculated directly from the Approximate Sampling Variability Tables by first determining from the appropriate table the coefficient of variation of the estimate $\hat{X}$, and then using the following formula to convert to a confidence interval CI:

$$CI_{\hat{X}} = [\hat{X} - t\hat{X}\alpha_{\hat{X}} , \hat{X} + t\hat{X}\alpha_{\hat{X}}]$$

where $\alpha_{\hat{X}}$ is the determined coefficient of variation of $\hat{X}$, and

t = 1 if a 68% confidence interval is desired
t = 1.6 if a 90% confidence interval is desired
t = 2 if a 95% confidence interval is desired
t = 3 if a 99% confidence interval is desired.

Note: Release guidelines which apply to the estimate also apply to the confidence interval. For example, if the estimate is not releasable, then the confidence interval is not releasable either.

10.4 Example of using the C.V. tables to obtain confidence limits

A 95% confidence interval for the estimated proportion of individuals who smoke daily from those who smoke at all (from example 2, section 10.2) would be calculated as follows.

$\hat{X} = .667$

$t = 2$

$\alpha_{\hat{X}} = .011$ is the coefficient of variation of this estimate as determined from the tables.

$CI_X = \{.667 - (2)\ (.667)\ (.011),\ .667 + (2)\ (.667)\ (.011)\}$

$CI_X = \{.652, .682\}$

10.5 How to use the C.V. tables to do a t-test

Standard errors may also be used to perform hypothesis testing, a procedure for distinguishing between population parameters using sample estimates. The sample estimates can be numbers, averages, percentages, ratios, etc. Tests may be performed at various levels of significance, where a level of significance is the probability of concluding that the characteristics are different when, in fact, they are identical.

Let X_1 and X_2 be sample estimates for 2 characteristics of interest. Let the standard error on the difference $\hat{X}_1 - \hat{X}_2$ be $\sigma_{\hat{d}}$.

If $t = \dfrac{\hat{X}_1 - \hat{X}_2}{\sigma_{\hat{d}}}$ is between -2 and 2, then no conclusion about the difference between the characteristics is justified at the 5% level of significance. If however, this ratio is smaller than -2 or larger than +2, the observed difference is significant at the 0.05 level.

10.6 Example of using the C.V. tables to do a t-test

Let us suppose we wish to test, at 5% level of significance, the hypothesis that there is no difference between the proportion of individuals who smoke daily at a rate of 10 or more cigarettes AND the proportion of those who smoke occasionally or not at all, but at one time smoked daily at a rate of 10 or more cigarettes. From example 3, section 10.2, the standard error of the difference between these two estimates was found to be = .014. Hence ,

$$t = \frac{\hat{X}_1 - \hat{X}_2}{\sigma_{\hat{d}}} = \frac{.73 - .48}{.014} = \frac{.25}{.014} = 17.86$$

Since t = 13.16 is greater than 2, it must be concluded that there is a significant difference between the two estimates at the 0.05 level of significance.

10.7 Exact Variances/ Coefficients of Variation

All coefficients of variation in the Approximate Sampling Variability Tables (ASV Tables) are indeed approximate and, therefore, unofficial. However, exact coefficients of variation for specific variables may be obtained from Statistics Canada on a cost-recovery basis. The types of estimates supported include aggregates, proportions, ratios, differences between aggregates, proportions or ratios, as well as more sophisticated types of analyses such as estimates of coefficients from linear regressions and logistic regressions, among others. The exact coefficients of variation are obtained via an exact variance program, which uses a technique called "jackknifing". This technique involves dividing the records on the microdata files into subgroups (or replicates) and determining the variation in the estimates from replicate to replicate. There are a number of reasons why a user may require an exact variance. A few are given below.

Firstly, if a user desires estimates at a geographic level smaller than the province (for example, at the urban/rural level), then the ASV tables provided are not adequate. Coefficients of variation of these estimates may be obtained using "domain" estimation techniques through the exact variance program.

Secondly, should a user require more sophisticated analyses such as estimates of coefficients from linear regressions or logistic regressions, the ASV tables will not provide correct associated coefficients of variation. Although some standard statistical packages allow sampling weights to be incorporated in the analyses, the variances that are produced often do not take into account the stratified and clustered nature of the design properly, whereas the exact variance program would do so.

Thirdly, for estimates of quantitative variables, separate tables are required to determine their sampling error. Since most of the variables for the National Population Health Survey are primarily categorical in nature, this has not been done. Thus, users wishing to obtain coefficients of variation for quantitative variables can do so through the exact variance program. As a general rule, however, the coefficient of variation of a quantitative total will be larger than the coefficient of variation of the corresponding category estimate (i.e., the estimate of the number of persons contributing to the quantitative estimate). If the corresponding category estimate is not releasable, the quantitative estimate will not be either. For example, the coefficient of variation of the estimate of the total number of cigarettes smoked each day by individuals who smoke daily would be greater than the coefficient of variation of the corresponding estimate of the number of individuals who smoke daily. Hence if the coefficient of variation of the latter is not releasable, then the coefficient of variation of the corresponding quantitative estimate will also not be releasable.

Lastly, should a user find himself/ herself in a position where he/she can use the ASV tables, but this renders a coefficient of variation in the "confidential" range (25.1% - 33.3%), the user should not release the associated estimate unless the coefficient of variation is recalculated through the exact variance program and it is found that the estimate is in fact releasable. The reason for this is that the coefficients of variation produced by the ASV tables are based on a wide range of variables and are therefore considered crude, whereas the exact variance program would give an exact coefficient of variation associated with the variable in question.

The exact variance/ coefficient of variation program will be available in November of 1995 and any user interested in this service should contact Diane Stukel (613-951-2244) from the Health Statistics Methods Section within Household Survey Methods Division at Statistics Canada. Although there will be no charge for any computer time required, there will be a fee charged for any consultation time required to set up the request as well as for any time required to set up the associated computer runs. The daily consultation rate, based on a 7.5 hour day, is $477.88; this rate may be broken down into an appropriate number of hours or minutes, if required. Naturally, the length of the consultation will vary from request to request and will depend upon the complexity of the analysis, the number of variables to be analyzed, etc.

10.8 Release cut-off's for the NPHS

The minimum cut-offs for estimates of totals at the provincial and Canada levels as well as those for various age groups at the Canada level, for both household members and selected members, are specified in the four tables below. Estimate sizes smaller than the minimum given in the "Confidential" column may not be released under any circumstances.

Table of Release Cut-offs for Totals Based on Provincial/ Canada Level Estimates for Household Members (All Ages)

Province	Unqualified	Qualified	Confidential
Newfoundland	8,000	3,500	2,000
Prince Edward Island	2,000	1,000	500
Nova Scotia	14,500	6,500	3,500
New Brunswick	10,000	4,500	2,500
Quebec	52,000	22,500	13,000
Ontario	38,500	17,000	9,500
Manitoba	19,000	8,500	4,500
Saskatchewan	15,000	6,500	3,500
Alberta	30,500	13,500	7,500
British Columbia	34,000	15,000	8,500
CANADA	38,000	16,500	9,500

Table of Release Cut-offs for Totals Based on Provincial/ Canada Level Estimates for Selected Members (Ages 12 and Over)

Province	Unqualified	Qualified	Confidential
Newfoundland	19,500	8,500	5,000
Prince Edward Island	4,000	2,000	1,000
Nova Scotia	30,000	13,500	7,500
New Brunswick	21,500	9,500	5,500
Quebec	103,000	45,500	25,500
Ontario	87,000	38,000	21,500
Manitoba	35,500	16,000	9,000
Saskatchewan	28,500	13,000	7,500
Alberta	62,000	27,500	15,500
British Columbia	73,500	32,500	18,500
CANADA	81,500	35,500	20,000

Table of Release Cut-offs for Totals Based on Age Group Estimates at the Canada Level for Household Members (All Ages)

Age Group	Unqualified	Qualified	Confidential
0-11	30,000	13,000	7,500
12-24	34,000	15,000	8,500
25-44	33,500	14,500	8,000
45-64	36,500	16,000	9,000
65+	43,500	19,000	11,000

Table of Release Cut-offs for Totals Based on Age Group
Estimates at the Canada Level for Selected Members (Ages 12 and Over)

Age Group	Unqualified	Qualified	Confidential
12-24	105,500	46,500	26,500
25-44	82,500	36,000	20,500
45-64	73,000	32,000	18,000
65+	48,000	21,000	12,000

11. Weighting

The household component of the National Population Health Survey has two basic designs: one for the nine provinces outside of Quebec, and one for Quebec. In the nine provinces outside of Quebec, the NPHS uses the design of the Labour Force Survey (LFS) with many modifications, to generate a sample of its own. For this reason, the derivation of weights is tied to the weighting procedure used for the LFS. In addition to the NPHS sample derived from the LFS design, there is a small additional independent sample drawn in the Prince George health region of B.C. via Random Digit Dialling (RDD), in order to allow for the production of reliable estimates at the health region level. In Quebec, however, a two-phase sample design was implemented, where the first phase was drawn by the Enquête Sociale et de Santé (ESS) in 1992-93, and the second phase sample was drawn by the NPHS. Thus, in Quebec, the derivation of the weights is tied to the weighting procedure used by the ESS. See the section entitled "Sample Design" for more details. In section 11.1 below, the weighting procedure for the provinces outside of Quebec is described, and in section 11.2, the weighting procedure for Quebec is outlined.

11.1 Weighting Procedure for the Provinces Outside of Quebec

To begin, the basic LFS weighting procedure is briefly described below, followed by the basic RDD weighting procedure. Then, a description of a number of other multiplicative weight adjustments that are necessary in the formation of final weights is given.

11.1.1 LFS Basic Weights

The LFS uses a stratified multi-stage design (mainly 2-stage, but in some cases, 3-stage).

For example, in those places where a 2-stage design is used, at the first stage, clusters are selected using either probability proportional-to-size, size systematic without replacement (PPS systematic) sampling or randomized PPS systematic sampling or the random group method. For more information on these methods, contact Diane Stukel in the Health Statistics Methods Section within Household Survey Methods Division at Statistics Canada. An LFS "cluster weight" is then calculated as the inverse probability of selecting a cluster, in accordance with the above sample selection schemes.

At the second stage, dwellings are selected within sampled clusters using systematic sampling. A "dwelling weight" is calculated as the inverse probability of selecting a dwelling given that the cluster which contains it is selected.
An "LFS basic weight" is then given by the product of the cluster weight and the dwelling weight.

11.1.2 RDD Basic Weights

Random Digit Dialling was implemented using the Elimination of Non-Working Banks Method, which gives rise to a stratified simple random sample (without replacement) of residential telephone lines. The entire RDD sample was drawn within three RDD strata, which were in no way related to the strata used in the LFS design in the Prince George region. Thus, an "RDD basic weight" is given by the inverse probability of selecting a residential telephone line from the list of working banks of numbers.

11.1.3 Further Weight Adjustments to the Basic Weights

All of the weight adjustments which follow are applied to the LFS basic weight, to compensate for design features specific to the LFS. However, a few are applied to the RDD basic weights, since they are germane to that design as well (specifically, the Multiples Weight Adjustment and the Household Non-response Weight Adjustment).

Adjustment 1: Rotation Group Weight Adjustment

The full LFS sample is comprised of 6 "rotation groups" (although in some remote areas and apartment strata this number differs from 6). In the LFS, the rotation group that has been in the sample for six months is rotated out of the sample, and a fresh rotation group is rotated in to replace it. This serves to reduce the respondent burden. The NPHS requests sample from the LFS in terms of integral numbers of rotation groups (between 1 and 6), although a fractional number may actually be required to fulfil sample size needs. For example, the NPHS may require 2.3 rotations. It will request 3 from the LFS and later "stabilize out" the .7 rotations that are not needed (see Stabilization Weight Adjustment). Thus, the first multiplicative weight adjustment, which compensates for the integral number requested, is given by:

$$\frac{\textit{number of rotations in an LFS stratum used by LFS (usually 6)}}{\textit{integral number of rotations in an LFS stratum requested by NPHS}}.$$

In Winnipeg there are two instances and in Vancouver one instance where, in each case, three LFS strata were collapsed together before selecting clusters within the collapsed strata. For these three cases, an extra adjustment is made to the corresponding LFS basic weights to reflect the fact that clusters were selected via (randomized) PPS systematic sampling within the collapsed strata rather than within the usual LFS strata.

Adjustment 2: Cluster Growth Weight Adjustment

There may be clusters which experience growth between the time when a Census enumeration of the cluster takes place and the time when the cluster is listed for the LFS. The cluster selection probability is based on the Census enumeration figure, which may be out of date. This has the effect that the number of dwellings in the LFS sample increases very slightly with moderate growth in the housing stock. Substantial growth can be tolerated in an isolated cluster before the additional sample represents a field collection problem. However, if growth takes place in more than one cluster in an interviewer assignment, the cumulative effect of all the increases may create a workload problem. In clusters where substantial growth has taken place, subsampling is used as a means of keeping interviewer assignments manageable. The NPHS also institutes a similar subsampling of clusters which have experienced moderate growth, albeit the growth is not great enough so that the cluster is considered to be a growth cluster by the LFS. Thus, the second multiplicative weight adjustment is given by the inverse of this subsampling ratio in clusters where subsampling has occurred for either the LFS or the NPHS.

Adjustment 3: Stabilization Weight Adjustment

Stabilization is a means of capping the sample size within a stabilization area to prevent the associated costs from becoming too prohibitive. A "stabilization area" consists of clusters in the high-income and apartment frame, and consists of groups of strata in the regular frame. "Stabilization" addresses the problem of growth that occurs within a stabilization area. The growth is large enough to be a concern even after cluster growth adjustment, although no single cluster contributes to the growth substantially enough to be considered the root of the problem. This problem is remedied through subsampling within the stabilization area. In addition to regular stabilization, it is at this point that the fractional part of a rotation requested of the LFS but not required by the NPHS, is "stabilized out" through subsampling (see Rotation Group Weight Adjustment). Thus, the third multiplicative weight adjustment is given by:

$$\frac{\textit{number of dwellings selected by the LFS within a cluster}}{\textit{number of dwellings actually used by the NPHS within a cluster}}.$$

Adjustment 4: Multiples Weight Adjustment

It sometimes happens that an interviewer discovers that a listing that was thought to constitute single private occupied dwelling in fact constitutes two or more

private occupied dwellings. This may happen, for instance, when a basement apartment is attached to a dwelling but has its own separate entrance. In this case, since interviewing takes place in only one of the two private occupied dwellings (selected at random), the weight associated with that dwelling is boosted up by a factor of two. Thus, the fourth multiplicative weight adjustment is given by the number of private occupied dwellings that the listing in question actually constitutes. For most listings, this adjustment factor will be one.

A similar type of weight adjustment is made separately for the RDD sample. A household that contains, say, two residential telephone lines which are both listed on the RDD frame has twice the probability of being selected as one with one such line. Thus, sampled households for which it is ascertained that multiple telephone lines are present within are assigned a weight adjustment equal to the inverse of the number of residential telephone lines within the household. Note that this adjustment is the inverted version of the adjustment made for LFS multiple dwellings.

Adjustment 5: Household Non-response Weight Adjustment

Despite all the attempts made by the interviewers, some non-response at the household level is inevitable. Non-response encompasses any of the following situations: refusal, special circumstance, language barrier, no one at home, temporarily absent or computer problem. Non-response is compensated for by proportionally adjusting the weights of responding households. This fifth adjustment is given by:

$$\frac{\textit{sum of weights for all sampled households in an NPHS stratum/season combination}}{\textit{sum of weights for respondent households in an NPHS stratum/season combination}}.$$

Note that this adjustment is made at the NPHS stratum level for each season. Here, NPHS strata are groups of LFS strata. The adjustment was made at this level since it was the smallest geographic level which ensured stability (i.e., adjustments less than or equal to 2.5). The adjustment was calculated separately for each season since the non-response rate was significantly different for each season. Here, the first two quarters of collection constitute the summer "season" while the last two quarters of collection constitute the winter "season". For those few cases where the nonresponse adjustment exceeded 2.5, the adjustment was recalculated at the NPHS stratum level rather than at the NPHS stratum/season level. The "weights" referred to above are the LFS basic weight multiplied by all the adjustments to this point (i.e., weight adjustments one through four). The adjustment is based on the assumption that the households that were actually

interviewed represent the characteristics of those that should have been interviewed. To the extent that this assumption is not true, the estimates are somewhat biased. Note that some non-respondents in a given collection period were successfully recontacted in a later period. These cases were treated as if they had responded in the collection period in which they were intended to be interviewed. Given the number of such cases, it is not expected that this will have a significant effect on seasonal data.

Since the RDD sample also experiences household non-response, a separate weight adjustment is made to compensate for this, although the method of adjustment used is almost identical to the one above. The first difference is that the weight adjustment is now made at the level of RDD stratum and season. The second difference is that the "weights" referred to in the formula are now the RDD basic weights multiplied by the RDD Multiples Weight Adjustment.

Adjustment 6: Rejective Method Weight Adjustment

As discussed in the section entitled "Sample Design", in the last two quarters of data collection a portion of the sampled households are screened out or rejected from the sample after determining that there are no youths or children residing within (i.e., no one under the age of 25). These "rejected" households come from that portion of the "Children Sample" that are "screened" for household composition. This methodology was implemented to compensate for an over-representation in the sample of members of small sized households and an under-representation of members of large sized households. The latter type of household tends to consist of parents and their children while the former type tends to consist of single people, older people or couples without children. Since some of the households containing no youths or children are screened out or "rejected", representation in the sample of households of this type comes solely from the "Adult Sample" and from the non-screened portion of the "Children Sample". Thus, to compensate for the "rejected" part of the sample, the weights for those households containing no youths or children from the "Adult Sample" and from the non-screened portion of the "Children Sample" are boosted by another multiplicative weight adjustment. This sixth adjustment is given by the inverse of one minus the overall screening rate within a stratum. Note that in P.E.I., this adjustment was implemented a little differently since, among other reasons, the rejective method was applied in all four quarters of data collection rather that in the last two quarters only. Also note that this adjustment was not applied in apartment strata, high income strata and remote strata, since the rejective method was not implemented there.

11.1.4 Further Weight Adjustments For Household Members

Data from the household members questionnaire is obtained for each member of a sampled household. The associated final weight for each individual on this file is obtained as follows. First, the LFS basic weight is multiplied by weight adjustments one through six, as well as the Household Member Non-response Weight Adjustment given below, to form an LFS "intermediate" weight. Then, the RDD basic weight is multiplied by the RDD Multiples Weight Adjustment, the RDD Household Non-response Weight Adjustment, and the RDD Household Member Non-response Weight Adjustment given below to form an RDD "intermediate" weight. The two independent samples (LFS and RDD) in the Prince George region are then combined via the "Household Member Weight Adjustment to Combine the LFS and RDD Samples" below, using the LFS and RDD "intermediate" weights as inputs. Finally, benchmarking is performed using the combined sample in the Prince George region and the usual LFS sample elsewhere.

Adjustment 7A: Household Member Non-response Weight Adjustment

It may happen that, although a household itself is considered to be "responding", the household member information for some of the members within the household is not complete. The members for which this is true are considered to be household member non-respondents and a weight adjustment is made to responding members in the same age-sex group and province, to compensate. The multiplicative adjustment is given by:

$$\frac{\textit{sum of weights of all sampled household members in a province–age–sex category}}{\textit{sum of weights of respondent household members in a province–age–sex category}}.$$

The "weights" referred to above are the LFS basic weight multiplied by all the adjustments to this point (i.e., weight adjustments one through six). The age categories used for each of the two sexes are: 0-11, 12-24, 25-44, 45-64, and 65+.

The adjustment for household member non-response coming from the RDD sample is implemented separately, although the adjustment itself is almost identical to the one above. The first difference is that the "weights" referred to in the formula are the RDD basic weights multiplied by RDD weight adjustments four and five. The second difference is that the weight adjustment is made within age/sex categories in the Prince George region rather than within age/sex categories in each province.

Adjustment 8A: Household Member Weight Adjustment to Combine the LFS and RDD Samples

Although an independent sample was drawn using the RDD technique in the Prince George region of B.C., regular LFS sampling also took place in this region. Since the two samples are independent but represent geographic areas which overlap, a dual frame approach was utilized to combine them. The approach used was applied within the entire of B.C. The method essentially consists of three multiplicative weight adjustments. The first is applied to the "RDD weights" corresponding to the RDD sample falling inside the three RDD strata within which RDD sampling took place. The second is applied to the "LFS weights" corresponding to the LFS sample also falling inside the three RDD strata. The third is applied to the "LFS weights" corresponding to the LFS sample falling outside the three RDD strata but within the rest of B.C. The weight adjustments themselves are rather complex; for more details see Skinner, C. and Rao, J.N.K. (*JASA*, 1996). The "RDD weights" referred to above consist of the RDD basic weights multiplied by RDD weight adjustments 4, 5 and 7A. The "LFS weights" referred to above consist of the LFS basic weights multiplied by weight adjustments 1 through 6 as well as 7A.

Adjustment 9A: Household Member Benchmarking Weight Adjustment

Independent estimates in the form of population projections are available monthly for various age and sex groups by province. The population projections are based on the most recent Census data, as well as records of births and deaths, and estimates of migration. In the final step, this auxiliary information is used to transform the weights to this point into final weights. The Household Member Benchmarking Weight Adjustment ensures that the final weights sum to the population projections mentioned above for the auxiliary variables in question, that is, for the following age categories for both males and females: 0-11, 12-24, 25-44, 45-64, 65+. Thus, this multiplicative weight adjustment is given by:

$$\frac{\textit{population projection for a province–age–sex category}}{\textit{sum of weights of respondent household members in a province–age–sex category}}.$$

The "weights" referred to in the above equation involve both the LFS weights and the RDD weights to this point. For the LFS, this means the LFS basic weights multiplied by the last eight weight adjustments. For RDD, this means the RDD basic weights multiplied by RDD weight adjustments 4, 5, 7A, and 8A. Since the data was collected over four quarters, the population projections used in the

benchmarking are an average of the projections for the four months in which the survey took place. At the last step, the final weights are formed by multiplying the "weights" to this point by the above Household Member Benchmarking Weight Adjustment.

11.1.5 Further Weight Adjustments For Selected Members

Data from the selected member questionnaire is obtained for only one member aged 12 or more from a sampled household. The associated final weight for each individual on this file is obtained as follows. First, the LFS basic weight is multiplied by weight adjustments one through six, as well as weight adjustments 7B through 10B given below, to form an LFS "intermediate" weight. Then, the RDD basic weight is multiplied by RDD weight adjustments 4, 5, and 8B through 10B given below, to form an RDD "intermediate" weight. The two independent samples (LFS and RDD) in the Prince George region are then combined via the "Selected Member Weight Adjustment to Combine the LFS and RDD Samples" below, using the LFS and RDD "intermediate" weights as inputs. Finally, benchmarking is performed using the combined sample in the Prince George region and the usual LFS sample elsewhere.

Adjustment 7B: NLSC Integration Weight Adjustment

In the last two quarters of data collection, the NPHS selects potential respondents for both the NPHS and NLSC selected member questionnaire. In some sampled households, a maximum of 4 children (aged less than 12) are selected, but are administered the NLSC questionnaire. Their data does not reside on the present microdata file. In other households, the one respondent aged 12 or older is selected and administered the NPHS questionnaire. The data for these respondents resides on the present microdata file. For more details on integration with the NLSC, see the section entitled "Sample Design". The respondents aged 12 or more from households containing children are selected from the "Adult Sample" only. To compensate for the fact that households containing children coming from the "Children Sample" do not contribute to the estimates for individuals aged 12 or more, the weights for those households containing children sampled in the last two quarters that come from the "Adult Sample" are boosted by the multiplicative weight adjustment given by the inverse of the proportion of the total sample which is assigned to the "Adult Sample". For those individuals aged greater than 12, one adjustment is made at the cluster level. On the other hand, for those aged 12, a separate adjustment is made for groups of LFS strata (which usually correspond to NPHS strata), to be consistent with Adjustment 9B, which is also made at this level.

Adjustment 8B: Selected Member Inverse Selection Probability

As mentioned above, one member aged 12 or more from each sampled household is chosen as the selected member. A weight adjustment must be made to reflect the selection and is given by the inverse selection probability. The original intention was that each member aged 12 or more would be selected with equal probability given by the inverse of the number of members in the household aged 12 or more. However, due to an error made in the CAPI application, no 12 year old were selected in the first two quarters. To compensate, in the last two quarters, instead of each member of a household being selected with the same probability, 12 year old were given a larger probability of selection. In P.E.I., 12 year old were twice as likely to be selected as any other member aged 13 or more, and elsewhere in Canada, 1.75 times as likely to be selected as any other member aged 13 or more .

This inverse selection probability was calculated for the RDD sample as well.

Adjustment 9B: Twelve Year Old Weight Adjustment

Due to the error mentioned above, twelve year olds were only selected in the last two quarters of data collection. In order to obtain an accurate representation of twelve year olds, their weights had to be adjusted to account for the first two quarters when they had no probability of being selected. This adjustment is made for groups of LFS strata which usually correspond to NPHS strata, except for the cases of remote and high income strata. In households with children, twelve year olds could be selected from the "Adult Sample" in all quarters, but were actually only selected from the "Adult Sample" in the last two quarters. Since, within most NPHS strata, 40% of the "Adult Sample" occurred in the last two quarters, the weights of twelve year olds selected in these two quarters were boosted by the inverse of this rate, or by 2.5. On the other hand, in households with youths but no children, twelve year olds could be selected from both the "Adult Sample" and the "Children Sample". However, in the first two quarters, they were not selected from the "Adult Sample" as they should have been. Thus, in households with youths but no children, the weights of twelve year olds were boosted by a multiplicative factor given by the ratio of the percentage of the total sample within an NPHS stratum where they should have been selected to the percentage of the total sample where they were actually selected, or by 1.6. Finally, in households with no youths or children, twelve year olds could never be selected, so no adjustment was made to the weights of twelve year olds in this household type. Note that the rates differ somewhat in P.E.I., apartment strata, high income strata and remote strata.

This was implemented for both the LFS and RDD samples.

Adjustment 10B: Selected Member Non-response Weight Adjustment

It may happen that, although a household is considered to be "responding", the information for the selected member of the household was not completed. The members for which this is true are considered to be selected member non-respondents and a weight adjustment is made to responding selected members in the same age-sex group and province, to compensate. The multiplicative adjustment is given by:

$$\frac{\textit{sum of weights of all sampled selected members in a province–age–sex category}}{\textit{sum of weights of respondent selected members in a province–age–sex category}}.$$

The "weights" referred to above are the LFS basic weights multiplied by all the adjustments to this point (i.e., weight adjustments 1 through 6 as well as 7B through 9B). The age categories used for each of the two sexes are: 12-24, 25-44, 45-64, and 65+ since only those aged 12 or more are administered the selected member questionnaire.

The adjustment for selected member non-response coming from the RDD sample is implemented separately, although the adjustment itself is almost identical to the one above. The first difference is that the "weights" referred to in the formula are now the RDD basic weights multiplied by RDD weight adjustments 4, 5, 8B and 9B. The second difference is that the weight adjustment is made within age/sex categories in the Prince George region rather than within age/sex categories in each province.

Adjustment 11B: Selected Member Weight Adjustment to Combine the LFS and RDD Samples

This weight adjustment is identical to the one for household members except that the "RDD weights" referred to consist of the RDD basic weights multiplied by RDD weight adjustments 4, 5, 8B, 9B and 10B. The "LFS weights" referred to consist of the LFS basic weights multiplied by weight adjustments one through six, as well as the first four weight adjustments in this section.

Adjustment 12B: Selected Member Benchmarking Weight Adjustment

This weight adjustment is similar to the Household Member Benchmarking Weight Adjustment, and is given by:

$$\frac{\textit{population projection for a province–age–sex category}}{\textit{sum of weights of respondent selected members in a province–age–sex category}}.$$

Here, the age categories used for both females and males are given by: 12-24, 25-44, 45-64, and 65+. The "weights" referred to in the above equation involve both the LFS weights and the RDD weights to this point. For the LFS, this means the LFS basic weights multiplied by weight adjustments one through six as well as the first five weight adjustments in this section. For RDD, this means the RDD basic weights multiplied by RDD weight adjustments 4, 5, and 8B through 11B. Since the data was collected over four quarters, the population projections used in the benchmarking are an average of the projections for the four months in which the survey took place. At the last step, the final weights are formed by multiplying the "weights" to this point by the above Selected Member Benchmarking Weight Adjustment.

11.2 Weighting Procedures for Quebec

The National Population Health Survey used a subsample of the *Enquête sociale et de santé* (ESS) in its design (see "Sample Design" section for more details). For this reason, the calculation of NPHS weights is tied to the weighting procedures used for the ESS. The following sections describe the ESS weighting procedures and the steps required to produce weights for NPHS members.

11.2.1 ESS Weights

The ESS contribution to the weights is calculated as follows:

ESS Cluster Weights

The ESS used a stratified multi-stage design. After several levels of stratification, clusters were selected from each stratum using probability proportional to size (PPS). The size measure used was the household count in the cluster based upon the 1986 Census. An "**ESS cluster weight**" can be calculated as the inverse probability of selecting a cluster.

ESS Dwelling Weights

After selecting a cluster, a fixed number of dwellings were allocated to be selected from the cluster. Each dwelling in the cluster had an equal chance of being selected. The "**ESS dwelling weight**" is then the inverse of the probability of selecting the dwelling within the cluster multiplied by the ESS cluster weight.

11.2.2 NPHS Basic Dwelling Weights

There were two major steps to selecting the NPHS sample. First the subset of ESS clusters to be used in the NPHS had to be identified. Second the subset of ESS dwellings within each retained cluster had to be selected.

Probability of Retaining an ESS Cluster for NPHS

As ESS strata were sometimes very small, NPHS strata were defined as comprising of one or more ESS strata. A fixed number of clusters were allocated to be retained from each NPHS stratum. In cases where the NPHS stratum consisted of more than one ESS stratum, the allocation of clusters to ESS strata was proportional to the number of households in each ESS stratum in order to produce a PPS sample of clusters in each NPHS stratum. Fractional sample sizes were randomly rounded up or down to the next integer. Once the number of

clusters to be retained from an ESS stratum had been determined, each cluster within the ESS stratum had the same probability of retention in most cases. The exceptions were clusters in which the number of dwellings grew by more than 150% between the 1986 Census and the 1992-93 ESS cluster listing. These clusters were given a higher probability of retention (either 100% or 40% greater probability of retention).

Probability of Retaining an ESS Dwelling for NPHS

In clusters that were retained for the NPHS, only dwellings that were selected for ESS were eligible to be selected for NPHS. Those dwellings which were out of scope for ESS (businesses, collectives, demolished or abandoned) had a probability of one of being retained. From the ESS in scope dwellings, a fixed number of dwellings within each cluster were initially retained for the NPHS. A further sub-group of these selected dwellings were dropped because of their ESS household composition. The probabilities that a dwelling would be retained due to its household composition are shown in the following table.

Probability of Retaining an Initially Selected NPHS Dwelling

ESS Household Composition	Probability of Retention
Households with children (under 12 years old)	1
One person households	1/3
Other households with at least one youth (aged 12-24)	5/6
Other households	1/2

The "**basic dwelling weight**" is the ESS dwelling weight times the inverse of the product of the ESS cluster retention probability and the ESS dwelling retention probability. The ESS dwelling retention probability includes both the probability of a dwelling being initially retained for NPHS and the probability of being retained due to its household composition.

11.2.3 Further Weight Adjustments to the Basic Weights

Multiples Weight Adjustment

Sometimes when an interviewer visited a dwelling, he/she found an extra dwelling that was missed during cluster listing. An example of this might be a basement apartment. In this case each dwelling is known as a multiple. When this occurred, one dwelling was selected at random and interviewed. The weight of the selected dwelling is then adjusted by a multiplicative factor equal to the number of multiples.

Cluster Growth Weight Adjustment

In a few cases, clusters were relisted by NPHS. If there was a growth of 15-30% between ESS counts and NPHS counts, then a multiplicative weight adjustment of

$$\frac{NPHS\ count}{ESS\ count}$$

is made to each selected dwelling within the cluster. If the growth was less than 15% then the growth is assumed to be negligible and this adjustment is set to one. For all of these dwellings, the multiples and cluster growth adjustments are multiplied by the basic dwelling weight to give a "**preliminary weight**".

If the growth was over 30% then extra dwellings were selected for NPHS from the extra dwellings listed within the cluster. For these selected extra dwellings, the "**preliminary weight**" is the inverse of the product of the ESS cluster selection probability and NPHS cluster retention probability multiplied by

$$\frac{number\ of\ extra\ dwellings\ listed}{number\ of\ extra\ dwellings\ selected}$$

and the multiples adjustments. Since none of these dwellings were interviewed by ESS, there is no way to categorize them into one of the ESS household composition categories.

Household Nonresponse Weight Adjustment

Nonresponse is inevitable in almost all surveys and NPHS is no exception. To adjust for total nonresponding households, the following adjustment is made

$$\frac{sum\ of\ weights\ for\ respondent\ and\ nonrespondent\ households}{sum\ of\ weights\ for\ respondent\ households}$$

The weight in this case is the preliminary weight.

A separate adjustment is done within a nonresponse weighting area. For the ESS in scope dwellings the nonresponse weighting areas are defined as an intersection of an NPHS stratum and ESS household type (the four ESS household composition categories described in Table 1) by quarter. If this produces a high

adjustment factor (greater than 2.5), then household types are systematically collapsed together until the factor is less than 2.5.

For the dwellings which were added because the cluster had greater than 30% growth during NPHS relisting, the weighting area consists of the added dwellings within the cluster by quarter.

The ESS out of scope dwellings are grouped into two non-response weighting areas by quarter for non-response adjustment purposes. The first group contains all of the dwellings which had an ESS response code of 10 (demolished, vacant, abandoned). The second contains all of the dwellings which had an ESS response code of 18 (collective or business).

Multiplying the preliminary weight by the household nonresponse weight adjustment produces the "**demographic weight**".

11.2.4 Further Weight Adjustments for Household Members

A household members questionnaire is intended to be administered to every member of a selected household. Household members nonresponse occurs if only certain members of the household answer the household members questionnaire. A weight adjustment has to be made to account for this nonresponse, which was negligible. As a final step, the weights are benchmarked to age and sex population projections.

Household Member Nonresponse Weight Adjustment

This adjustment compensates for individuals within responding households (i.e. the demographic questionnaire was completed) who do not respond to the household member questionnaire. The adjustment is equal to

$$\frac{\textit{sum of weights for respondent and nonrespondent individuals in an age–sex category}}{\textit{sum of weights for respondent individuals in an age–sex category}}$$

The weight in this case is the demographic weight. The age-sex categories are people aged 0-11, 12-24, 25-44, 45-64, 65 and over - males and females. There is one adjustment for each age-sex category within the province.

Household Member Benchmarking Weight Adjustment

Provincial population projections are available for various age-sex categories. The

weights of responding individuals are adjusted so that the sum of the weights of respondents in an age-sex category matches the projection. This is done using the following multiplicative adjustment:

$$\frac{\textit{population projections for an age-sex category}}{\textit{sum of weights for respondent individuals in an age-sex category}}$$

The weight in this case is the demographic weight multiplied by the household member nonresponse weight adjustment. The age-sex categories are 0-11, 12-24, 25-44, 45-64, 65 and over - males and females. Note that there are three northern health regions that were excluded from the ESS and hence from the NPHS. These regions account for approximately 0.5% of the entire in scope population for the NPHS. The population projections have been adjusted to account for the removal of these areas. Since the survey took place over four quarters, the population projections used in the benchmarking will be an average of the projections for the four months in which the survey took place.

The "**household member weight**" is achieved by multiplying the demographic weight by the household member nonresponse weight adjustment and the household member benchmarking weight adjustment.

11.2.5 Further Weight Adjustments for Selected Members

One member from each responding household is designated as the selected longitudinal member. If this person is a child under twelve years of age who lives in a "Children" sample dwelling (see "Sample Design" section for the definition of "Children" sample dwelling) then all of the children in the household to a maximum of four are administered the National Longitudinal Survey of Children (NLSC) questionnaire. Otherwise the selected member (aged twelve and over) is asked an additional set of NPHS questions. Several adjustments have to be made to account for this design and the nonresponse to this questionnaire.

NLSC Integration Weight Adjustment

In a "Children" sample household where a child is found, one child is chosen to be the selected member for the NPHS longitudinal panel. This child, as well as all other children in the household, to a maximum of four, is administered the NLSC selected member questionnaire. This data does not preside on the present microdata file. An adjustment has to be made to account for the adults and youths in these dwellings who had no chance of being the selected member. This adjustment is only applied to adults and youths that are selected for the longitudinal panel in "Adult" dwellings where children were found by NPHS.

The adjustment is equal to the inverse subsampling rate for the "Adult" sample. The adjustment depends upon which combination of the following categories the dwelling fell into

1) Did ESS find children in the dwelling? (yes or no)
2) Which ESS urban density class does the dwelling belong to?

A separate adjustment is generated for dwellings where ESS found children and dwellings where ESS did not find children because the subsampling rate was different for these two categories. In the ESS Montreal and regional capitals classes, the adjustment is made at the cluster level while in the ESS smaller urban agglomerations and rural sector classes, it is made at the NPHS stratum level. For an exception to this rule see "Twelve Year Old Weight Adjustment" later in this section.

Selected Member Inverse Selection Probability

In a dwelling belonging to the "Children" sample in which there were no children under the age of twelve or a dwelling belonging to the "Adult" sample, every member aged 12 or more was originally intended to have an equal probability of being the selected longitudinal member. However, due to a software error, twelve year olds were not eligible to be selected in the first two quarters. To compensate for this they were given double the probability of being selected in quarters 3 and 4. A weight adjustment equal to the inverse probability of an individual within the household being the selected member is applied.

Twelve Year Olds Weight Adjustment

In order to get an accurate representation of twelve year olds, their weight has to be increased to account for households where they were not eligible to be selected as a result of the software error. This adjustment is equal to the inverse probability that a twelve year old was eligible to be selected from a dwelling where a person twelve or over was intended to be the longitudinal respondent.

Recall that in the Montreal and regional capitals classes, clusters are only covered in one quarter. In quarters 1 and 2 a twelve year old was not eligible to be selected. Therefore, in order for the weight adjustment to account for these ineligible twelve year olds, it must be done at the NPHS stratum level rather than the cluster level. For consistency, both the integration and twelve year old weight adjustment are calculated at the NPHS stratum level for twelve year olds regardless of the ESS class.

Selected Member Nonresponse Weight Adjustment

This adjustment compensates for selected individuals within responding households (i.e., household for which the demographic questionnaire was completed) who do not respond to the selected member questionnaire. The adjustment is equal to

$$\frac{\textit{sum of weights for respondent and nonrespondent individuals in an age–sex category}}{\textit{sum of weights for respondent individuals in an age–sex category}}$$

The weight in this case is the demographic weight multiplied by all of the previous adjustments made in the selected members weight adjustment section. The age-sex categories are 12-24, 25-44, 45-64, 65 and over - males and females. The adjustment is made at the provincial level.

Selected Member Benchmarking Weight Adjustment

The formula for this adjustment is the same as the benchmarking adjustment used for household members.

$$\frac{\textit{population projections for an age-sex category}}{\textit{sum of weights for respondent individuals in an age-sex category}}$$

The weights are the demographic weights multiplied by all of the previous adjustments made in this section including the selected member nonresponse weight adjustment. The age-sex categories are 12-24, 25-44, 45-64, 65 and over - males and females. Once again adjustments to the benchmarks have been made to account for the out of scope northern regions.

The "**selected member weight**" is calculated by multiplying the demographic weight by all of the adjustments made in this section.