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Hippocrates c. 460 - 377 B.C.

British Columbia Nutrition Survey

Report on Energy and Nutrient Intakes

March 2004

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British Columbia Nutrition Survey
Report on Energy and Nutrient Intakes

March 2004

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Executive Summary

The B.C. Nutrition Survey (BCNS), conducted in 1999, is a study by Health Canada and the B.C. Ministry of Health Services, in association with University of British Columbia, to obtain comprehensive up-to-date information on the eating habits of adult British Columbians. One thousand eight hundred and twenty-three (1823) British Columbians participated in the survey, aged from 19 to 84 years. The province-wide survey involved ninety-minute, in-home interviews by trained public health nurses and nutritionists utilizing several questionnaires to assess food consumption and nutrition concerns. The questionnaires included a 24-hour recall, a food frequency questionnaire and a general nutrition questionnaire focusing on physical activity, healthy weight and body image and food security. Socio-demographic information and body measures were also collected.

The purpose of the B.C. Nutrition Survey was to obtain information on the eating habits of adult British Columbians in order to answer key questions about the nutritional health of the adult population. The specific objectives were:

1. To measure food consumption.
2. To determine the contribution of major food groups, food types and dietary supplements to the diet.
3. To determine the distribution of nutrients in the diet.
4. To determine age, gender, education, income and geographic differences in nutrient intake and food consumption.
5. To assess food security, body weight and physical activity.

Several reports were prepared to disseminate the findings of the BCNS. This report is the first of a series of reports from the BCNS and focuses on the energy and nutrient intakes from food and from food plus supplements. It also presents selected data on food security and on Body Mass Index (BMI). Four additional reports on physical activity and body weight, on food and food group use, on supplement use and on seniors' issues will complete the series.

Estimates of usual nutrient intakes in this report represent intakes from food sources as well as supplements. The key findings reported in this document are highlighted here.

The response rate for the BCNS was between 42%-52%, a rate that is comparable to other federal/provincial nutrition surveys. A comparison of BCNS respondents to non-respondents and the general B.C. adult population was made to determine how representative the results would be to the adult population. Overall, the study participants have attained a higher level of education and may have been slightly more health- and/or nutrition-conscious than the non-respondents, as well as the general adult population in B.C.

Median usual intakes for reported food energy were slightly below estimates of requirements for most age-sex groups. However, since more than 50% of the adult population were classified as overweight (BMI=25-29.9) or obese (BMI≥30), it appears that energy levels are likely underreported. The high prevalence of overweight and obesity is a significant public health problem in B.C.

Most British Columbians fell in the acceptable macronutrient distribution ranges for carbohydrates (45-65%), total fat (20-35%) and protein (10-35%).

Even though most British Columbians fell within the acceptable range for total fat, about one-quarter were still consuming more than 35% of their energy from fat. In addition, half of the population was consuming less than 5% of their calories from polyunsaturated fats and more than 10% of their calories from saturated fat.

Two-thirds of British Columbians consumed supplements, including nutritional and non-nutritional supplements. The major supplements taken, in descending order, were a combination of vitamins and minerals, vitamin C, vitamin E and various natural and herbal types. Nutritional supplement use greatly increased with age. Nutritional supplements played an important role in decreasing the proportion of those with inadequate intakes of several nutrients, indicating future dietary guidance must consider the contribution of both food and supplements together.

Geographic strata and income level did not affect intakes of nutrients for which inadequate intakes were a concern. Of these nutrients, educational attainment only effected the intakes of vitamins C and B12.

Food insecurity was reported by 14% of the population.

Overall, British Columbians had adequate usual intakes of thiamin, riboflavin, niacin and phosphorus.

A high percentage of the population had inadequate usual intakes of folate, vitamin B12, vitamin B6, vitamin C, magnesium and zinc, thereby identifying these nutrients as public health concerns. Excessive usual intakes of synthetic niacin from supplements were identified across all age-sex groups, making this an issue for future monitoring.

Median usual intakes of fibre and calcium were below recommendations in most age/sex groups.

Inadequate usual intakes of iron were only a concern for premenopausal women.

The nutrient intake along with the food consumption information from the BCNS will be helpful nationally and provincially to assess the diets of the population; to target, plan and evaluate nutrition intervention programs; and to establish dietary recommendations, food regulations and nutrition policies. The BCNS created a provincial database of food consumption and nutrient intakes that will serve as a baseline for future nutrition surveillance activities. Ultimately, the BCNS information will help to assess progress towards attaining the Provincial Health Goals and Objectives of encouraging healthy eating, physical activity and healthy body weight; reducing nutrition-related chronic illnesses, such as cardiovascular disease, osteoporosis, diabetes and some cancers; and ensuring access to adequate and nutritious foods (B.C. Ministry of Health, 1997).

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1.0 Introduction

1.1 Background

Nutrition is a vital contributor to a healthy population. Nutrition interventions that promote and support the public's health require a strong evidence base of up-to-date nutrition surveillance information. Effective and appropriate health decision-making depends on the ability to measure and monitor food consumption and its linkages to the risk factors for disease and the determinants of health.

The B.C. Nutrition Survey (BCNS), conducted in 1999, investigated the nutrition and health practices of adult British Columbians. The last time a similar nutrition survey was conducted in B.C. was three decades ago. Information from the Nutrition Canada Survey, conducted in 1972, is grossly out of date.

In the intervening years, the food supply has changed dramatically, with many new foods becoming available on the market. Food consumption patterns have changed as well. More than ever, people are eating away from home, enjoying foods from many cultures and embracing dietary supplements and herbal remedies. Public interest in food and nutrition is high. Yet, overweight and dieting are now commonplace. Recently, food insecurity due to poverty has become a concern for many individuals and families. For seniors, food insecurity, combined with chronic debilitating conditions and social isolation, presents even greater challenges to healthy eating (National Institute of Nutrition, 1997).

Good nutrition prevents many immediate and long-term health problems. Poor nutrition ranks along side tobacco use as a risk factor for the chronic diseases that jeopardize population health and burden the health system in British Columbia. Thirty percent of cancer and diabetes and twenty percent of cardiovascular disease are attributable to poor nutrition (Frazao, 1999).

Nutrition surveillance information is required to inform and evaluate health promotion policies and programs to improve the nutritional health of British Columbians. Decision makers in many aspects of public health, including nutrition, toxicology, chronic disease prevention and health promotion, will use information from the BCNS. The BCNS builds the capacity for targeting resources and measuring health outcomes related to nutrition.

1.2 Overview of the B.C. Nutrition Survey

The BCNS is a study by Health Canada and the B.C. Ministry of Health Services, in association with the University of British Columbia, to obtain comprehensive up-to-date information on the eating habits of adult British Columbians. Similar provincial nutrition surveys have been conducted in all other provinces beginning in 1988 with the Nova Scotia Nutrition Survey.

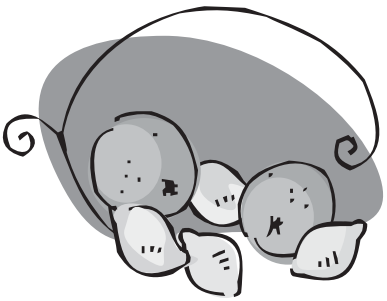
The province-wide survey involved ninety-minute, in-home interviews by trained public health nurses and nutritionists utilizing several questionnaires to assess food consumption and priority nutrition concerns. The questionnaires included a 24-hour recall, a food frequency questionnaire and a general nutrition questionnaire focusing on physical activity, healthy weight and body image and food security. Socio-demographic information and body measures were also collected from 1823 participants, aged 19 to 84 years.

1.3 Purpose and Goals of the B.C. Nutrition Survey

The purpose of the BCNS was to obtain information on the eating habits of adult British Columbians in order to answer key questions about the nutritional health of the adult population.

The food consumption and nutrient intake information from the BCNS is needed nationally and provincially to assess the diets of the population; to target, plan and evaluate nutrition intervention programs; and to establish dietary recommendations, food regulations and nutrition policies. The information will also be used to make assessments of the risk of exposure to contaminants or potentially toxic elements in the food supply. The BCNS created a provincial database of food consumption and nutrient intakes that will serve as a baseline for future nutrition surveillance activities.

Ultimately, the BCNS information will help assess progress towards attaining the Provincial Health Goals and Objectives of encouraging healthy eating, physical activity and healthy body weight; reducing nutrition-related chronic illnesses, such as cardiovascular disease, osteoporosis, diabetes and some cancers; and ensuring access to adequate and nutritious foods (B.C. Ministry of Health, 1997).



The specific goals of the BCNS were:

1. To measure food consumption.
2. To determine the contribution of major food groups, food types and dietary supplements to the diet.
3. To determine the distribution of nutrients in the diet.
4. To determine age, gender, education, income and geographic differences in nutrient intake and food consumption.
5. To assess food security, body weight and physical activity.

1.4 Contents of the Reports on the B.C. Nutrition Survey

The findings of the BCNS are presented in five reports. These reports are key to moving ahead provincial and national nutrition agendas. This report, the *Report on Energy and Nutrient Intakes*, focuses on the energy and nutrient intakes from food and from food plus supplements. It also presents selected data on food security and on Body Mass Index. Four additional reports describe (1) food group use, (2) seniors' nutrition and health issues, (3) physical activity and body weight and (4) supplement use.

The goals of the BCNS can be addressed through review and reporting of the results of the 24-hour recall, general health and nutrition questionnaire, demographic data and anthropometric data. Therefore, the results of the food frequency questionnaire are not reviewed and reported in any of the reports of the BCNS.

The literature review, the methodology and the results related to response rate and the demographic data of the sample are presented only once in this *Report on Energy and Nutrient Intakes*.

2.0 Literature Review

2.1 Introduction

The purpose of this literature review is to provide background on issues relevant to the British Columbia Nutrition Survey. A major focus of this document is thus to review existing data on food and nutrient intakes and food-related behaviours of British Columbians. In addition, literature on risk factors addressed in the B.C. Nutrition Survey is reviewed, including obesity, poor body image and disordered eating, physical inactivity and food insecurity. Because survey participants were age 19 to 84, data obtained from this age group form the focus of the review and because seniors (up to age 84) were over-sampled, information pertaining to this age group is also presented. Whenever possible, B.C.-specific data are cited.

2.2 Food and Nutrient Intakes

Data on food and nutrient intakes can be obtained through dietary surveys, in which individuals recall or record their food intakes on one or more days and through food disappearance data. Both have limitations: Food records or recalls appear to be subject to an underreporting bias (Black et al, 1993; Briefel et al, 1997; Howat et al, 1994; Mertz et al, 1991; Trabulsi and Schoeller, 2001) and thus underestimate true intakes, while food disappearance data do not account for food wastage and may thus overestimate true intakes. Nevertheless, both can provide an indication of average intakes and may allow inferences about changes over time.

2.2.1 Dietary Surveys

2.2.1.1 Nutrition Canada

The only previous comprehensive nutrition survey completed in B.C. was the Nutrition Canada Survey, conducted between 1970 and 1972 (Nutrition Canada, 1973, 1975a, 1975b). That survey obtained information on food and nutrient intakes of infants, children aged 1-4 and 5-11, adolescents 12-19 and adults 20-39, 40-64 and 65 and above. Nutrient intake data represented intakes from both food and supplements and intakes were compared to standards developed for use in the survey. It should be noted that these standards differed from recommendations in the Dietary Standard for Canada at the time of the survey and also differed from current Recommended Nutrient Intakes and Dietary Reference Intakes (Health and Welfare Canada, 1990; Institute of Medicine 1997, 1998, 2000a, 2001). It should also be noted that different survey reports used different methods to assess the intake

adequacy for various age/sex groups. In the provincial reports (Nutrition Canada, 1975b), which also present the national data, adequacy was assessed by comparing median intakes to the standards and classifying the median intake as adequate, marginal or inadequate. Although these reports also tabulate percentiles of the distribution of intakes (i.e., 5th, 25th, 50th, 75th and 95th), these were not considered in the assessments. As a result, conclusions drawn must be interpreted with caution: Although median intake may have been adequate (and thus intakes for the group assessed as "adequate"), a substantial proportion of the group could have inadequate intakes. Nevertheless, the median and mean intakes do provide data for comparison purposes. In contrast, in *Nutrition: A National Priority* (Nutrition Canada, 1973) the proportions of each age/sex group with intakes that were "inadequate" or "less than adequate" are tabulated separately and, in many cases, the assessments of adequacy are different than when median values are compared to the standards.

2.2.1.1.1 Assessment of median intakes.

Median and mean nutrient intakes for men and women aged 20-39, 40-64 and 65 and above (total n = 6767) are shown in Table 2.1.

Table 2.1 Median and mean intakes[1] from food and supplements of adults in the Nutrition Canada Survey, 1970-72

Nutrient	Men			Women		
	20-39 yr	40-64 yr	≥65 yr	20-39 yr	40-64 yr	≥65 yr
Energy (kcal)	3188/3374	2465/2671	1902/2056	1933/2001	1653/1726	1479/1530
Protein (g)	110.5/119	85.0/94	67.2/72	66.6/72	59.6/63	49.3/54
Fat (g) [2]	- /154	- /118	- /89	- /89	- /75	- /63
Carbohydrate (g) [2]	- /351	- /286	- /235	- /227	- /197	- /187
Thiamin (mg)	1.46/1.57	1.21/1.32	1.05/1.08	0.96/1.02	0.88/0.90	0.80/0.85
Riboflavin (mg)	2.20/2.59	1.80/2.09	1.50/1.77	1.50/1.70	1.30/1.49	1.20/1.47
Niacin (mg NE)	45.5/48	34.9/37	25.5/28	26.2/28	24.1/25	20.1/21
Vitamin C (mg)	94/118	81/101	67/85	70/89	81/106	79/87
Vitamin A (mcg)	1123/1551	1061/1332	823/1113	793/1292	688/1031	708/1008
Calcium (mg)	957/1081	777/883	600/709	587/709	537/613	518/619
Vitamin D (IU) [3]	108/ -	108/ -	101/ -	80/ -	75/ -	95/ -
Iron (mg)	17.3/18	14.3/16	12.5/13	11.1/12	10.8/11	9.4/10

Source: Nutrition Canada 1975a, 1975b.

[1] Values are presented as median/mean.

[2] Only means are shown; median values were not reported.

[3] Only medians are shown; mean values were not reported.

Major findings for the national sample included the following: Median caloric intakes, particularly of women and older adults, were lower than generally accepted standards, yet this was accompanied by a high prevalence of high-risk Ponderal Index values (the measure of relative weight used in the survey). Protein intakes were generally adequate, but median intakes in senior women were close to the marginal range. Intakes of thiamin, riboflavin and niacin were adequate in most adults, although some low values were observed in the elderly. Vitamin C intakes were low in elderly men, while vitamin A intakes were close to the marginal range in 40-64 year old women and in both men and women 65 and above. Calcium intakes were reported to be adequate in adults up to age 64, but were low in senior adults, for whom vitamin D intakes were also a concern. Low iron intakes were a concern for menstruating women and for senior men.

True mean and median values for percentage energy distribution from protein, fat and carbohydrate were not reported in the Nutrition Canada survey. However, approximate estimates can be derived by dividing mean intakes from each macronutrient by mean total energy intakes. These values, presented in Table 2.2, suggest that dietary fat provided approximately 40% of energy, protein about 14% and carbohydrate about 42-46%.

Table 2.2 Estimated mean percentage of energy derived from protein, carbohydrate and fat, Nutrition Canada Survey, 1970-72

Macronutrient	Men			Women		
	20-39 yr	40-64 yr	≥65 yr	20-39 yr	40-64 yr	≥65 yr
Protein	14.1	14.1	14.0	14.4	14.6	14.1
Fat	41.1	39.8	39.0	40.0	39.1	37.1
Carbohydrate	41.6	42.8	45.7	45.4	45.6	48.9

Derived from Nutrition Canada, 1975a.

2.2.1.1.2 Assessment of the distribution of intakes.

Table 2.3 reports the proportions of adults aged 20-39, 40-64 and 65 and above with intakes that were assessed as "inadequate" or "less-than-adequate".

Table 2.3 Proportions of intakes classified as "inadequate" or "less than adequate", Nutrition Canada Survey, 1970-72

Nutrient	Cut-points	Men			Women		
		20-39 yr	40-64 yr	≥65 yr	20-39 yr	40-64 yr	≥65 yr
Protein							
Inadequate	<0.5 g/kg	1.6	7.2	7.1	9.2	11.1	14.5
Less-than-adequate	0.5-0.7 g/kg	7.4	5.6	20.2	8.8	15.9	23.2
Iron							
Inadequate	<6, <10 mg[1]	3.8	3.5	4.9	37.7	30.7	8.4
Less-than-adequate	6-10, 10-15 mg[1]	11.5	14.8	30.0	38.4	36.1	47.5
Calcium							
Inadequate	<300 mg	8.6	4.4	9.9	19.3	17.8	20.0
Less-than-adequate	300-500 mg	13.2	18.4	22.4	22.3	26.1	27.8
Vitamin A							
Inadequate	<500 RE	14.3	15.1	23.1	24.4	29.6	32.1
Less-than-adequate	500-750 RE	12.9	15.2	22.9	22.4	25.4	21.6
Vitamin C							
Inadequate	<10 mg	3.5	3.4	4.0	5.8	4.2	1.9
Less-than-adequate	10-30 mg	11.0	10.3	12.8	14.8	12.4	11.2
Thiamin							
Inadequate	<0.5 mg[2]	7.7	7.6	10.7	11.9	16.1	14.5
Less-than-adequate	0.5-0.8 mg[2]	34.8	32.8	29.9	35.9	33.7	18.3
Riboflavin							
Inadequate	<0.6 mg[3]	5.2	2.9	4.3	8.8	11.6	14.8
Less-than-adequate	0.6-1.1 mg[3]	27.0	27.3	36.8	33.0	36.9	32.8
Niacin							
Inadequate	<8.8 NE[4]	1.6	1.4	1.6	1.1	3.6	4.7
Less-than-adequate	8.8-13.2 NE[4]	0.3	3.2	7.2	8.2	7.4	14.1

Source: Nutrition Canada, 1973.

[1] Lower values for men and postmenopausal (>55 yr) women, higher values for menstruating women.

[2] Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <0.25 mg/1000 kcal and 0.25-0.4 mg/1000 kcal.

[3] Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <0.3 mg/1000 kcal and 0.3-0.55 mg/1000 kcal.

[4] Values shown are for diets <2000 kcal. For diets over 2000 kcal, cut-points are <4.4 NE/1000 kcal and 4.4-6.6 NE/1000 kcal.

For many nutrients, this leads to noticeably different assessments than those reported above based on median intakes. Specifically, over 30% had "inadequate" or "less-than-adequate" intakes as follows: Protein in senior women, iron and calcium in all women and senior men, vitamin A in all groups except young men and thiamin and riboflavin in all groups. It should be noted that the methodology used for obtaining

intake distributions in the Nutrition Canada survey (a single 24-hour recall) results in an intake distribution that is much broader than if repeat measurements are made on a subset of individuals and the data adjusted for day-to-day variability (i.e., on any given day, individuals may have unusually low or unusually high intakes, leading to distributions with long 'tails' at the lower and upper ends. Adjusting for day-to-day variability, as is now the standard, "tightens" the distribution and leads to lower proportions of individuals in the "tails" of the distribution.) With unadjusted distributions, assessing the proportion of individuals below certain cut-points can lead to overestimates (Institute of Medicine, 2000b; Nusser et al, 1996). Thus, the percentages presented in Table 2.3 also need to be interpreted cautiously.

2.2.1.1.3 Assessment of intakes of British Columbians

Mean values for nutrient intakes of adult British Columbians who participated in the Nutrition Canada survey are presented in Table 2.4. Few major differences from national data were observed, although energy intakes of those aged 20-39 and 65 and above tended to be lower than national means.

Table 2.4 Mean nutrient intakes of British Columbia adults, Nutrition Canada Survey, 1970-72

Nutrient	Men			Women		
	20-39 yr	40-64 yr	≥65 yr	20-39 yr	40-64 yr	≥65 yr
Energy (kcal)	3071	2590	1925	1762	1743	1422
Protein (g)	109	95	71	67	68	54
Fat (g)	135	116	80	77	76	58
Carbohydrate (g)	324	269	227	198	198	173
Thiamin (mg)	1.42	1.20	1.07	0.92	0.97	0.83
Riboflavin (mg)	2.60	2.17	1.80	1.56	1.68	1.39
Niacin (mg NE)	44	38	28	26	28	20
Vitamin C (mg)	106	98	98	78	100	83
Vitamin A (mcg RE)	1363	1890	1016	1036	1062	772
Calcium (mg)	1143	905	789	676	709	641
Total folate (mcg)	211	186	159	142	154	131
Iron (mg)	18	16	13	11	12	10

Source: Nutrition Canada, 1975a.

2.2.1.2 Food Habits of Canadians

In 1997-1998, a national survey of adult Canadians aged 18-65, 1502 of whom were aged 20-64, was undertaken, again using 24-hour recall methodology to estimate mean energy and nutrient intakes (Gray-Donald et al, 2000). In the initial analysis of the data, intakes from nutrient supplements were not considered, so the nutrient intake data are not strictly comparable to the data from the Nutrition Canada survey. Possible limitations of the study include a low response rate and the possibility that the tendency to under-report food intake may have increased since the time of the Nutrition Canada survey. Nevertheless, the data, presented in Table 2.5, suggest that considerable changes have occurred in dietary intakes during the last three decades.

Table 2.5 Energy and nutrient intakes of Canadians, Food Habits of Canadians Survey, 1997-98

Nutrient	Men		Women	
	20-39 yr	40-64 yr	20-39 yr	40-64 yr
Energy (kcal)	2918	2464	1869	1749
Protein (g)	123	104	75	75
Fat (g)	98	84	63	58
Thiamin (mg)	2.57	2.23	1.58	1.70
Riboflavin (mg)	2.70	2.27	1.68	1.67
Niacin (mg NE)	52	46	33	32
Vitamin C (mg)	204	134	143	132
Vitamin A (mcg RE)	2018	1854	1462	1832
Calcium (mg)	1177	896	781	745
Total folate (mcg)	322	301	239	241
Iron (mg)	21	17	14	13

Source: Gray-Donald et al, 2000.

In most cases, reported energy intakes were lower than in the past and this was associated primarily with a decrease in the intake of fat, to an average of about 30% compared to the 40% of energy observed by Nutrition Canada. Protein intakes were stable in adults aged 20-39, but increased by about 10 g/day in adults aged 40-64. Intakes of most vitamins and minerals were also higher, which is particularly noteworthy since the Nutrition Canada data included supplement use and the reported values from the Food Habits of Canadians survey did not. Given the lower reported energy intakes, it appears that the nutrient density of the diet has improved. Possible mechanisms include an

increase in the intakes of fortified foods, as well as change in dietary patterns themselves (for example, increased intakes of fruits, vegetables and whole grains).

2.2.1.3 Other Studies of British Columbians

Other studies reporting energy and nutrient intakes of subgroups of British Columbians (e.g., vegetarian and nonvegetarian women, women with high and low levels of cognitive dietary restraint, women aged 85 and above living in an extended care facility) have been published (Barr and Broughton, 2000; Janelle and Barr, 1995; Barr et al, 1983; Barr et al, 1984; Barr 1993, McLean et al, 2001). These data will not be discussed in detail here because the samples were convenience samples, rather than representative population samples. However, the studies of vegetarian and nonvegetarian women will be summarized briefly because of the apparent growing prevalence of a vegetarian dietary pattern, particularly among women. Furthermore, vegetarianism appears to be more common in B.C. than in the rest of Canada: the Tracking Nutrition Trends survey found that 8.5% of British Columbians are vegetarian, compared to a national average of 3.7% (Canadian Facts and National Institute of Nutrition, 1997).

2.2.1.3.1 Studies of vegetarian women.

Two studies of vegetarian women in the Lower Mainland area of British Columbia have been completed. In the first, Janelle and Barr (1995) studied 22 nonvegetarian women (who ate red meat 3 or more times per week) and 23 vegetarian women (who had excluded all flesh foods for at least two years). All women were carefully screened. Inclusion criteria included age 20-40, Body Mass Index (BMI; kg/m^2) 18-25, being a nonsmoker, exercise of < 7 hr/wk and alcohol use of < 7 drinks/wk. In the second study, Barr and Broughton (2000) assessed intakes of a broader cross-section of 90 vegetarian and 68 nonvegetarian women. In that study, vegetarian status was self-defined and the only inclusion criterion was premenopausal status. Findings from the two studies were generally similar: In both cases, vegetarians and nonvegetarians reported similar energy intakes and percentage of energy from fat. Diets of both vegetarians and nonvegetarians adhered closely to current nutrition recommendations in terms of macronutrient composition (e.g., <30% fat, <10% saturates) and dietary fibre intake. Vegetarians, however, consistently reported a lower percentage of energy from protein, lower intakes of saturated fat, cholesterol, niacin, vitamin B12 and vitamin D and higher intakes of fibre. Zinc intakes tended to be lower among vegetarians. Vegetarians' vitamin B12 and vitamin D intakes were well below current recommendations.

2.2.1.4 Recent Changes to Nutrient Intake Recommendations

Another challenge in interpreting nutrient intake data, vis-à-vis their implications for population level interventions, is related to the standards to which nutrient intakes are compared. Until recently, the Recommended Nutrient Intakes (RNIs) represented the nutrient intake goals for the Canadian population. Beginning in 1997, however, the RNIs have been undergoing revision as part of a joint Canada/U.S. initiative to harmonize nutrient intake recommendations. The new recommendations, termed Dietary Reference Intakes (DRIs), include the Estimated Average Requirement (EAR), the Recommended Dietary Allowance (RDA), the Adequate Intake (AI) and the Tolerable Upper Intake Level (UL). To date, DRIs have been released for calcium and related nutrients (Institute of Medicine, 1997), B vitamins (Institute of Medicine, 1998), antioxidants (Institute of Medicine, 2000), micronutrients (Institute of Medicine, 2001) and energy and macronutrients (Institute of Medicine, 2002).

The intakes recommended for individuals are presented as either an RDA or an AI. The RDAs are set at two standard deviations above the Estimated Average Requirement for nutrients with normally distributed requirements or at the 97.5th percentile of the requirement distribution for nutrients with skewed distributions. AIs are established when there is insufficient data to establish an EAR from which an RDA can be estimated, but represent a level of intake thought to exceed the requirements of almost all healthy individuals. Thus, both RDAs and AIs represent recommendations for intakes by individuals to minimize the risk of nutrient inadequacy. For those nutrients with EARs, the proportion of the population with inadequate intakes can be quantitatively estimated as the proportion with intakes below the EAR (Institute of Medicine, 2000b). For nutrients with an AI, the prevalence of nutrient inadequacy cannot be quantitatively determined.

For several nutrients, the new recommendations are considerably higher than the 1990 RNIs. For several nutrients the implications are particularly strong for older adults. As an example, Table 2.6 compares the 1990 RNIs for selected nutrients to the new RDA or AI for adults age 50 and above and indicates that recommendations for calcium, magnesium, vitamin D, folate, vitamin B12, vitamin C and vitamin E have increased by 50% to 200%. Many of these nutrients are consumed in marginal amounts by older adults; thus, higher recommendations suggests that even larger proportions will be at potential risk. The new recommendations also impact on other age groups. The most notable of these include calcium, magnesium, folate, vitamin E and for menstruating women, iron.

Table 2.6 Comparison of 1990 RNIs to new RDAs or AIs for adults aged over 50

Nutrient	RNI[1]		RDA/AI[2]	
	Men	Women	Men	Women
Calcium (mg/d)	800	800	1200	1200
Magnesium (mg/d)	250 (230)	210	420	320
Vitamin D (mcg/d)	5	5	10 (15)	10 (15)
Fluoride (mg/d)	in water	in water	4	3
Vitamin B_6 (mg/d)	0.9-1.5[3]	0.8 – 1.1[3]	1.7	1.5
Folate (mcg DFE/d)	230 (215)	195 (200)	400	400
Vitamin B_{12} (mcg/d)	1.0	1.0	2.4[4]	2.4[4]
Choline (mg/d)	N/A	N/A	550	425
Vitamin C (mg/d)	40	30	90	75
Vitamin E (mg/d)	7 (6)	6 (5)	15	15
Vitamin A (RAE/d)	1000 RE	800 RE	900[5]	700[5]

[1] Values shown are 1990 RNIs for adults aged 50-74. Values for those aged 75 and above are shown in parentheses when they differ from values for those aged 50-74.

[2] Values shown are RDAs or AIs for adults aged 51-70. Values for those aged 71 and above are shown in parentheses when they differ from values for those aged 51-70.

[3] The RNI for vitamin B6 was expressed as 0.015 mg/g protein. Values shown represent a range of protein intakes from the RNI to 100g/d for men and 70 g/d for women.

[4] It is advisable for those older than 50 years to meet their RDA mainly by consuming foods fortified with B12 or with a supplement containing B12.

[5] The bioavailability of dietary carotenoids is now estimated to be only 50% of that estimated in the 1990 RNI. Thus, individuals who rely on plant sources of vitamin A will need to consume substantially larger amounts (effectively, twice as much) to meet the new recommendations.

2.2.2 Food Disappearance Data

2.2.2.1 Food Consumption in Canada

National data on apparent food consumption is produced using a supply-disposition approach (Statistics Canada, 1997a). To calculate total supply, the amounts produced and imported during the year are added to stocks available at the beginning of the year. The net supply (i.e., that available for consumption) is determined by subtracting stock at the end of the year, exports, manufacturing uses, livestock feed and (occasionally) waste during processing. The waste factors, however, do not account for losses in stores, households, private institutions or restaurants. The net supply is divided by the Canadian population at July 1 of a given year to determine per capita food availability for that year.

Data on per capita disappearance of major food groups are available between the years of 1961 and 1996 (Statistics Canada, 1997b) and thus permit inferences to be made about changes in the food supply over that time period. For the purpose of this report, the most relevant changes are likely those that occurred between the time of the Nutrition Canada Survey (1970-72) and now. Table 2.7 shows these data for major food

Table 2.7 Changes in per capita food disappearance, 1970-72 versus 1994-96

Food Group	Disappearance 1970-1972	Disappearance 1994-1996	Net change (kg or L)	Percent change
Fruits (kg)	84.92	122.65	37.73	44.4
Vegetables (kg)	142.69	178.19	35.50	24.9
Oils and fats (kg)	20.69	25.71	5.02	24.2
Cereals (kg)	66.65	78.19	11.54	17.3
Alcoholic beverages (L)	123.94[1]	96.99[1]	(26.95)	(21.7)
Soft drinks (L)	60.28[2]	77.55	17.27	28.6
Fluid milk (L)	95.59	89.23	(6.36)	(6.6)
Cheese (kg milk solids)	5.58	11.44	5.86	105
Total dairy products (kg milk solids)	25.16	23.44	(1.72)	(6.8)
Red meat (kg)	75.85	60.87	(14.98)	(19.7)
Poultry (kg)	19.62	30.72	11.1	56.6
Eggs (dozen)	20.93	14.65	(6.28)	(30.0)
Pulses and nuts (kg)	7.52	8.35	0.83	11.0
Sugar (kg)	45.4	39.93	(5.47)	(12.0)

Source: Statistics Canada, 1997b. Negative values are shown in parentheses.

[1] For population aged 15 and above.

[2] Data are not reported for 1970 and 1971, thus, disappearance is for 1972-1974.

groups and indicates that apparent consumption of fruit, vegetables, oils and fats, cereals, poultry and pulses and nuts have increased, while alcoholic beverages, red meat and eggs have decreased. Small changes were observed in dairy product and sugar disappearance. These changes are generally consistent with the changes in nutrient intake observed between the 1970-72 Nutrition Canada Survey and the 1997-98 Food Habits of Canadians Survey.

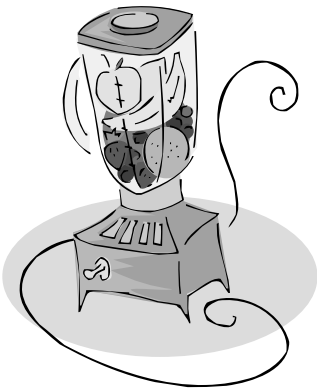
2.3 Food and Nutrition Behaviours

In addition to the quantitative data available on food and nutrient intakes, a number of studies have reported on consumers' nutrition-related knowledge, attitudes and self-reported behaviour. The most prominent of these are the Heart Health Surveys (Ministry of Health, Province of B.C. and Health and Welfare Canada, 1990), Tracking Nutrition Trends (Canadian Facts and National Institute of Nutrition, 1997), the National Population Health Survey (Hooper, 1996) and the Canadian Community Health Survey (Statistics Canada Health Indicators, 2002), which will be discussed below.

2.3.1 Heart Health Surveys

Although the mortality rate from cardiovascular disease in Canada has been declining since the mid-1960s (Heart and Stroke Foundation of Canada, 1997a), it nevertheless remains the primary cause of death for Canadians, accounting for 36% of male deaths and 39% of female deaths in 1996 (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999). At that time, the age-standardized mortality rate for cardiovascular disease in British Columbia was the lowest in Canada for both men and women. Despite this observation, that parallels national data for smoking, hypertension and obesity, further improvement is possible and desirable.

Information about the prevalence of cardiovascular disease risk and the level of knowledge and awareness among British Columbians aged 18-74 is available from the British Columbia Heart Health Survey (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990). This survey, conducted in 1989, included measurements of height, weight, blood pressure and serum lipids, as well as self-report data on smoking, alcohol consumption, diabetes and physical activity. Knowledge and awareness about dietary factors that affect cardiovascular risk were also assessed. These questions revealed that most British Columbians knew that cholesterol was found in foods and affects health, while fewer were aware of sources of dietary cholesterol other than eggs. When asked an open question about what can a person do to lower their blood lipids, the most common response was to eat foods with less cholesterol (71%) and to eat less fatty foods (52%). The report concluded that there was a need for public education programs to address the need to reduce total and saturated fat intake and that would provide practical guidance for individuals about how this should be done. The survey was conducted prior to the release in 1990 of the *Nutrition Recommendations for Canadians, Canada's Guidelines for Healthy Eating* and *Canada's Food Guide to Healthy Eating,* which provide much of this suggested advice. Whether these resources have affected British Columbians' knowledge and practices cannot be directly assessed, although changes in national food disappearance data suggest that food habits are changing in the desired direction.



2.3.2 Tracking Nutrition Trends

The National Institute of Nutrition, in partnership with member organizations and Agriculture Canada, has commissioned a national survey on the nutrition-related knowledge, attitudes and behaviours of Canadians, particularly as they pertain to fat, fibre and cholesterol (Canadian Facts and National Institute of Nutrition, 1997). Three

waves of the survey have been conducted, in 1989, 1994 and 1997. Objectives for the most recent survey were: 1) to identify recent changes in attitudes, awareness and reported behaviour towards nutrition in general and fat, fibre and cholesterol in particular; 2) to gather baseline data for new issues such as calcium; and 3) to assess awareness of *Canada's Food Guide to Healthy Eating* and level of knowledge of the four food groups. National probability samples were used to survey five geographic regions: B.C., the Prairies, Ontario, Quebec and the Atlantic provinces. Data were weighted to reflect the Canadian adult population. Aspects of the results that may be pertinent to the B.C. Nutrition Survey include information on food and nutrition concerns and on vegetarian dietary practices.

2.3.2.1 Food and Nutrition Concerns

The major food and nutrition related concerns of Canadians are shown in Table 2.8, which shows the percentage of respondents who were "very" or "somewhat" concerned about various issues. The table also shows how the level of concern has changed since 1989 and 1994.

Fat was the issue of concern to the largest proportion of Canadians in 1997, with almost 4 of 5 being "very" or "somewhat" concerned, but more than 50% of respondents were concerned about all issues except caffeine, trans fatty acids and hydrogenation. In most cases, the proportions expressing concern decreased between 1994 and 1997, but remained above 1989 levels (Canadian Facts and National Institute of Nutrition, 1997).

Table 2.8 Percent of Canadians who are "Very/Somewhat concerned" about food and nutrition issues

Food/nutrition issue	Percent of Canadians who are "Very/Somewhat Concerned"		
	1997	Change since 1994	Change since 1989
Fat	79	-3	+8
Food poisoning	70	N/A	N/A
Vitamins	70	-3	+8
Chemical residues	67	-9	-1
Calcium	67	-5	+4
Fibre	66	-7	-1
Saturated fat	66	-5	N/A
Calories/energy	62	-7	+3
Cholesterol	61	-9	+1
Salt/sodium	60	-7	+3
Sugar	57	-9	+1
Iron	53	-9	N/A
Preservatives	52	-10	-2
Trans fatty acids	40	N/A	N/A
Hydrogenation	34	-3	+6

Source: Canadian Facts and National Institute of Nutrition, 1997.

Respondents who were "very" or "somewhat" concerned about each of fat, cholesterol, fibre and calcium were asked whether they were doing anything to address their concerns. Actions were reported by 95%, 86%, 91% and 88% of those concerned about fat, cholesterol, fibre and calcium, respectively. Among those concerned about fat, reported actions included buying and eating lower fat products (39%), using less fat in food preparation (39%), eating less or avoiding fatty and fried foods (26%), modifying use of fats and oils (21%) and changing consumption of meat and meat alternatives (16%) (Canadian Facts and National Institute of Nutrition, 1997).

The proportion of Canadians considering themselves as "very" or "somewhat" likely to decrease or further decrease their fat intake over the coming months decreased from 46% in 1994 to 33% in 1997. Similarly, the proportions planning to increase or further increase their fibre intake fell from 33% to 23%. In both cases, three-quarters of those who did not plan to change indicated that they were already eating well and had no need to change. Without nationally-representative intake data, it cannot be determined if diets have improved and additional change is not required or whether, having made small changes, the public has become less sensitive to these issues.

2.3.2.2 Vegetarian and Special Diets

Nationally, 3.7% and 11.3% of Canadians responded positively to the statements "I am a vegetarian" and "I follow a special or prescribed diet", respectively (Canadian Facts and National Institute of Nutrition, 1997). These proportions were higher in the B.C. region than in the national sample, with 8.5% of British Columbians reporting that they were vegetarian and 15.1% reporting that they followed a special diet. In both cases, these were the highest among the five regions studied.

Respondents who considered themselves vegetarian reported whether they "ever ate" various foods (see Table 2.9 for national and B.C. data). In general, fewer British Columbians included each food category as compared to the national sample, although comparisons must be made with caution because of the small sample size. Nevertheless, it is clear that self-defined vegetarians have varied dietary practices and that few would be considered vegan vegetarians.

Table 2.9 Percentages of self-defined vegetarians who "ever eat" various foods

	Percentage who report that they "ever eat"	
	National (n=73)	**B.C. (n=23)**
Milk/dairy products	89.5	84.9
Fish or seafood	77.9	76.0
Eggs	70.7	62.6
Chicken/poultry	60.6	49.6
Red meats	19.9	20.3
None of the above	1.4	2.3
At least one of the above	92.5	86.7

Source: Canadian Facts and National Institute of Nutrition, 1997, Table 73.

2.3.2.3 Awareness of Canada's Food Guide to Healthy Eating

All participants in the survey were shown a copy of *Canada's Food Guide to Healthy Eating* and asked whether they ever recalled seeing it before. Sixty-three percent of the national sample reported having seen it, higher than the 58% reported for the B.C. region (Canadian Facts and National Institute of Nutrition, 1997). Before being shown the Guide, participants were asked to provide the names of the four food groups that are promoted in the Guide. Results, shown in Table 2.10, indicate that over half of Canadians could identify all four groups and that almost nine of ten could identify at least one food group. In the B.C. region, the ability to name each of the food groups was consistently lower than for the national sample.

Table 2.10 Percentages of respondents able to identify the four food groups

Food Group	National (n=73)	B.C. (n=23)
Grain/starch	71	67
Meat/protein	81	74
Milk products	75	66
Vegetables and fruit	80	75
Nothing/don't know	12	16
All four food groups	56	42
At least one of four groups	87	83

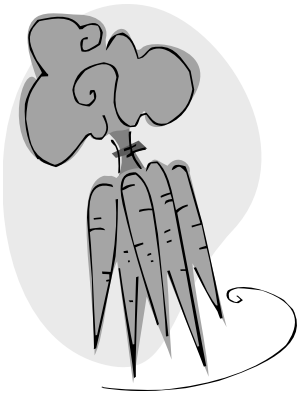
Source: Tracking Nutrition Trends, Table 64.

2.3.3 National Population Health Survey

The National Population Health Survey (NPHS) is a longitudinal survey on Canadians' health (Hooper, 1996). The first wave, for which data are available, was conducted in 1994-95 with 13,400 individuals aged 12 and above. Nutrition questions included asking respondents whether they were eating more of selected food groups than they had 12 months ago and whether they were increasing the amount of starch and fibre and/or decreasing the amount of fat in the foods they ate.

The data indicate that 35.6% of men and 44.8% of women reported increasing their vegetable and fruit intake over the past 12 months. Increased grain product intakes were reported by about 25% of men and 30% of women.

In response to a "yes" or "no" question, 43% of respondents reported that they were concerned about the amounts of starch and fibre in their diets. This was lower than the 66% who were "very/somewhat concerned" in the 1997 Tracking Nutrition Trends (TNT) survey; however, that survey asked individuals whether they were "very", "somewhat", "not too" or "not at all" concerned and the difference in question format may have affected the response. Similar to the TNT survey, however, a majority of those who were concerned reported taking action to increase their starch and fibre intakes. About 80% of both men and women who were concerned about starch and fibre responded "yes" to queries about whether they were eating vegetables or fruit at most meals and were eating whole grain products. Substantial proportions (30%-60%) also indicated that they were eating meals with less meat, choosing foods high in fibre, baking with whole wheat flour and using meat alternatives.



Similar questions were asked in regard to dietary fat. Seventy-six percent of women and 60% of men were concerned about fat and the large major-

ity of those concerned reported taking action to reduce fat intake: approximately four out of five reported that they were "using less butter, oil or salad dressing", "eating less fried or deep fried foods" and "eating leaner meat, poultry and fish". Although women were somewhat more likely to report these changes than men, the proportions were reasonably close. The proportions reporting these changes in the NPHS were notably higher than those reporting similar changes in the TNT study; however, the data cannot be compared because the NPHS asked individuals to respond "yes" or "no" to each change, whereas the TNT survey asked an open question and respondents generated their own responses.

2.3.4 Canadian Community Health Survey

Data are available from the Canadian Community Health Survey (2000/01) on fruit and vegetable consumption among Canadians and British Columbians, in categories of <5 times/day, 5-10 times/day and >10 times/day (Statistics Canada, Health Indicators 2002). The results suggest that the majority of Canadians and British Columbians may not meet the recommendation to consume 5-10 servings a day: Nationally, 61.8 % of individuals aged 12 and above consumed <5 times/day, 33.4% consumed 5-10 times/day and 3.7 % of consumed over 10 times/day. The percentages were similar for B.C., at 60.7%, 34.7% and 2.9%, respectively. There were noticeable trends in fruit and vegetable consumption with age. Nationally, the proportions consuming at least 5 times/day increased from 34.4% among those aged 19-34 to 44.5% among those aged 65 and above and almost identical changes with age were seen in the B.C. sample. Also, women consumed fruits and vegetables more frequently than men. Nationally, the proportions are 4.9 times per day versus 4.2 times per day (Perez, 2002). For B.C., 66.1% of males and 55.5% of females consume fruit and vegetables less than 5 times/day (unpublished data, B.C. Ministry of Health Planning, September 2002).

2.4 Risk Factors

2.4.1 Obesity

2.4.1.1 Definition and Associated Health Risks

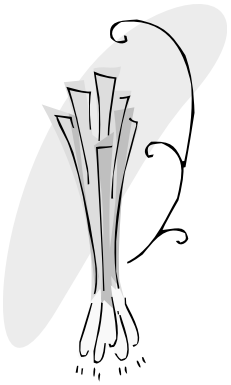
The World Health Organization (WHO) currently defines "overweight" as a BMI of 25 or greater and "obesity" as a BMI of 30 or more (World Health Organization, 1998). Canada has used BMI to assess weight status since 1988 (Health and Welfare Canada, 1988). In May 2003, Health Canada released the new Canadian Guidelines for Body Weight Classification in Adults (Health Canada, 2003), which are aligned with the WHO's global weight classification system. Prior to

this release, Canada's guidelines were that a BMI of 20-25 is healthy for most people, that a BMI of 25-27 is associated with increased health risk in some people and that a BMI of 27 or more is associated with increased health risk in most people. Health risks that have been associated with obesity include type 2 diabetes mellitus, coronary heart disease, hypertension, dyslipidemia, sleep apnea, gallbladder disease, liver disease, osteoarthritis, impaired reproductive function and certain forms of cancer (National Task Force on the Prevention and Treatment of Obesity, 2000). Mortality is also increased (Manson et al, 1995; Calle et al, 1999).

2.4.1.2 Costs to the Health Care System

The direct costs related to the treatment of and research into obesity in Canada were recently estimated by Birmingham (Birmingham et al, 1999). Using the medical literature, these authors identified 10 co-morbidities associated with obesity. For each co-morbidity, a population attributable fraction (PAF) was determined, reflecting the extent to which obesity contributed to the condition and its management costs. PAFs ranged from 4.7% for colorectal cancer to 50.7% for type 2 diabetes. Direct costs of each co-morbidity were determined using national data for the costs of hospital care, physician services, services of other health professionals, drugs and health research. The costs attributable to obesity were then estimated by multiplying the total direct costs of each co-morbidity by the PAF. Using this approach, the total direct cost of obesity in Canada in 1997 was estimated to be in excess of $1.8 billion and the three largest contributors were hypertension, type 2 diabetes and coronary artery disease.

Another indication of the economic costs of obesity is provided by health care resource utilization data. Obese Canadians also use a disproportionate amount of health care resources, including physician visits, admissions to hospital and use of medications (Trakas et al, 1999). They also report a greater number of disability days, which increase costs to employers and ultimately, to society at large (Trakas et al, 1999).



2.4.1.3 Prevalence

The most recent measured data on the prevalence of obesity in Canada were obtained during the National Heart Health Surveys, conducted between 1986 and 1992. A probability sample of almost 30,000 men and women aged 18 to 74 years was selected using health insurance registration files in each province and anthropometric measurements were performed on almost two-thirds of participants. Nationally, 35% of men and 27% of women were classified as obese (BMI > 27) and when a less stringent criterion was used (BMI > 25), 57% and 48% of men and women,

respectively, were at potential health risk from overweight (MacDonald et al, 1997). Regional analysis of the data (eastern, central and western Canada) indicated that the prevalence of obesity was lower in western and central Canada than in the Atlantic provinces (Reeder et al, 1997).

Data from the B.C. Heart Health Survey, collected in 1989, revealed an overall prevalence of obesity (BMI>27) of 28%, considerably lower than the Canadian average (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990). The prevalence of BMI>27 increased steadily with age in both men and women. In men, prevalence was 22%, 35% and 44% for those aged 18-34, 35-64 and 65-75, respectively. In women, corresponding values were 17%, 28% and 38%.

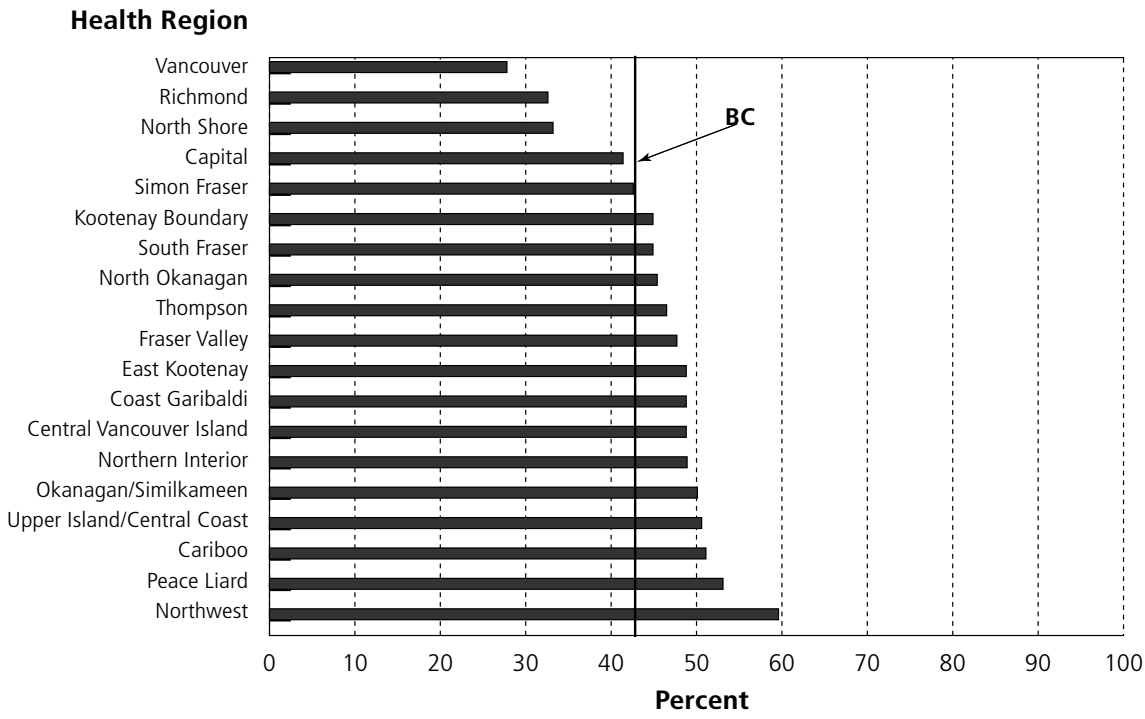
More recent B.C. data are available from the longitudinal National Population Health Survey (NPHS), conducted beginning in 1994-1995 and continuing every two years until 1998-1999 (Table 2.11). In 2000-2001, the Canadian Community Health Survey (CCHS) was introduced and provided cross-sectional data at the provincial and regional levels. Although the data were self-reported and thus likely underesti-

Table 2.11 Proportions of Canadian and B.C. adults aged 20-64 with self-reported BMI classified as underweight (<20), acceptable (20.0 – 24.9), some excess weight (BMI 25.0 – 27.0) or overweight (>27.0), 1994-5 through 2000-01

	NPHS 1994 - 1995		NPHS 1996 - 1997		NPHS 1998 - 1999		CCHS 2000 - 2001	
	Canada	B.C.	Canada	B.C.	Canada	B.C.	Canada	B.C.
Women and Men	%	%	%	%	%	%	%	%
BMI <20	8.5	9.3	8.0	7.5	7.2	8.7	8.1	9.0
BMI 20.0 – 24.9	42.2	46.4	42.2	45.9	41.6	44.9	42.9	46.4
BMI 25-27.0	18.7	17.4	18.6	19.3	19.0	17.3	15.6	15.3
BMI >27.0	29.4	25.7	28.1	26.1	31.2	28.4	31.9	27.0
Missing	1.2	1.3	3.0	1.2	1.0	0.8	1.6	3.7
Women								
BMI <20	13.5	15.5	13.4	12.2	11.4	13.7	12.3	13.9
BMI 20.0 – 24.9	46.6	52.1	46.7	52.7	47.7	51.5	45.9	49.0
BMI 25-27.0	13.3	11.1	13.1	13.3	13.6	12.5	11.6	10.3
BMI >27.0	24.9	19.7	22.2	20.2	25.7	21.7	27.5	23.1
Missing	1.8	-	4.7	-	1.5	-	2.6	3.7
Men								
BMI <20	3.6	3.3	2.8	2.9	3.1	3.6	3.9	4.2
BMI 20.0 – 24.9	38.0	40.7	37.9	39.2	35.5	38.1	39.9	43.8
BMI 25-27.0	24.0	23.5	23.9	25.2	24.2	22.1	19.5	20.2
BMI >27.0	33.8	31.6	34.0	32.0	36.6	35.2	36.1	30.8
Missing	0.6 -	1.4 -	0.6	-	0.6	1.0		

Source: Statistics Canada, Health Indicators 2002. National Population Health Survey, 1994-5 through 1998-9, and Canadian Community Health Survey, 2000-01.

Figure 2.1 Regional comparisons of body mass index[1]



[1] Body Mass Index (BMI), Canadian Standard, Excess Weight (BMI ≥ 25.0),
Sexes Combined, Household Population Aged 20-64, by Health Region, B.C., 2000/01.
Source: Canadian Community Health Survey cycle 1.1, 2000-01.

mate actual BMI, they confirm that the prevalence of obesity is lower in B.C. than in Canada as a whole and also indicate that women are less likely than men to report a BMI > 27 or between 25 and 27. Nevertheless, overweight and obesity still represent a concern for a substantial proportion of the B.C. population.

The 2000-2001 CCHS data allows regional comparisons to be made of the proportion of excess weight (BMI 25+) within the B.C. population (Figure 2.1). While provincially 42.3% of adults were classified with excess weight, regionally this varied from 27.8% in Vancouver to 59.6% in the Northwest (B.C. Ministry of Health Planning, September 2002).

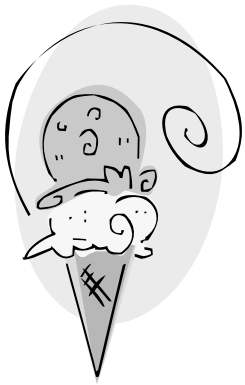
There is every reason to expect that obesity will become even more prevalent in the years to come. First, national data indicate that since 1985, the proportion of adult Canadians that is overweight has increased substantially (Federal, Provincial and Territorial Advisory

Committee on Population Health, 1999). Second and perhaps of greater concern, is the large increase in childhood obesity that has been observed over the past 15 years. Tremblay and Willms (2000) recently analyzed nationally representative data from the 1981 Canada Fitness Survey, the 1988 Campbell's Survey on the Well-being of Canadians and the 1996 National Longitudinal Survey of Children and Youth. The 1981 data were used as a baseline to define "overweight" as a BMI equal to or above the 85th percentile and "obese" as a BMI equal to or above the 95th percentile. Accordingly, the prevalences of overweight and obesity in 1981 were 15% and 5% by definition. Between 1981 and 1996, the prevalence of overweight increased from 15% to 28.8% in boys and 23.6% in girls, while the prevalence of obesity more than doubled from 5% to 13.5% in boys and 11.8% in girls (Tremblay and Willms, 2000). Regional data were not reported.

2.4.2 Poor Body Image and Disordered Eating

2.4.2.1 Overview

It has been suggested that dissatisfaction with their own body has become almost normative among women living in Western cultures and may also be increasing among men. Among Canadians surveyed in the 1990 National Health Promotion Survey (Health and Welfare Canada, 1993), only 30% of women and 42% of men reported desiring no change in their current weight. Of those who desired a change, a large majority wanted to weigh less. Even when the responses of those at an acceptable weight were examined separately, 68% of women and 49% of men wanted to weigh less. And although obesity does represent a growing concern, in many cases weight loss may not be warranted. Yet 37% of women with body weight in the healthy range reported currently trying to lose weight in the 1990 Health Promotion Survey (Health and Welfare Canada, 1993). Furthermore, there may be a substantial proportion of individuals (particularly women) who, although not actively "dieting" to lose weight, are nevertheless extremely conscious of what and how much they are eating. This phenomenon (i.e., conscious efforts to control food intake in order to achieve or maintain a desired body weight) has been termed "cognitive dietary restraint" (Stunkard and Messick, 1985) and can be assessed using the restraint subscale of the Three-Factor Eating Questionnaire (Stunkard and Messick, 1985). Although one would anticipate that high levels of dietary restraint would be more common among individuals who are currently dieting for weight loss, many women who have body weights in the normal range and are not currently dieting also have high restraint scores (McLean, 1999).



2.4.2.2 Associated Health Risks

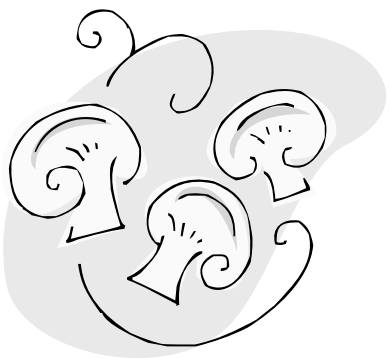
It could be speculated that some degree of dietary restraint is functional if it acts to prevent weight gain or to assist with weight loss in overweight individuals. However, high levels of restraint, particularly among those who do not need to lose weight for health reasons, may represent a health risk. Women with high scores for restraint and BMI within the healthy range have been found to have a higher incidence of subclinical ovulatory disturbances (Barr et al, 1994a; Barr et al, 1994b; Schweiger et al, 1992; Lebenstedt et al, 1999) and irregular menstrual cycles (McLean, 1999). Ovulatory disturbances, such as anovulation and cycles with a short luteal phase, are obviously related to reduced fertility in women. Furthermore, they were shown to be related to loss of spinal trabecular bone in young adult B.C. women (Prior et al, 1990) and to be associated with total body bone mineral content in women students at the University of British Columbia (McLean et al, 2001b). Little is known, however, about levels of dietary restraint in other age groups or in men.

2.4.3 Physical Inactivity

Physical inactivity is now recognized as an important risk factor for poor health outcomes, comparable to the effects of smoking, hyperlipidemia or hypertension (Physical activity and health, 1996; Pate et al, 1995). Because physical inactivity is more prevalent in Canada than are smoking, hypertension and hyperlipidemia (Katzmarzyk et al, 2000), this suggests that improvements in activity have the greatest potential to impact positively on health. Importantly, modest improvements in fitness have the greatest incremental benefits (Pate et al, 1995, Blair et al, 1995).

2.4.3.1 Confounding with Obesity

When considering the health impacts of inactivity, it is also important to note that considerable research has accumulated to indicate that physical inactivity may greatly confound the observed relationships between obesity and negative health outcomes (Blair and Brodney, 1999). For example, when physical fitness level was controlled, overall and cardiovascular disease mortality were considerably higher in 'unfit' men in the healthy weight range than in 'fit' men with BMI over 30 (Wei et al, 1999). Furthermore, only minimal differences were observed between obese and lean men of comparable fitness levels. The observed associations with obesity are thus largely due to the fact that physical inactivity and poor fitness are much more common among obese individuals than among those in the healthy weight range. For



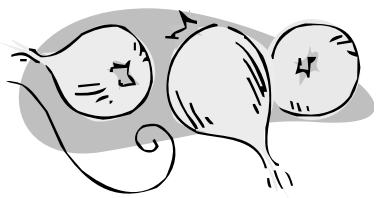
example, among normal weight men, 9.3% were classified in the lowest quintile for fitness, while among overweight and obese men, 19.4% and 50.8% were similarly classified (Wei et al, 1999). Finally, improving physical fitness in overweight individuals can improve glucose tolerance, blood pressure and blood lipid levels, irrespective of meaningful changes in body weight or body composition (Wilmore et al, 1999, Leon et al, 2000, Rankinen et al, 1997). Given the difficulty of treating obesity once it is established, interventions to increase physical activity and improve physical fitness clearly have potential to impact meaningfully on population health.

2.4.3.2 Costs to the Health Care System

The costs of physical inactivity in Canada have recently been estimated (Katzmarzyk et al, 2000). Using an approach similar to that described above for obesity, the population attributable fraction was computed for coronary artery disease, stroke, colon cancer, type 2 diabetes and osteoporosis using relative risks associated with inactivity and the population prevalence of inactivity. The costs of inactivity were estimated at about $2.1 billion, at least as great as the costs of obesity.

2.4.3.3 Prevalence

Interpretation of data on the prevalence of physical inactivity is complicated by the use of different definitions across different surveys, making secular comparisons difficult. For example, the National Population Health Survey (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999) estimated energy expenditure during leisure time physical activity and used values of >3.0 kcal/kg/d to represent "active", 1.5-2.9 kcal/kg/d to represent "moderately active" and <1.5 kcal/kg/d to represent "inactive". (To provide context, a 70 kg adult walking 2 miles/d at a moderate pace would expend about 170 kcal or about 2.4 kcal/kg and would thus be classified as moderately active.) Using this definition, 21% of Canadians were active, 23% were moderately active and 57% were inactive. Other surveys, using slightly different definitions, found that 62% of Canadians were not active enough to obtain the benefits of an active lifestyle (Craig et al, 1999) or that 66% were not meeting the activity guidelines specified in *Canada's Physical Activity Guide to Healthy Active Living* (Canadian Fitness and Lifestyle Research Institute, 1998). The Guide specifies an hour of low-intensity activity every day or 4-7 days per week of moderate-intensity activity (30-60 minutes per occasion) or high-intensity activity (20-30 minutes per occasion) (Health Canada and the Canadian Society for Exercise Physiology, 1998). Regardless of the definition used, however, it is apparent that the majority of Canadians are physically inactive.



The situation in British Columbia is somewhat better than that in other Canadian provinces, but is still far from optimal. Using the classification system of the National Population Health Survey (leisure time energy expenditure per kg/d leading to classifications of "physically active", "moderately active" and "inactive"), in 1996-1997 B.C. had the lowest prevalence of inactivity (50%) and the highest prevalence of active adults (27%) among Canadian provinces (Federal, Provincial and Territorial Advisory Committee on Population Health, 1999). However, the prevalence of inactivity had increased slightly from 1994-95, when it was 48% (British Columbia Ministry of Health, 1999). Data from the Canadian Community Health Survey, conducted in 2000/2001, indicate that British Columbians remain more likely to be physically active than Canadians as a whole (26.9% vs 21.0%) and less likely to be physically inactive (38.0% vs 49.1%) (Statistics Canada, 2002).

The Canadian Community Health Survey also provided information on physical activity by age (Statistics Canada, 2002). Among all Canadians, the proportion who were physically active decreased progressively with age, from 22.5% among those aged 19-34 to 15.2% among those aged 65 above, while the proportions classified as inactive increased from 47.2% to 56.1%. The proportion of physically active British Columbians also decreased progressively with age, from 29.6% in 19-34 year olds to 20.9% in those aged 65 and above. However, in B.C. the prevalence of physical inactivity did not increase progressively with age: although it increased between aged 19-34 and 35-44 from 36% to 41.3%, it remained relatively stable at 41%-42% among adults aged 45 and above.

2.4.4 Food Insecurity

2.4.4.1 Definitions

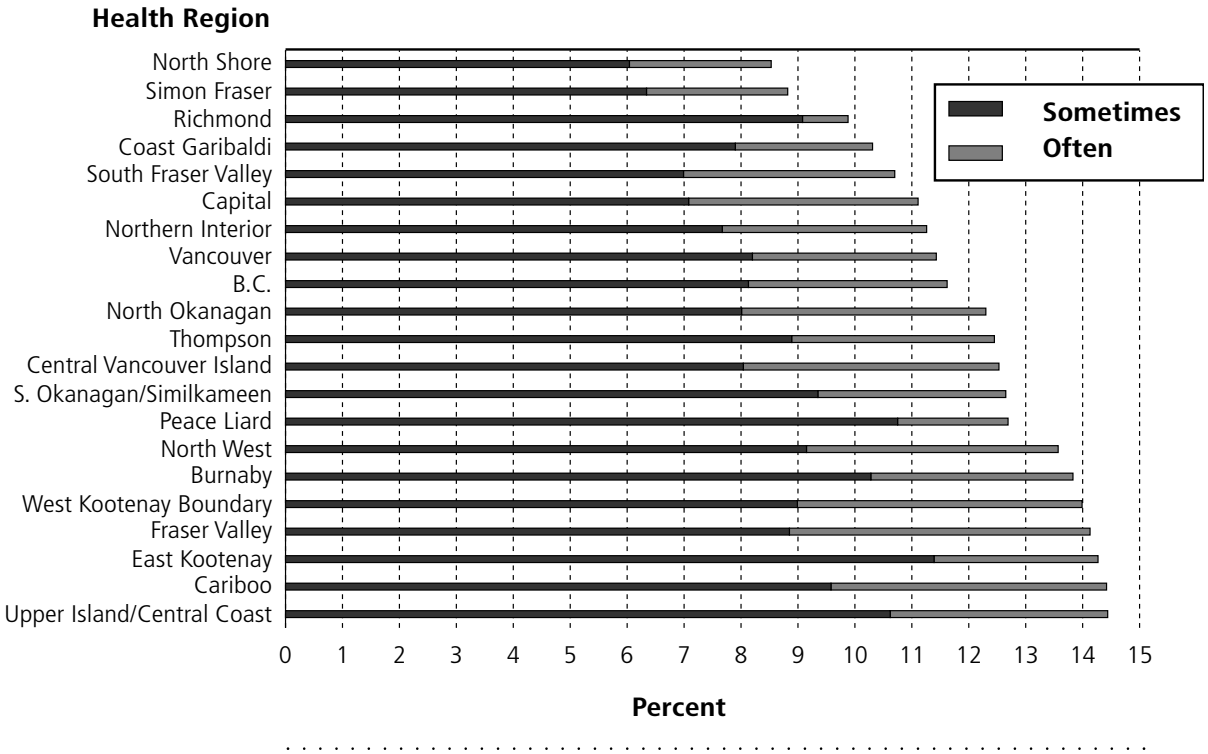
Food security is defined as "a condition in which all people at all times can acquire safe, nutritionally adequate and personally acceptable foods that are accessible in a manner that maintains human dignity. These are conditions that promote health by providing essential nutrients and minimizing food-related stress." (Canadian Dietetic Association, 1991) Conversely, food insecurity is defined as "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson, 1990). Recently, a standardized scale has been developed to assess the severity and prevalence of food insecurity (Carlson et al, 1999). This instrument contains 18 questions that assess the spectrum of food insecurity, ranging from concern that food would run out, to skipping meals because of inadequate food, to not eating for

a whole day. Although national Canadian data are not available using this instrument, U.S. data showed that in the 12 months preceding April 1995, almost 12% of U.S. households experienced food insecurity, including 4.1% with a recurring pattern of hunger (Carlson et al, 1999).

Canadian data on food insecurity were obtained in the 1998/99 National Population Health Survey (NPHS) (Che and Chen, 2001). Individuals were considered to be living in a food insecure household if they answered "yes" to any of the following questions: "In the past 12 months, did you or anyone in your household: 1) Worry that there would not be enough to eat because of a lack of money? 2) Not eat the quality or variety of foods that you wanted because of a lack of money? 3) Not have enough food to eat because of a lack of money?" Those who answered "yes" only to the first question were considered to be "worried", while those responding in the affirmative to the second or third questions were defined as having a "compromised diet". Overall, over 10% of Canadians were defined as living in food insecure households, with 8% experiencing a compromised diet (Che and Chen, 2001).

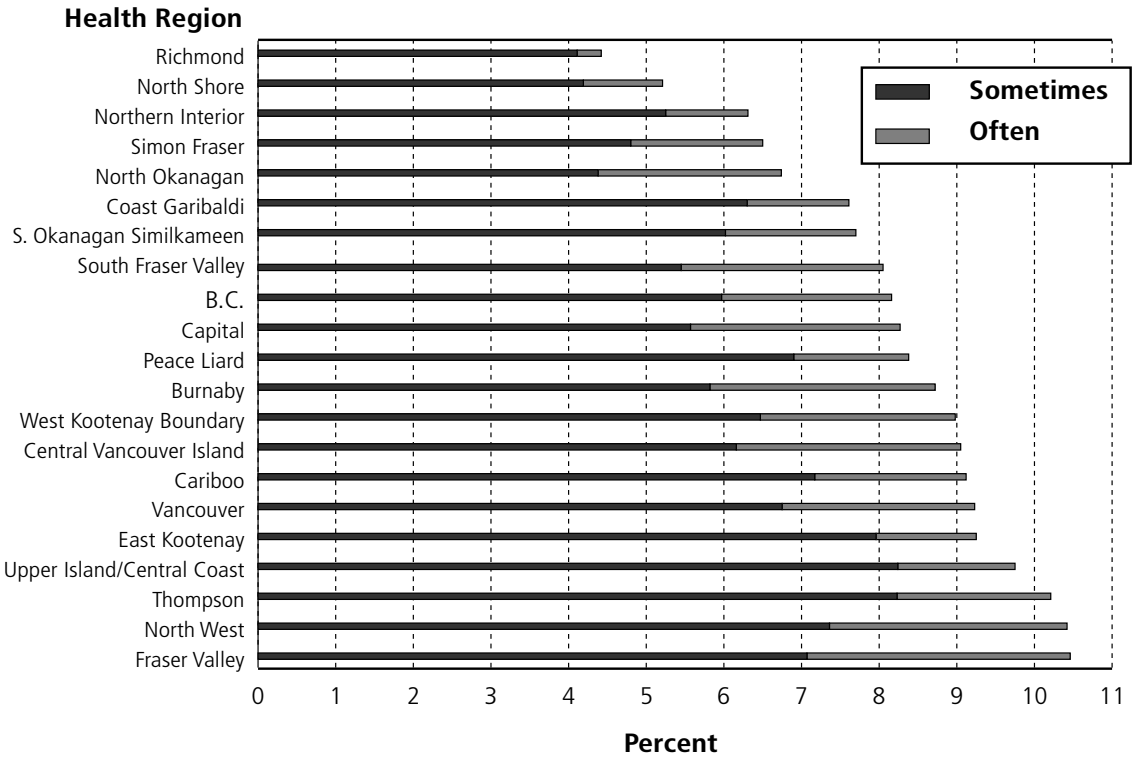
The 2000-01 Canadian Community Health Survey repeated the questions from the NPHS and found that for British Columbians: 11.63% reported sometimes or often worrying that there would not be enough to eat; 14.83% reported sometimes or often not eating the quality of foods wanted; 8.16% reported sometimes or often not having enough to eat (unpublished data, B.C. Ministry of Health Services, January 2003). Figures 2.2a-c show the regional differences in food insecurity reported.

Figure 2.2a Regional comparisons in food insecurity.
1. In the past 12 months, how often did you or anyone else in your household worry that there would not be enough to eat because of a lack of money?



Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001

Figure 2.2b: Regional comparisons in food insecurity
In the past 12 months, how often did you or anyone else in your household not have enough food to eat because of a lack of money?



Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001

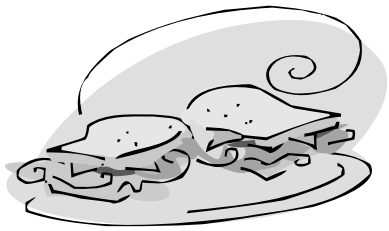
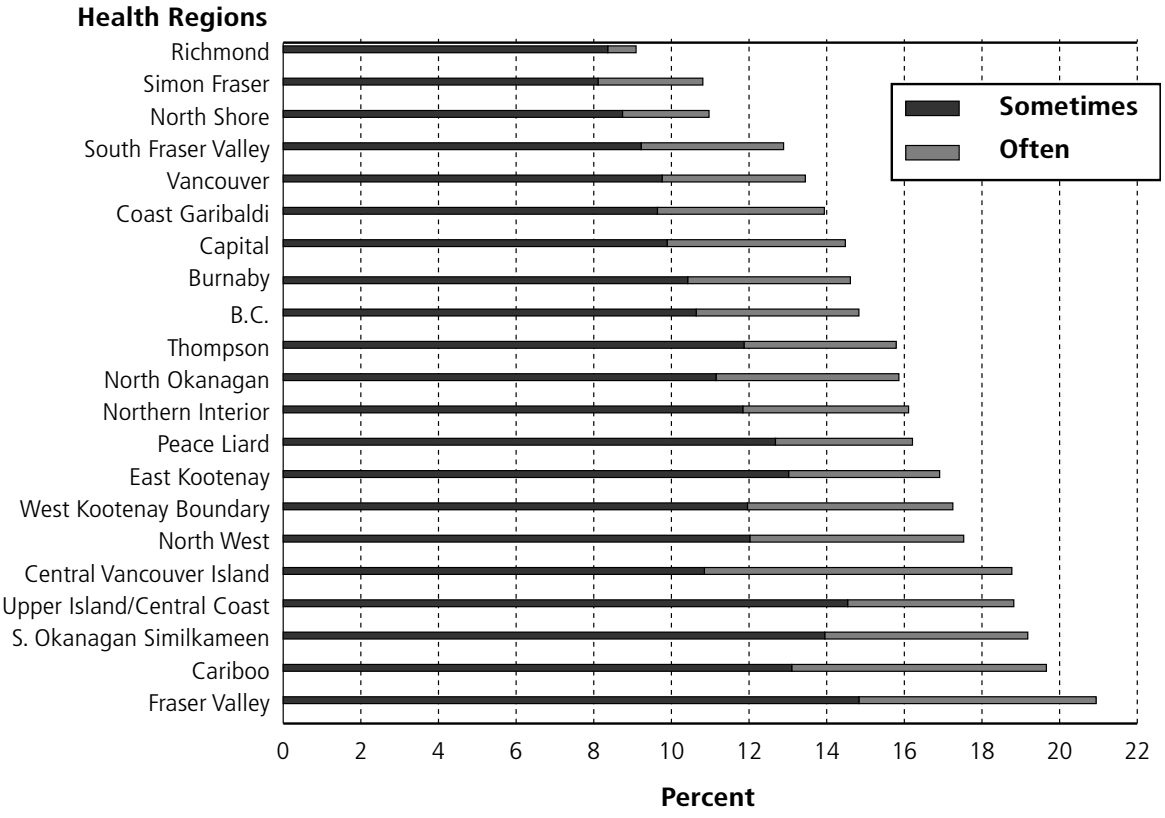
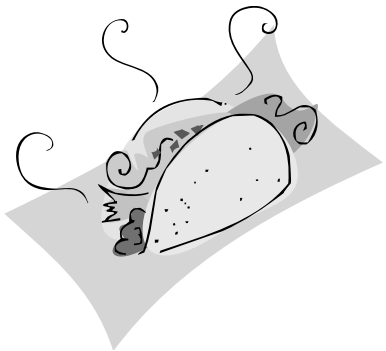


Figure 2.2c Regional comparisons in food insecurity
In the past 12 months, how often did you or anyone else in your household not eat the quality or variety of foods that you wanted to because of a lack of money



Source: Canadian Community Health Survey: Cycle 1.1, 2000/2001



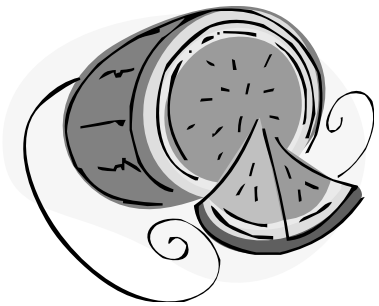
2.4.4.2 Associated Health Risks

It is well-known that poverty is associated with poor health outcomes: For example, the incidence of heart disease and all other chronic diseases studied, was significantly higher for those in the lowest 40% of income adequacy than for those in the upper 60% (Statistics Canada, 1998). B.C. data also show close links between the average socio-economic status (SES) of health regions and health outcomes. Using a combined index of SES that incorporated education (percent of those age 25-54 who did not complete high school), employment (unemployment rate among those aged 15 and above) and income (percent of the population aged up to 64 on income assistance), a linear relationship was observed with premature deaths, expressed as potential years of life lost (years before age 75) per 1000 population (British Columbia Ministry of Health, 1999a).

Food insecurity and income are not completely synonymous, however and the nutritional and broader social consequences of food insecurity are only beginning to be examined and understood (Hamelin et al, 1999). Food insecurity was shown to be related to nutrient inadequacy in a sample of 153 low-income women in Toronto Ontario (Tarasuk and Beaton, 1999) and large surveys in the U.S. have also documented this relationship (Rose, 1999). Other health outcomes may also be affected by food security. For example, in the United States, the least severe level of food insecurity (described as household food insecurity) was found to be associated with a higher BMI and increased prevalence of obesity in women, even when other available and known correlates of obesity (including income level) were controlled (Olson, 1999). In low income school-age children, the risk of hunger and hunger itself were associated with lower scores on an instrument designed to assess psychosocial functioning, even when socio-economic status was controlled (Olson, 1999). Canadian data from the NPHS found that, compared to food secure households, food insecure households were significantly more likely to describe their health as poor or fair (17% vs 7%); to have three or more chronic conditions (21% vs 14%); to be obese (15% vs 12%); to experience distress (31% vs 10%); and to be at risk for depression (14% vs 4%) (Che and Chen, 2001).

2.4.4.3 Relative Food Costs in British Columbia

Although the above examples suggest that food insecurity has consequences that may be independent of income level, income is one factor that has an obvious impact on the ability to achieve food security (Rose, 1999), through its influence on the ability to purchase sufficient quantities of nutritious food. B.C. data on food costs and expenditures are available from Family Food Expenditure in Canada and recent surveys conducted by B.C. community nutritionists.



2.4.4.3.1 Family Food Expenditure in Canada

The Family Food Expenditure in Canada survey, conducted in 17 Canadian cities in 1984, showed clearly that as income increased the amount spent per person on food each week increased, averaging about 35% higher in the highest compared to the lowest quintile (Statistics Canada, Household Surveys Division, 1986). However, there were relatively few differences in per capita expenditure for various food commodities by income level (i.e., the amounts spent per person per week on meat, fruit, vegetables, etc did not vary substantially by income quintile). Where differences were seen was in the amounts spent on food purchased from restaurants and this rose with income level. Only two B.C. cities were surveyed (Victoria and Vancouver) and at that time, food prices appeared similar to or slightly lower than the average of the 17 cities surveyed. Thus, in 1984 it appeared that relative income did not have a major impact on British Columbians' ability to purchase basic food commodities.

2.4.4.3.2 The Cost of Eating in B.C.

Since 1984, however, the gap in income between the lowest quintile and the highest quintile has likely broadened considerably and it cannot be concluded that relative income does not impact on the ability to purchase adequate amounts of nutritious foods. For example, beginning in June 2000, B.C. community nutritionists surveyed 130 grocery stores in 16 provincial health regions to determine the cost of healthy eating (Dietitians of Canada and Community Nutritionists Council of B.C., 2002). Health Canada's National Nutritious Food Basket 1998, consisting of 66 foods chosen to reflect basic energy and nutrient needs, was used for the survey. Results of the 2000 survey and subsequent surveys show that many families living on social assistance or with a single parent working for minimum wage would be at risk for food insecurity.

2.5 Senior Citizens

2.5.1 Population Trends in Canada and B.C.

The proportion of the population that is 65 years and above has been increasing in Canada for a number of years and it is apparent that this trend will continue for at least the next 25 years. For example, it was estimated that as of July 1, 2000, 12.5% of Canadians were aged 65 and over. Projections for the years 2011, 2016 and 2026 suggest that these proportions will rise to 14.5%, 16.5% and 21.4% respectively (Statistics Canada, website accessed December 2000). In July 2000, the age distribution of the B.C. population did not differ greatly from the Canadian average, with about 13% of British Columbians aged 65 and over (Government of British Columbia, Ministry of Finance and Corporate Relations, website accessed December 2000). This population sector is projected to undergo the largest increase of any age group in the province over the next 25 years, increasing to 20.8% by the year 2025. At that time, there will be more B.C. seniors than children and adolescents combined.

2.5.2 Health and Nutritional Status

Although most older adults in North America do not suffer from overt nutrient deficiencies, surveys reveal a prevalence of marginal nutrient intakes (U.S. Department of Agriculture, Food Surveys Research Group, website accessed December 2000), an increased risk of malnutrition and subclinical deficiencies that may affect function and quality of life (Blumberg, 1997; Lesourd et al, 1998; Vailas et al, 1998; Weddle et al, 1996). Lower energy requirements with aging, associated with loss of lean body mass and less physical activity, contribute to these nutrition problems (Gariballa and Sinclair, 1998). Thus, from the nutrition perspective, older adults represent a group at potential risk.

2.5.2.1 Cardiovascular Risk Factors

As in all Canadians, cardiovascular disease is the leading cause of death in those aged 65 and above (Heart and Stroke Foundation of Canada, 1997). National data on the prevalence of risk factors in seniors 65 and above from the Heart Health Surveys has been published (Langille et al, 1999). The five risk factors assessed included smoking, hypertension, elevated blood lipids, physical inactivity and BMI; results indicated that all but 4% of senior Canadians had at least one major risk factor and 50% had three to five. Comparable data are available for senior British Columbians and these values are compared to the national data in Table 2.12. Although it appears that the prevalence of hypertension

is considerably lower in B.C. than in the rest of Canada, the definitions used were not identical: Nationally, hypertension was defined as one or more of systolic blood pressure >140 mm Hg, diastolic blood pressure > 90 mm Hg, on prescription medication for hypertension or on dietary therapy for hypertension (Langille et al, 1999), while in B.C., only the latter three criteria were included. With regard to other risk factors, it appears that the prevalence of hypercholesterolemia and a high BMI are similar in B.C. and Canada, while the prevalence of smoking is somewhat lower in B.C. Inactivity appears to be considerably less prevalent in B.C; however, it should be noted that the criterion used for "being active" was exercising at least once a week for at least 15 minutes. This clearly would not provide the amount of activity required for health benefits.

2.6 Summary

In summary, the last comprehensive nutrition survey of British Columbians was the Nutrition Canada National Survey of 1970-1972. At that time, few differences were observed between average intakes of British Columbians and Canadians as a whole. The data suggested that median intakes of most nutrients were adequate in most age groups, but that considerable proportions of women and seniors had inadequate or less-than-adequate intakes of several nutrients. Since then, comprehensive provincial or national intake data have not been collected, with the exception of a survey of about 1500 Canadian adults in 1997-1998. That study indicated that, since the time of the Nutrition Canada survey, decreases had occurred in fat intake as a percentage of energy, while intakes of most vitamins and minerals had increased. Food disappearance data collected over the same time period appear to support these observations.

Table 2.12 Prevalence of cardiovascular risk factors in men and women aged 65-74, Canada and British Columbia

Risk Factor	Men		Women	
	Canada	B.C.	Canada	B.C.
Hypertension[a]	56	28	58	30
Cholesterol ≥ 6.2 mmol/L	23	23	40	42
Smoking	19	13	16	12
Exercise < 1/wk	43	19	49	33
BMI > 27	40	44	40	38

[a] Different definitions of hypertension were used to develop the Canadian (Langille et al, 1999) and B.C. data (Ministry of Health, Province of British Columbia and Health and Welfare Canada, 1990).

In addition to information on nutrient intakes, data are also available on nutrition-related knowledge, attitudes and behaviours. The 1989 B.C. Heart Health Survey provided information about British Columbians' knowledge and awareness with regard to cardiovascular disease risk. Although cardiovascular disease mortality has decreased since the 1960s and B.C. has the lowest age-standardized rate, it remains the leading cause of death in both Canada and B.C. The survey concluded that there was a need for public education programs to provide practical guidance on reducing total and saturated fat intake. In support of this, Tracking Nutrition Trends, a 1997 survey commissioned by the National Institute of Nutrition, found that fat intake was the primary food/nutrition concern among Canadians. Most of those concerned about fat reported having changed their diets; however, the proportions planning to make additional changes decreased between 1994 and 1997. Dietary intake data are needed to determine whether this reflects that additional changes are not required or whether consumers are becoming less sensitive to this issue. Finally, the survey also reported that a majority of Canadians were aware of *Canada's Food Guide to Healthy Eating* and could name the four major food groups, but that British Columbians had lower levels of knowledge and awareness than the national sample.

Obesity is recognized as a major risk factor for a number of chronic conditions and contributes significantly to health care costs. The prevalence of obesity is lower among British Columbians than among Canadians as a whole, but over one in two B.C. adult men and about one in three B.C. women have a BMI that places them at risk from overweight. The prevalence of obesity appears to be increasing and there is reason to believe that this trend will continue.

At the same time as obesity appears to be increasing in prevalence, the prevalence of dieting and concern about body weight are high, even among those who are not in a BMI category that reflects health risk. High levels of cognitive dietary restraint (the attempt to limit food intake in an effort to achieve or maintain a desired weight), appear to be common in normal-weight young urban B.C. women and are of potential concern with regard to fertility and bone health. Little is known about the levels of restraint among other age/sex groups.

Like obesity, physical inactivity is also recognized as a risk factor for poor health outcome and has been shown to contribute to health care costs. The prevalence of physical inactivity increases substantially as relative body weight increases and considerable research suggests that much of the health risk associated with overweight may instead result from physical inactivity. British Columbians are less likely to be physi-

cally inactive than are Canadians as a group; however, at least half of B.C. adults do not engage in the amounts of physical activity recommended for health.

Food insecurity and its potential impact on nutritional health have only recently been recognized as concerns in North America. Although related strongly to income, food insecurity has been demonstrated to have an independent influence on risk of obesity in adult women and on psychosocial functioning in low income school-age children. Nationally representative Canadian data on the prevalence of food insecurity are not available, but data from the Canadian Community Health Survey and recent surveys on food costs in B.C. communities suggested that some low income British Columbians may not be able to afford to eat well.

3.0 Methodology

3.1 Introduction

This chapter describes the methodology used for the BCNS including sampling strategies, survey instruments, survey staff recruitment and training and data entry and analysis. The chapter begins with a discussion of the BCNS in relation to other provincial nutrition surveys.

3.2 Background

The BCNS is a collaborative effort between the British Columbia Ministry of Health Services (Ministry), Health Canada and the University of British Columbia (UBC). The Ministry managed the data collection phase, Health Canada was responsible for the data entry and analysis phases and UBC led the data interpretation phase. The ethical approval for the BCNS was obtained from UBC's Office for Research Services and Administration Behavioural Research Ethics Board.

The BCNS benefited greatly at all phases of the study from experience of the nine other provinces that completed nutrition surveys prior to B.C. The expert advice from Health Canada and Statistics Canada was also invaluable to the success of the study.

For comparative purposes, the BCNS used as much as possible the protocols from Health Canada and Statistics Canada for sampling, staff training, data collection, entry and analysis. The protocols were developed for the Nova Scotia Nutrition Survey conducted in 1988 and were followed by subsequent provincial surveys (Nova Scotia Department of Health, 1993; Sante Quebec, 1995; Stephen and Reeder, 2001; Taylor et al, 2002). There were four components common to all the provincial surveys – 24-hour dietary recall, food frequency questionnaire, demographic questionnaire and anthropometric measurements – plus a fifth general nutrition and health questionnaire component with content relevant and specific to each province.

Because the content of the general questionnaires varied greatly among the provinces and reflected the changing nutrition priorities over the eleven years between the first and last provincial nutrition survey, there is little or no opportunity for inter-provincial comparisons. Furthermore, because the dietary recalls for the latter three surveys (Ontario, Manitoba and British Columbia) were analysed using the 1999 version of the Canada Nutrient File, comparisons of nutrient intakes would be possible only among these three provinces.

3.3 Sample

3.3.1 Target Population

The target population for the BCNS was adults aged 19 to 84 years, who were residing in the province at the time of the BCNS. Persons living in care or correctional facilities were excluded from the sample because their diets would be influenced by their institutional situation. Individuals living on military bases or Indian reserves were excluded from the sample because responsibility for surveys of these populations is not part of the mandate of Health Canada. Pregnant and lactating women, although included in the sample, were not eligible to participate in the BCNS due to their special nutritional requirements.

The target population was extended beyond the 19 to 74 years required by Health Canada to include individuals aged 75 to 84 years. Older seniors were a particular focus for the BCNS because they may be at greater nutritional risk than younger seniors due to potentially higher prevalences of food insecurity, chronic diseases and other debilitating conditions and social isolation.

3.3.2 Sampling Frame

The sampling frame used for the BCNS was the B.C. Health Registry, a central repository of standard identifying information related to persons who are eligible to receive Ministry of Health Services programs including Medical Services Plan, Pharmacare and hospitals. Each individual who obtains health services in B.C. is assigned an unique numeric identifier – a personal health number (PHN). Each PHN contains identification information (name, date of birth and gender) and locator information (address and phone number). A memorandum of understanding regarding access to the client registry data and confidentiality of the personal information was established between the B.C. Health Registry and the Investigative Team.

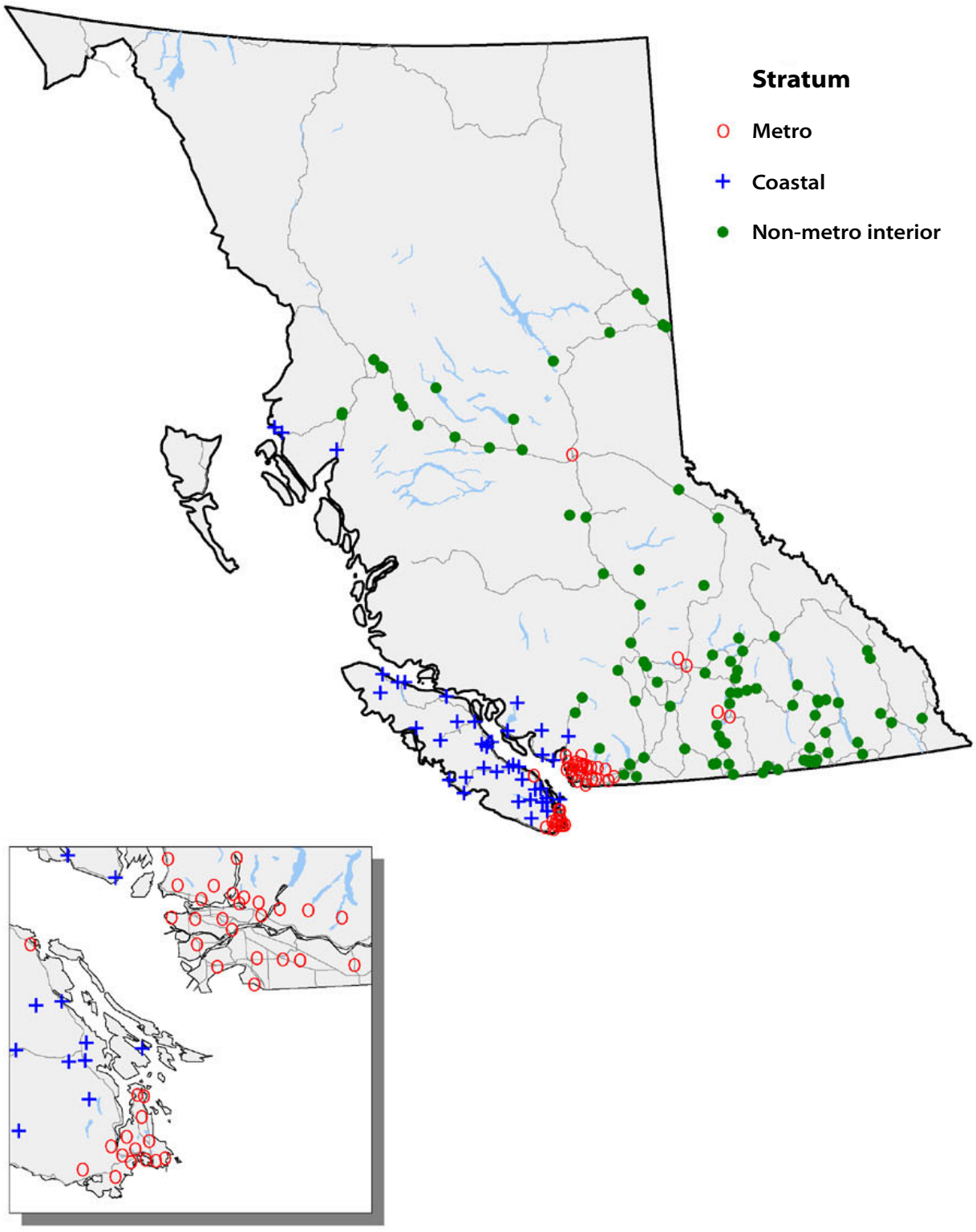
3.3.3 Geographic Stratification

The 1996 Census Sub-Divisions (CSDs) were used to define three geographic strata. (See Figure 3.1.) First, the out-of-scope CSDs, to be excluded from the data collection due to remoteness, were determined with the assistance of BC Stats demographers using criteria such as more than a three-hour drive from health unit office; inaccessible by car alone; scarce population density. Then, the remaining in-scope CSDs were divided into three geographic strata:

1. Metro (6 Census Metropolitan Areas – Vancouver, Victoria, Nanaimo, Kamloops, Kelowna, Prince George);
2. Coastal – rural island and coastal communities; and
3. Non-metro Interior – other rural communities.

The decision to divide the province into three strata, instead of the traditional two strata (urban and rural), was based on the expectation that rural coastal populations would differ from rural interior populations in health behaviours influenced by socio-demographic factors. The sample was designed to allow comparisons among these three strata.

Figure 3.1 Geographic strata for the B.C. Nutrition Survey



Prepared by: BC Stats, Victoria

The Non-metro Interior stratum was further divided into ten clusters that closely approximated health authority boundaries. With staffing and travel costs in mind, the sampling frame for this stratum included four of these ten clusters.

In 1999, there were twenty health authorities designated in B.C. The sample included individuals from all but three health authorities – Peace/Liard, Cariboo and East Kootenay were excluded from the study. The sample was not designed to allow comparisons to be made among the health authorities. A sample sufficiently large to obtain regionally valid information in B.C. would be cost-prohibitive.

3.3.4 Sample Design

Details of the sample design specifications, developed by Statistics Canada, are provided in Appendix A. It was a two-stage probability sample design.

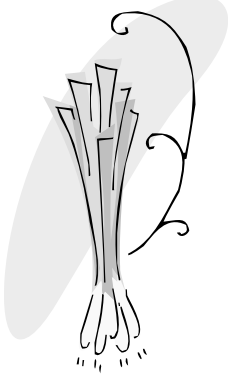
In the first stage, all individuals in stratum 1 and stratum 2 and all individuals in four of the ten clusters in stratum 3 were chosen as in-scope CSDs.

In the second stage, all individuals in the B.C. Health Registry from in-scope CSDs who were aged 18 to 84 years at the time of the data collection in the selected strata and clusters were chosen. They were stratified into 14 age-sex groups:

18-24 years old males	18-24 years old females
25-34 years old males	25-34 years old females
35-44 years old males	35-44 years old females
45-54 years old males	45-54 years old females
55-64 years old males	55-64 years old females
65-74 years old males	65-74 years old females
75-84 years old males	75-84 years old females

3.3.5 Sample Size

An expected sample size of 2200 individuals aged 18 to 74 years and 500 individuals aged 75 to 84 years was determined by Statistics Canada. The expected sample size was corrected for out-datedness of the sampling frame, which was estimated to be 20% for all age/gender groups by the B.C. Health Registry. The expected sample size was also adjusted to deal with anticipated non-response upon the advice of BC Stats demographers. The non-response factors varied by characteristics of the age/gender groups, such as the transience of young adults and the frailty of older seniors. The allocation was performed proportionally to (population



size)$^{1/3}$ to give less importance to the largest stratum and more to the smaller ones. A file of 5320 names was drawn from the B.C. Health Registry – 2660 for the spring season and 2660 for the fall season.

3.3.6 Selection Procedure

With the assistance of the Ministry economist, a multi-step selection procedure, determined by Statistics Canada, was used to assign the following:

- an identification number;
- Fall versus Spring data collection;
- day of the week for first 24-hour recall for every person; and
- day of the week for the second 24-hour recall for every third person.

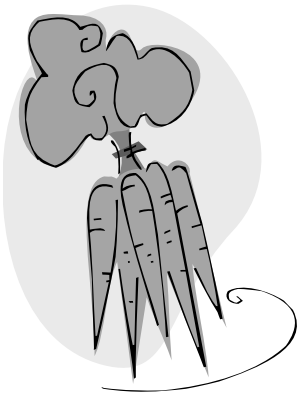
With the assistance of the Ministry epidemiology research officer, participant lists for the spring and fall seasons were created based on postal codes of the names drawn.

3.4 Survey Components

According to Health Canada protocols and similar to other provincial surveys, the BCNS had five components – the 24-hour Recall, the Food Frequency Questionnaire, the Nutrition, Activity and Health Questionnaire (Provincial Questionnaire), the Demographic Questionnaire and anthropometric measurements. Copies of the survey instruments are included in Appendices B-E.

3.4.1 24-hour Dietary Recall

In the BCNS, dietary intake was assessed in a personal interview by the 24-hour dietary recall method, an open-ended technique in which the respondent is asked to recall all foods, including beverages, consumed in the previous 24 hours. Details that affect nutrient composition are recorded, such as added condiments, spreads and salt and cooking methods. Whenever possible, recipe ingredients, product brand names and grocery store or restaurant sources are included as well.



The accuracy of the 24-hour recall methods depends on the memory and honesty of the respondents. Because of embarrassment or desire to please or impress, respondents tend to over-report consumption of foods perceived to be healthy and under-report consumption of foods perceived to be unhealthy (Lee and Nieman, 2003). Overall, there is a tendency to under-report energy intake, which appears to be more pronounced in overweight individuals (Briefel et al, 1997).

In an attempt to obtain accurate intake data, the BCNS used a standardized "multi-pass" system of questioning with unbiased, supportive and non-judgmental probes. This involved the interviewer and respondent reviewing the recall three times in order to obtain successively more detailed and complete information. Portion sizes were estimated using a 70-item kit with three-dimensional food models and household measures in order to improve recall accuracy.

However, no matter how accurate the recall information, a single day's food intake is a very poor descriptor of an individual's usual food intake due to day-to-day or intra-individual variability. Therefore, in order to assess intra-individual variability in food intake, repeat recalls were conducted on one-third of the sample. These took place at least one week following and on a different day of the week than the first recall.

While one 24-hour recall is almost never representative of an individual's usual intake, sufficiently large numbers of 24-hour recalls, adjusted for within-person variability, can provide a reasonable estimate of the intake of populations. Therefore, the 24-hour dietary recall was an appropriate method for the BCNS. Some other advantages of this method for population surveys are that it is easily and quickly administered; it has a low respondent burden; and it is relatively inexpensive (Lee and Nieman, 2003).

Information on the type, amount and frequency (i.e., yesterday, monthly) of nutritional and non-nutritional supplements was also collected as part of the 24-hour dietary recall (Appendix B). Whenever possible, information, including the brand name and DIN (drug information number), was recorded directly from the labels. For the BCNS, the definition of non-nutritional supplements included everything that was not vitamin and/or mineral, including herbal, botanical and homeopathic preparations.

3.4.2 Food Frequency Questionnaire

In the BCNS, a semi-quantitative food frequency questionnaire was used to obtain detailed information on the usual consumption of various foods of interest primarily to Health Canada. The Food Frequency Questionnaire was not a comprehensive tool. Rather, it was developed for the Nova Scotia Nutrition Survey with a focus on fat intake and evolved over time to deal with some foods that are eaten less often or seasonally (for example, broccoli) and some foods that are toxicologically important (for example, liver).

Participants were asked about their frequency of consumption during a specific time period (past day/week/month) and their average portion size of 41 food items that were common to all provincial nutrition sur-

veys. The B.C. survey added five food items at the request of the B.C. Ministry of Agriculture, Food and Fisheries. Information on these five food items – bell peppers, tomatoes, tomato juice, cranberries and cranberry juice – will support provincial marketing and production decisions.

The Food Frequency Questionnaire also included questions required by Health Canada about consumption of added fat and reasons for choosing foods. It also contained questions added by the Ministry to identify respondents who were vegetarians, who were following a special diet or who were diagnosed with a nutrition-related chronic disease.

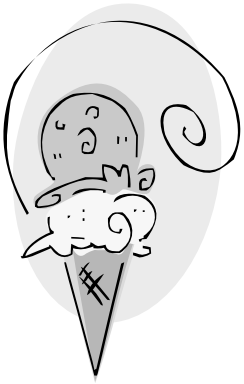
Health Canada and the Ministry of Agriculture, Food and Fisheries will use the results of the Food Frequency Questionnaire for internal research and evaluation projects. Because the Food Frequency Questionnaire data do not add to the information on nutrient intakes already provided by the 24-hour dietary recall data, the findings from the Food Frequency Questionnaire will not be reported in this document.

3.4.3 Nutrition, Activity and Health Questionnaire (Provincial Questionnaire)

The Provincial Questionnaire was unique to B.C. Its content was chosen to address provincial nutrition priorities in food security, physical activity, healthy weight and body image. The Provincial Questionnaire also included questions on food safety, dental health and wild food use in the Spring season to support complementary public health initiatives.

The content of the questionnaire was determined after consultation with stakeholders including government and non-government agencies. To the extent possible, the questions selected met these five criteria:

- The information was not available through another source.
- The information could best be collected through face-to-face interviews.
- Program policy decisions depended on the information.
- There were a large number of users of the information.
- Valid/reliable questions were available.



The questions were tested on twenty consumers who spanned the same age range as the target population and revised and re-tested by researchers at UBC to ensure that the questions were as clear and specific as possible. In addition, questions that were not part of standardized questionnaires were revised based on recommendations of a plain language review. The time required to complete the provincial questionnaire was checked to make certain it met the 30-minute guideline.

3.4.3.1 Physical Activity

The physical activity questions focused on physical activity levels in work and leisure time, motivational readiness to adopt exercise and physical activity and the barriers to adopting an active lifestyle. The Godin Leisure Time Exercise Questionnaire was used to assess leisure-time physical activity (Godin and Shephard, 1985). For the purposes of assessing motivational readiness for physical activity, two different definitions of physical activity were used: one used a definition that reflects structured exercise and the other used a broader lifestyle activity (unstructured exercise) definition. Motivational readiness for each of these two types of exercise was assessed using a staging algorithm based on the Transtheoretical Model of Behaviour Changes (Marcus and Simkin, 1994). Additional details on the methodology and results pertaining to physical activity are presented in the *Report on Physical Activity and Body Weight.*

3.4.3.2 Healthy Weight and Body Image

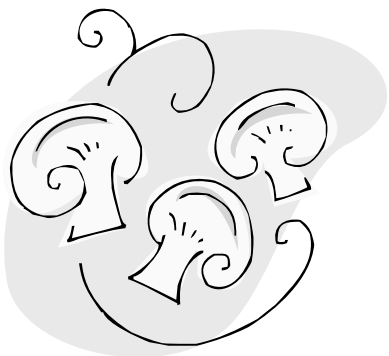
The healthy weight and body image questions focussed on perceived weight status, weight change efforts, body image and eating behaviour (Stunkard and Messick, 1985; Health and Welfare Canada, 1990). In addition, a question about bodily comfort was developed.

3.4.3.3 Food Security

Food security means that all people at all times have dignified access to sufficient food that is safe, nutritious and culturally appropriate and has been produced in a manner that is environmentally and socially sustainable. Hunger is the inability to obtain and consume sufficient food that is safe, nutritious and culturally appropriate because of lack of money.

Three screening questions from Statistics Canada National Health Population Survey were used to identify participants who experience food insecurity (Che and Chen, 2001). Three additional questions from the Human Resources Development Canada Food Insecurity Supplement were used to determine prevalence and severity of food insecurity among identified participants (Che and Chen, 2001).

The four remaining questions, asked of all participants, dealt with food action programs (for example, community kitchens) and food shopping practices (for example, choosing organic food) and were developed to support provincial policy and program development related to food security.



3.4.3.4 Dental Health, Food Safety and Wild Food Use

There were six questions about personal oral health and dental health practices taken from a Scottish dental practices survey (Kelly et al, 2000) on the provincial questionnaire. There were four questions about food safety developed to determine food-handling practices in the home. The questions dealt with cooking food adequately, cooling cooked food rapidly and preventing cross contamination by washing hands and sanitizing dishcloths to prevent food borne illnesses, a major public health concern.

There were six questions about the consumption of locally caught and gathered foods (for example, wild mushrooms) designed to provide information on the prevalence, frequency and amount of consumption in the general B.C. population in order to interpret data on environmental contaminants in food.

These data (on dental health, food safety practices and wild food use) are not included in the present report.

3.4.4 Demographic Questionnaire

According to Health Canada protocols, date of birth and gender were confirmed and marital status, family composition, education and income were collected to characterize the sample, as well as to allow for comparisons in nutrient intake and food consumption among various demographic groups. Information on cigarette use was collected, including lifetime smoking behaviour, which is considered a better measure of exposure than present smoking practice (Heart and Stroke Foundation of Canada, 1997).

A question on aboriginal status was included to document the proportion of First Nations people included in the BCNS, which was expected to be small due to the exclusion of Indian reserves from the sample. The information will help build the case for a future survey targeting this important population.

3.4.5 Anthropometric Measurements

Measurements were taken according to protocols established by Health Canada and with the awareness of potential personal sensitivities around body size and shape. Each interviewer kit contained: A weight scale, which was calibrated weekly; a setsquare and measuring tape to measure height; and a measuring tape to measure girth. The participant was asked to remove shoes, hats, any heavy clothes and any heavy items from pockets for this final phase of the interview. No adjustment to the weight measurement was made for clothing. Weight

and height were measured and recorded once. Waist and hip circumferences were measured and recorded at least twice.

3.4.6 Changes to Questionnaires

The questionnaires were modified on two occasions in order to reduce respondent burden for those over 75 years of age. Midway through the spring season, these participants were no longer asked about the portion size of the foods in the Food Frequency Questionnaire. Also, Parts 2 and 3 in the Food Frequency Questionnaire, which focused on the use of fat, were eliminated for them as well. In the Provincial Questionnaire, they were asked only whether or not they had consumed the wild foods over the last year, not the frequency or amount of consumption.

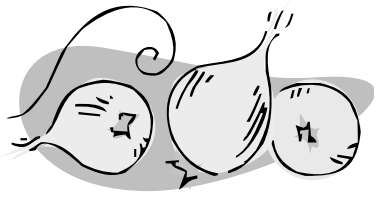
For the fall season, the Food Frequency and Provincial Questionnaires were both shortened for all respondents to further reduce respondent burden. In the Food Frequency Questionnaire, the five food items requested by the Ministry of Agriculture, Food and Fisheries were eliminated. In the Provincial Questionnaire, the sections on dental health and food safety were eliminated, as well as two of the questions on physical activity. The two physical activity questions were eliminated since they had not been validated and were causing some confusion for some of the respondents. For the participants over 75 years of age, the two questions on body image and the one question on the physical demands of respondents' work time were eliminated, as these questions were deemed not applicable to older seniors.

3.5 Survey Staff Recruitment and Training

3.5.1 Recruitment

Twenty-nine nurses and nutritionists were recruited as interviewers, including two multi-lingual interviewers (Punjabi/English and Cantonese/Mandarin/English). They were based out of health units working as seconded or contracted staff. Interviewers were primarily responsible for contacting potential participants and conducting in-home interviews. They were also required to review, compile and forward all completed survey materials to their facilitators.

All but two of the interviewers returned for the second season, therefore retention of survey staff between seasons was not an issue. However, four new interviewers were recruited and trained during two and a half intense days for the fall season to lessen and redistribute the workloads more equitably.



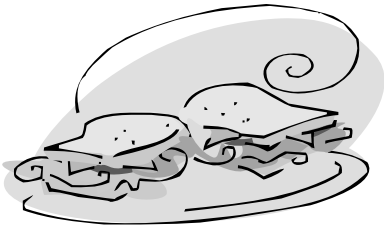
Seven dietitian/nutritionists, all health unit staff, were recruited as facilitators. They were responsible for overseeing all aspects of data collection for an assigned team of interviewers. They tracked the progress of interviewers and verified the completed questionnaires prior to forwarding them to the provincial co-ordinator. Through regular contact with the interviewers and in consultation with the provincial co-ordinator, they resolved day-to-day data collection problems.

The provincial co-ordinator completed the complement of staff utilized for data collection. The provincial co-ordinator was a dietitian/nutritionist who worked closely with the principal investigator on the overall co-ordination and implementation of the BCNS. She prepared the training and resource manual and organized the training sessions. She liaised with the facilitators and finished the final verification of the completed questionnaires prior to forwarding them to Health Canada. Assisted by two tracking officers (co-operative education students from University of Victoria, Health Information Science Program), she managed the tracking and reporting of survey progress, following training by Health Canada staff.

The skills, talents and enthusiasm of the survey staff greatly contributed to the success of the BCNS. Health authority employees were utilized if possible in order to provide the opportunity to enhance the research skills of those involved. The choice of experienced, skilled health professionals greatly facilitated the implementation of the BCNS. However, because they typically worked on the Survey part-time while continuing their regular work part-time, they were sometimes challenged to be flexible in responding to the many and varied demands of the BCNS.

A separate qualitative evaluation was conducted to document the strengths and weaknesses of the data collection process and to document experiences of the survey staff. They highlighted the opportunity to meet new people of all ages in the community, to work with teams of supportive and dedicated colleagues and to participate in a major research endeavor outside of their usual work as key benefits of working on the BCNS (Earnshaw et al, 2000).

3.5.2 Training



All survey staff completed eight days of training prior to the Spring season and two days of training prior to the fall season. Health Canada staff, in conjunction with the principal investigator and provincial co-ordinator, developed the training agendas and conducted the training sessions. A training and resource manual, modified from manuals used in previous provincial surveys, was created for the BCNS (B.C.

Ministry of Health, 1999). The spring training session focused on administering the questionnaires and locating and contacting potential participants. It also covered completion of administrative, control and tracking forms. There were many opportunities for practice incorporated into the training schedule.

The two-day retraining session in the fall provided the opportunity to share experiences from the first data collection period; to discuss the changes that had been made to the survey protocol and procedures; and to refresh skills and rekindle team spirit.

Feedback from survey staff on the training sessions and the manual was overwhelmingly positive. However, survey staff did indicate that the training could have been improved by taking into account the background of those participating in the training. For example, nutritionists did not believe that they needed extensive training on how to take detailed food intake records and public health nurses considered themselves to be experts in finding and contacting people in the community. Suggestions for further strengthening the training sessions included a video of the interview process from start to finish and more advice on organizing workloads (Earnshaw et al, 2000).

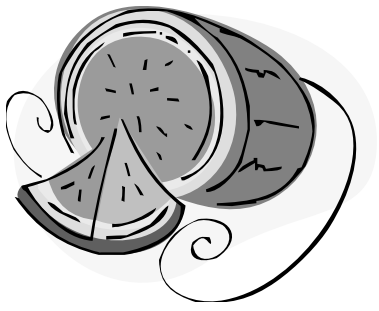
3.6 Data Collection

The BCNS adapted the survey protocol and standard procedures that were established in earlier provincial surveys. The data collection was divided in two 12-week seasons to account for seasonal variations in eating habits. The spring season was from April 26 to July 18, 1999 and the fall season was from September 20 to December 12, 1999.

3.6.1 Contacting Participants

A letter of introduction from the Ministry was sent to potential participants inviting them to participate in a study of British Columbians' food habits and the factors that influence these food habits. The letter included a message and telephone number (written in French, Punjabi and Chinese) for readers requiring the information in any of these languages. (See Appendix G for a copy of this letter.)

The potential participants were clearly advised in the letter that their participation was voluntary and that they may refuse to answer any questions or to have their body measurements taken. The letter described the importance of the study in terms of enhancing the understanding of eating habits of British Columbians in order to plan food and nutrition programs services in the province.



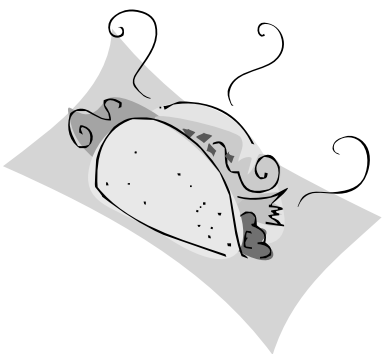
Each interviewer was provided with lists sorted by postal code by health authority and then sorted alphabetically by last name with the following information:

- Identification number;
- Last name, first name and initial;
- Address;
- Telephone number (if available);
- Sex;
- Date of birth;
- Age/Sex group;
- Age;
- Assigned interview day; and
- Assigned repeat interview day (if applicable).

The lists frequently contained inaccurate and incomplete information and this hampered the interviewers' ability to easily contact potential participants. Many addresses were considerably out of date, particularly for the younger adults who are typically more transient. There was a small number of deceased individuals included on the lists. Errors in postal codes, the basis for sorting, frequently led to misassignment of potential participants to interviewers and subsequent switching of files.

Between the two seasons, the B.C. Health Registry "refreshed" the client data in order to capture changes that occurred since the first file was created. There were several changes, such as death of client (61), moved out of province (12), moved out of survey area (19) and duplicate PHN (1).

Feedback from interviewers revealed that contacting potential participants was the least desirable part of their work. It took all of the their considerable communication skills to obtain interviews from individuals who were resistant to involvement for many reasons including concerns about personal safety, confidentiality, length of interview and confusion about survey purpose (Earnshaw et al, 2000).



The interviewer made a minimum of six attempts by telephone at different times and on different days to reach each individual on the list. The interviewer left a recorded message or a message with the person answering the telephone after the third attempt. If a telephone number was not available, the interviewer tried a minimum of three resources, such as criss-cross telephone directories, health unit databases, personal contacts and home visits.

For each individual on the list, the final status of the interview was coded on a special administrative form called an A1. This form was used to review and report response rate. (See Appendix J for a copy of the A1.)

If the interviewer did not make contact, the file was closed and coded accordingly. In the spring season, once the closed file reached the survey office, the co-ordinator sent a 'request for contact letter' as a last attempt to reach the respondent. In the fall season, the interviewer took over the task of sending out the letter. (See Appendix H for a copy of the letter.)

If the individual refused to participate in the BCNS, the interviewer attempted to complete the non-response questionnaire and the file was closed and coded accordingly. A copy of the non-response questionnaire is in Appendix F. The non-response questionnaire was used to determine if those who refused to participate in the BCNS differed systematically from those who agreed to participate. The non-response questions were administered as part of the demographic questionnaire for participants. The questions dealt with type of bread and milk eaten, vitamin/mineral supplement use, present smoking behaviour, marital status and education level. The reason that these variables were selected for comparison was because earlier studies conducted by Health Canada examined the relationships of these variables (excluding bread consumption and type of bread preferred) and found that they were significant factors that related to the intakes of many nutrients (personal communication, Beth Junkins, Bureau of Biostatistics and Computer Applications Health Canada, January 2002). After completion of this short questionnaire, the potential participant was asked if he/she would like to reconsider his/her decision to not participate in the full interview. Some individuals "converted" at that point but the actual number was not monitored.

If the individual agreed to participate in the BCNS and his/her eligibility for the study was verified (for example, not pregnant or lactating), the interviewer scheduled an appointment. Every attempt was made to schedule the interview on the assigned day. If this was not possible, the interviewer could switch days by following a set protocol. Generally, it was deemed more important to obtain an interview for any day in any region than to lose an interview.

Sometimes, the interviewer determined the individual had moved from the region. If the region was outside of the scope of the BCNS, the file was closed and coded accordingly. If the new address was located in another interviewer's region, the file was switched by following a set protocol.

In other cases, the individual was located but could not participate due to language difficulties, hospitalization/extraordinary illness or extended absence (for example, working at logging or fishing camp or "snowbird"). These files were closed and coded accordingly.

3.6.2 Interviewing Participants

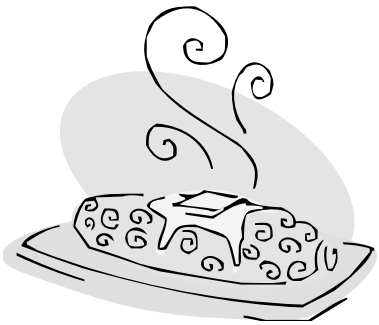
Prior to beginning the interview, the interviewer went through an oral and written process to obtain informed consent from the potential participant. This included asking the individual to read and sign the informed consent form documenting that all information provided during the interview would be held in strict confidence and that any personal identifying information would not appear in any reports. A copy of the consent form is found in Appendix K.

Then, the 24-hour recall was conducted followed, in order, by the food frequency questionnaire, provincial questionnaire and demographic questionnaire. Lastly, height, weight and hip and waist circumference measurements were taken. If an interview had to be "cut short", it was considered a partial interview if the 24-hour recall and demographic questionnaire were completed.

The interviews most commonly took place in participants' homes; however, interviews were also conducted at health unit offices, coffee shops, restaurants and participants' workplaces. All interviewers expressed concerns for their personal safety related to working alone in private homes, however no incidents were reported. Feedback from interviewers indicated that future surveys would benefit from use of cell phones, involving local police in reviewing lists of potential participants and increased publicity about the survey (Earnshaw et al, 2000).

The BCNS was designed to take 1.5 hours in total, however, even in the fall season with shortened questionnaires and experienced interviewers, the average length of the interview was two hours. This increased to an average of 2.5 hours for interviews with seniors.

At the end of the interview, the respondent received a thank you letter from the Ministry and a token gift. Gifts were Heart and Stroke Foundation merchandise, such as key chains, pens and HeartSmart Woman kits and HeartSmart cookbooks, as well as specially designed grocery list note pads.



Interviews were conducted in English throughout the Province. Additionally, in selected communities, interviews were also conducted in Punjabi and Chinese in the spring and in Chinese only in fall. (The decision to discontinue interviews in Punjabi was made based on the low number of unilingual Punjabi surveys conducted in the previous

season.) Richmond, Vancouver and Burnaby have a high proportion of people with Chinese or Punjabi as their home language; therefore these communities were targeted (personal communication, David O'Neil, BC Stats, 1998). Letters, consents and questionnaires were all translated into Chinese and Punjabi and multilingual interviewers were employed in order to remove the inability to speak English as a barrier to participation.

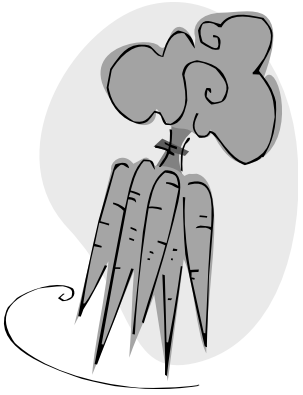
3.6.3 Checking Data

Several checkpoints were in place to ensure the accuracy and completeness of the data collected. The interviewer reviewed the forms twice, once at the conclusion of the interview with the participant present and again within 24 hours. All survey forms were then photocopied and the originals were forwarded to the facilitator who checked them a third time. The photocopies were useful for clarification and followup between the facilitator and the interviewer. Any new information obtained was added to the original forms by the facilitator and to the photocopies by the interviewer. The original forms were then forwarded to the provincial co-ordinator who completed the fourth and final check. At the same time, the photocopies were sent from the interviewer to the facilitator for reference. The provincial co-ordinator worked with the facilitator, who in turn worked with the interviewer, to address any queries she had. Any new information obtained was added to the original forms by the co-ordinator and to the photocopies by the facilitator.

In the spring season, every effort was made to adhere to these four checks for every questionnaire, however, the volume of questionnaires made it challenging to meet, particularly the fourth check by the provincial co-ordinator. In the fall, after discussions with Health Canada staff, the protocol for checking data was changed so that the provincial co-ordinator checked approximately one-third of the questionnaires of experienced interviewers and all of the work by the newly-recruited interviewers.

3.6.4 Tracking Forms

Several systems developed by Health Canada were used to manage the many survey and administrative forms. A data control form was used to track all the closed survey files in transit either by courier or by hand-delivery between interviewer and facilitator and between facilitator and provincial co-ordinator. In the fall season, the data control form also served as a tally sheet for monitoring performance of interviewers and facilitators.



A computer-based batch sheet was created to account for all the closed files shipped to Health Canada. The batch sheet listed the identifier number, interviewer number, number of pages of the file and final status of the interview. The batch sheet, which accompanied the shipment, was also faxed to Health Canada to serve as an alert of a pending delivery.

A tracking system was developed to monitor the progress of the BCNS. Of particular interest was the number of files closed each week as a percentage of the total files drawn, the distribution of completed interviews across age/sex groups and the ratio of second interviews to first interviews completed. The tracking officer produced weekly reports for the principal investigator and Health Canada for evaluation and action.

3.7 Data Entry and Analysis

3.7.1 Data Entry

All questionnaires and forms were sent to the Bureau of Nutritional Sciences (BNS) at Health Canada for data entry into the Nutrition Survey System (NSS). The NSS is a custom-designed software program, developed by research staff at the BNS and the Bureau of Biostatistics and Computer Applications to facilitate the entry, processing, storage and retrieval of data on the nutrient and food intakes from the 24-hour dietary recall form and on the many variables from other questionnaires and forms (Administrative form A1; non-response, demographic, provincial and food frequency questionnaires). The NSS is updated and adapted to reflect each provincial nutrition survey.

The NSS uses several databases of foods, mainly the Canadian Nutrient File (Health Canada, 1997) and a recipe database of nearly 3000 recipes, adapted from the USDA CSFII recipe database. The Canadian Nutrient File is a computerized food composition database containing average values for up to 115 nutrients in 4668 basic foods available in Canada. The data are compiled at the BNS of Health Canada. Much of the data in the 1997 version were from the United States Department of Agriculture (USDA) Nutrient Database for Standard Reference, up to and including SR13. Modification for Canadian levels of fortification and regulatory standards, addition of food items only available in Canada and inclusion of some unique Canadian brand names characterize this Canadian standard reference database. The 1999 version, to which values reflecting folic acid fortification of flour and pasta had been added, was used to analyse the BCNS data.

The 24-hour recall data were entered into the NSS by experienced data clerks familiar with food descriptions. The data clerks received training

on the specifics of the B.C. survey and were supervised by professional staff to ensure data quality. Problems and questions related to the recorded data that were identified during data entry were relayed to the researchers in B.C. for clarification or correction. Professional staff at the BNS manually checked the data input for each record by comparing a printed copy of the computer-recorded data with the information on the original questionnaire or form.

Input of 24-hour dietary recall data began with the entry of a key name for a food or mixed dish, followed by the selection of the exact or best match to the food or mixed dish from the many options displayed. Existing computerized recipes were used for mixed dishes, with ingredient substitutions or the addition of new recipes as required. Amounts consumed were entered as weights, volumes or coded portion-size models, but all were converted into weights for the output analysis.

Nutrient supplement data were entered by the Drug Identification Number (DIN) or by the name and/or nutrient content if the DIN was not available. When insufficient or inadequate information was provided, the strength of the supplement was selected by default that was determined by BNS staff.

Custom-designed displays were used for the data entry for the other questionnaires and forms. Some automated validations were built-in to ensure a certain degree of consistency and data quality. Questionnaires and forms were entered twice to ensure accuracy. Reports comparing both entries were generated where inconsistencies were highlighted to facilitate corrections.

3.7.2 Data Analysis

The data were analyzed using the statistical software programs, SAS (SAS Institute Inc, Cary, NC) and SPSS (Statistical Package for Social Sciences, version 11.0, Chicago, Ill., 2002). This section briefly describes the method of estimating the distribution of usual nutrient intakes from food sources and supplements, the estimation of the proportion of nutrient inadequacy in the B.C. population and additional analyses conducted by the BCNS research team.

3.7.2.1 Estimating Distribution of Usual Intakes

The method of estimating the distribution of usual intakes from food sources alone is described in the BBCA Technical Report 451311-011 (Appendix L). The method used for the BCNS is an adaptation of the method described by the U.S. National Research Council in 1986. A stratum-adjusted method was then developed and first used for the Nova Scotia Nutrition Survey (Karpinski and Nargundkar, 1992).

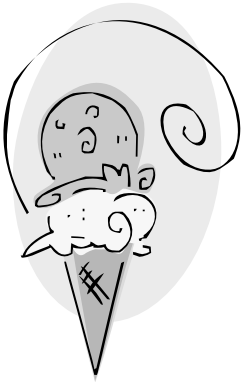
This method was peer reviewed by an international panel (Karpinski and Nargundkar, 1992) and evaluated at the Consensus Workshop on Dietary Assessment (1994). A two-step procedure is used: A normalizing transformation is found and then, a linear transformation, which provides a distribution of intakes without the intra-individual component, is used.

The distributions of usual intakes from food sources and supplements were determined using an approach that is further discussed in the BBCA Technical Report 451311-011 (Appendix L) and in more detail in "Methodology for Estimating Usual Intake of Micro-Nutrients from Food and Supplements" (Hayward, 2003, in progress). To determine nutrient intake from food plus supplements, the monthly nutritional supplement use recorded for each participant was expressed as a daily amount and was added to the usual intake obtained from food sources alone. For example, if someone took a multivitamin/mineral supplement containing 50 mg of vitamin C each day and a 500 mg vitamin C supplement 4 times in the past month, the monthly intake from supplements would be 3500 mg (50 mg x 30 + 500 mg x 4). This amount would be averaged over the month (3500 mg/30 = 116.7 mg) and added to the individual's usual vitamin C intake from food to obtain total vitamin C intake.

3.7.2.2 Determining Inadequate Intakes

To estimate the inadequacy of nutrient intakes, the EAR cutpoint method, developed by the Institute of Medicine (Institute of Medicine, 2000b), was used for all nutrients except for iron. A more detailed mathematical approach was used to determine the inadequacy of iron intakes (i.e., the full probability approach). This approach, rather than the EAR cutpoint method, must be used when the requirement distributions are skewed. This is the case for iron. A more detailed description of the method used for iron is explained in Appendices M and N.

3.7.2.3 Influence of Income and Education on Nutrient Intakes



Comparison of survey respondents to non-respondents and to the B.C. population indicated that respondents were better educated and therefore may have had higher incomes. (See Chapter 4.) To determine whether these differences may have biased the results in the direction of more positive findings for nutrient intakes, it was necessary to determine whether education and income were associated with nutrient intakes.

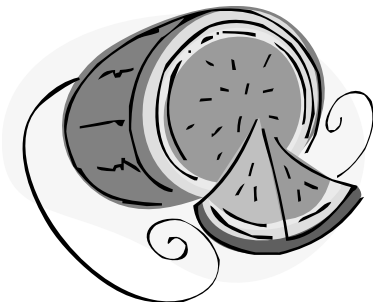
Before analyzing the effects of income and education, these two variables were reclassified. Income levels (n=10) obtained from the BCNS demographic profiles were reclassified as "low income" or "not low

income". This assessment took into account the household income level, the number of occupants living in the household and the breakdown of children and adults living in the household. The "low income" cut-offs were based on the 1999 Statistics Canada low income measures by family type (Statistics Canada, 2001). Education level, which included ten levels in the BCNS demographic profile, was collapsed into three groups: high school or less, trade school or some university and completion of university.

Only nutrients with a measurable prevalence of inadequacy (>10%) were evaluated to assess whether nutrient intakes were influenced by education level or income level. If the prevalence of inadequacy was essentially zero, then an effect of education or income would not be meaningful. To perform the analysis, the unadjusted nutrient intakes were initially transformed logarithmically and outliers were excluded to obtain a reasonably symmetric intake distribution. (Refer to Appendix O.) The possible effects of education and income were then examined using a General Linear Model procedure in SPSS. The dependent variable was the transformed nutrient of interest. The study design elements, including sex, age group, season and geographic strata, were entered as fixed effects, as were the reclassified education and income variables. Unadjusted energy intake was entered as a covariate in each model. Both the main effects and two-way interactions of these variables were determined.

3.7.3 Data Review

One of the conditions of the funding contribution by Health Canada was that prior to publication, the findings of the survey were to be reviewed by an external panel of experts. (See Acknowledgements.) These individuals were provided with a draft of this report and asked to comment on the analysis and interpretation of the data. They were also asked to provide feedback on the clarity and appropriateness of report overall. In appreciation of their time and expertise, the reviewers were offered an honorarium. The peer review process provided detailed comments that were addressed and incorporated in this report.



4.0 Response Rates

Summary

The response rate for the B.C. Nutrition Survey was between 42% and 52%, a rate that is consistent with other provincial nutrition surveys. A comparison of BCNS respondents to non-respondents and the general B.C. adult population was made to determine how representative the results would be of the adult population. Overall, the study participants were higher educated and therefore may have been more health- or nutrition-conscious than the non-respondents as well as the general adult population in B.C. Thus, it is important to investigate the impact that education may have on energy and nutrient intakes.

4.1 Introduction

This chapter summarizes the response rates for the B.C. Nutrition Survey (BCNS). A discussion of how representative the respondents are of the adult population in B.C. is presented. As well, response/non-response comparisons as analyzed by the Bureau of Biostatistics and Computer Applications in the Food Directorate in Health Canada (Appendix P) are included.

4.2 Response Rates for the B.C. Nutrition Survey

The calculation of the response rates was adapted from the Statistics Canada Methods and Standards Committee document *Standards and guidelines for reporting of non-response rates: definitions, framework and detailed guidelines (1992)* and outlined in Figure 4.1. Table 4.1 lists and describes the four response rates that were calculated for the BCNS. The following discussion provides an overview of each of the four response rate categories and whether differences were observed according to age, sex and geographic area.

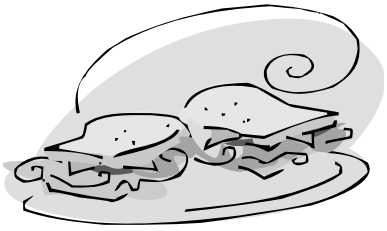
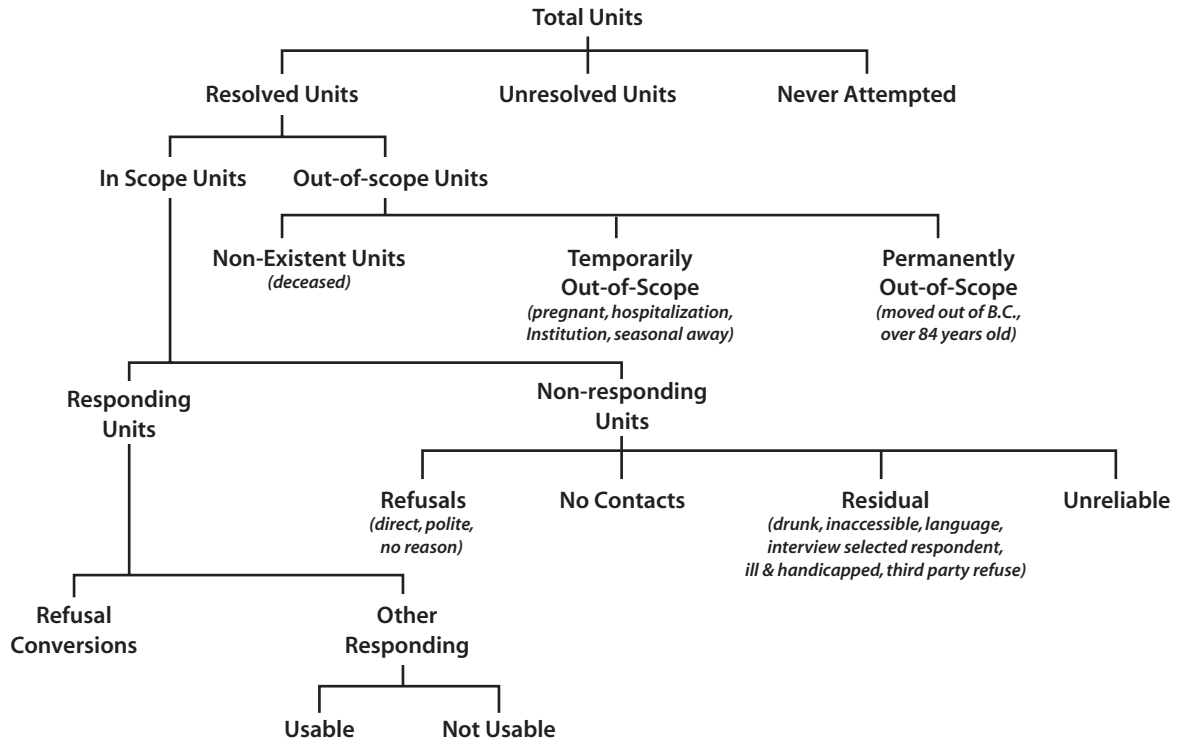


Table 4.1 Definitions of rates involved in the calculation of response rates for the B.C. Nutrition Survey (BCNS)

Rate	Definition	Equation
Resolved Rate	Number of potential participants located and contacted to participate in the BCNS from the total number of contacts attempted.	$\frac{\text{Number resolved}}{\text{Total attempted}}$
In-scope Rate (eligible)	Number of potential participants successfully contacted that meet the inclusion criteria and thus are eligible over the total number resolved. Out-of-scope means that these individuals are not eligible to participate since they do not meet the inclusion criteria, moved out of province or are deceased.	$\frac{\text{Number in-scope}}{\text{Number resolved}}$
Refusal Rate	Number of potential participants who refused to participated over the number that were successfully contacted and met the inclusion criteria , thus eligible. This rate only includes those individuals who simply refused and does not include those participants who were located but were not able to complete the interviews for various reasons such as language barriers and unsafe environments for the interviewers.	$\frac{\text{Number refusals}}{\text{Number in-scope}}$
Response Rate	The response rate is based on the number of usable first interviews provided by the in-scope individuals and is dependent on if the unresolved individuals were eligible or ineligible to participate. The lower bound of the response rate is calculated assuming that all the unresolved cases were in-scope. The upper bound is calculated assuming that all unresolved cases are out-of-scope.	Lowerbound = $\frac{\text{\# responding - \# unusable}}{\text{\# in-scope + \# unresolved}}$ Upper bound = $\frac{\text{\# responding - \# unusable}}{\text{\# in-scope}}$

Source: BBCA Technical Document 451311-0010NR (Appendix P).

Figure 4.1 Calculation of response rates[1]



[1] Chart adapted from Statistics Canada Methods and Standards Committee (1992) "Standards and Guidelines for Reporting of Non-response Rates: Definitions, Framework and Detailed Guidelines.

Source: BBCA Technical Document 451311-0010NR (Appendix P).

Overall, 82% of the names drawn for the BCNS were resolved – located and contacted to participate. This rate varied across geographic strata with the Metro (79%) and Coastal (81%) strata being lower than the Non-metro stratum (87%). Resolved rates were greater for males than females and lowest in the younger age group but generally increased with age. The pattern with age was expected, as younger individuals are likely to be more mobile than older ones and, consequently, more difficult to track (BBCA Technical Document 451311-0010NR).

Eighty-seven per cent (87%) of the resolved names were in-scope or eligible. Individuals were considered out-of-scope or not eligible if they were dead, moved out of province or exhibited at least one of the exclusion criteria (such as pregnant, lactating, living on-reserve or living in an institution.) (Refer to form A1 in Appendix J.) The in-scope rate was similar between the Metro and Coastal strata (88%) and slightly

higher than the Non-metro stratum (84%). The pattern of in-scope rates was the same for both gender groups and appeared to be lowest in the youngest age group (18 - 24 years), increasing with age and dropping off in the older age groups. This pattern was also expected as pregnancy and transient residence affect the in-scope status of the youngest ages, while factors such as severe illness and seasonal residences are prominent in the older groups (BBCA Technical Document 451311-0010NR).

Of those contacted and eligible, 38% refused to participate in the study. The refusal rate varied slightly amongst the geographic strata with Metro stratum having the lowest refusal rate (36%) and Non-metro stratum having the highest (41%). This rate was consistent over the age groups for both genders until 64 years of age, at which point the refusal rate increased for males and decreased for females.

The overall response status for the BCNS by season is presented in Table 4.2. There were 1823 usable responses, 868 in the spring and 955 in the fall. Four hundred and eighty-one repeat recalls were completed, with 230 in the spring and 251 in the fall. Table 4.3 provides the response rates for the BCNS. The response rate is dependent upon the unresolved cases (those individuals that couldn't be reached) and the unusable interviews (for example, incomplete data collection). Upper and lower bounds of the response rate were calculated to account for the proportion of unresolved individuals who were likely to be in-scope. Rates that represent the upper bounds are calculated based on the assumption that all unresolved cases are counted as out-of-scope or ineligible individuals. Alternatively, lower bounds are calculated under the assumption that all unresolved cases represent in-scope individuals. The true rate lies somewhere between these values.

For the BCNS, the lower and upper bounds of the response rate were 42% and 52%. The response rates were similar among the geographic strata ranging from 40% to 44% for the lower bound and from 52% to 53% for the upper bound. Response rates were higher for females than males up to 64 years of age, at which point males had a slightly higher response rate. The response rates increased with age but then decreased in older individuals. For females, the response rate decreased after 64 years and for males, it decreased after 74 years (see Appendix P).

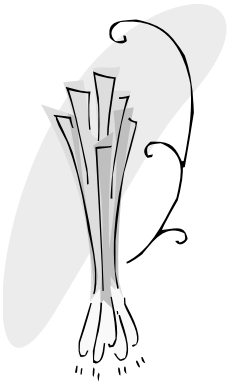


Table 4.2 Response status for the BC Nutrition Survey by season[1]

Summary Status	Spring 1999	Fall 1999	Total
Drawn	2658	2615	5273
Attempted	2397	2502	4899
Resolved (contacted and located)	1965	2044	4009
In-scope (eligible)	1716	1772	3488
Responding with interview	869	957	1826
Response usable 1st recall	868	955	1823
(% eligible cases)	(51%)	(54%)	(52%)
Repeat recalls	229	250	479
(% of usable 1st recalls)	(26%)	(26%)	(26%)

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] Accountability tables by age, sex and geographic stratum are provided in BBCA Technical Document 451311-0010NR (Appendix P).

Table 4.3 Response rates of the BC Nutrition Survey by season and geographic strata

Geographic Stratum	Spring 1999				Fall 1999				Both seasons			
		Response rate				Response rate				Response rate		
	n[1]	LB[2]	n	UB[3]	n	LB	n	UB	n	LB	n	UB
Metro	1022	40%	791	52%	1134	41%	872	53%	2156	40%	1663	52%
Coastal	487	38%	384	48%	540	44%	430	55%	1027	41%	814	52%
Non-metro Interior	639	43%	541	51%	556	46%	470	54%	1195	44%	1011	53%
All strata	2148	40%	1716	51%	2030	43%	1772	54%	4378	42%	3480	52%

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] "n" reflects the number used in the denominator for the response rates equations found in Table 4.1.

[2] LB is lower bound and is the lower bound of the response rate that is calculated assuming that all the unresolved cases were in-scope (eligible).

[3] UB is upper bound and is the upper bound of the response rate that is calculated assuming that all unresolved cases are out-of-scope (ineligible).

4.3 Comparison of B.C. Nutrition Survey Respondents to Non-respondents

A low response rate suggests the potential for bias. Non-responders may differ from survey responders suggesting a non-response bias and results that may not be reflective of the general adult population in B.C. In an effort to determine the direction and/or extent of potential bias introduced with a low response rate, researchers with the BCNS obtained demographic and selected available data on both non-responders and respondents to determine whether differences exist between the two groups. In the BCNS, the non-responders were asked to complete a

short survey including questions on smoking, consumption of bread, milk and supplements, education and marital status.

About 66% of the non-respondents were willing to answer this survey. Their responses to the questions were compared to the responses obtained from the study participants. The results are presented in Table 4.4 and summarized in this section.

Table 4.4 Comparison of B.C. Nutrition Survey responders to non-responders

Characteristic	Responders		Non-responders	
	n	%	n	%
Daily smokers:				
All	1806	16.7*	863	23.4
Males	860	16.7	427	24.8
Females	946	16.7	436	22.0
Bread consumers: (All)	1809	98.9	874	98.5
Bread consumption				
By type (All):	1790		861	
Whole wheat		49.7		51.0
Multigrain		23.7		24.4
White bread		17.5		13.7
Rye, pumpernickel		4.8		4.6
Other		4.1		5.2
Don't know		0.1		0.8
Milk consumers:				
All	1809	94.6*	876	89.4
Males	860	92.7	432	88.9
Females	949	96.3	444	89.9
Milk consumption				
By type (All):	1711		783	
Whole		10.5		13.2
2%		43.0		44.4
1%		24.3		23.8
Skim		16.2		14.2
Powdered		0.8		1.2
Evaporated		1.2		0.6
Other		4.0		2.3
Don't know		<0.1		0.3
Vitamin/mineral supplement usage:				
All	1809	66.2*	874	59.8
Males	860	60.2	431	53.1
Females	949	71.7	443	66.4

Table 4.4 continued

Characteristic	Responders		Non-responders	
	n	%	n	%
Education (Bachelor degree and above):				
All	1808	14.4*	861	9.2
Males	860	16.2	423	11.8
Females	948	12.9	438	6.6
Marital status				
Married:				
All	1806	65.2	861	64.1
Males	858	70.0	422	69.2
Females	948	60.8	439	59.2
Single:				
All	1806	15.1	861	16.5
Males	858	16.9	422	19.2
Females	948	13.5	439	13.9
Widowed:				
All	1806	10.2	861	11.7
Males	858	5.6	422	4.5
Females	948	14.3	439	18.7
Divorced/separated:				
All	1806	9.6	861	7.7
Males	858	7.5	422	7.1
Females	948	11.4	439	8.2

Source: BBCA Technical Document 451311-0010NR (Appendix P).

*Indicates a significant difference between the responders and the non-responders.

The results show that there were significantly fewer smokers, more vitamin/mineral supplement users and more postgraduate degree holders in the respondents than the non-respondents and these findings are consistent over age and sex groups. Respondents reported higher proportion of milk consumers for both sexes and for those 45 years and over. There was little effect of the type of milk consumed, but a slight trend to lower fat milk preference for study participants. There were no significant differences regarding marital status or bread consumption between the two groups.

4.4 Comparison of B.C. Nutrition Survey Participants to the B.C. Adult Population

To determine whether the findings in the BCNS are representative of the general adult population, BCNS participants were compared to B.C. adult population in terms of factors such as smoking, education

and marital status using B.C. population statistics and the demographic information obtained from the study participants. The results, as shown in Table 4.5, suggest that the participants in the BCNS had similar smoking status, were more educated and a higher proportion were married than the general B.C. population.

Table 4.5 Comparison of the BCNS respondents to BC population profiles[1]

Characteristic	Group	BCNS Respondents		B.C. Population Profile	
		Weighted Proportion	n	Weighted Proportion	n
Smokers[2]	All	16.9	1806	17.3	1722
	Males	17.3	860	17.9	790
	Females	16.5	946	16.8	932
Education[3]	Males (all ages)		860		not applicable
Secondary school or less		33		57	
Trade or College		21		27	
Some University		26		3	
Completed University		21		13	
	Females (all ages)		948		
Secondary school or less		34		52	
Trade or College		20		30	
Some University		28		2	
Completed University		18		16	
Marital Status[3]	Males (all ages)		858		not applicable
Married		64		55	
Single		28		23	
Separated/divorced		7		13	
Widowed		2		9	
	Females (all ages)		948		
Married		60		58	
Single		20		30	
Separated/divorced		12		10	
Widowed		9		2	

Source: BBCA Technical Document 451311-0010NR (Appendix P).

[1] All survey estimates are weighted by sample weights to ensure that the responders contribute to estimates proportionally with respect to age and sex to be representative of the general population.

[2] The smoking statistics are from the Canadian Tobacco Use Monitoring Survey (CTUMS, January 1999), a national survey sponsored by Health Canada and conducted by Statistics Canada. The BC specific CTUMS results were provided by personal communication from M. de Groh, Health Canada, January 2002.

[3] The education and marital status statistics are from the 1996 Census.

4.5 Discussion

The overall response rate for the BCNS was between 42% to 52%. This rate is within the range of response rates achieved by other provincial nutrition surveys (BBCA Technical Report 451311-006NR, Junkins, 1999). Some reasons for non-response include the time commitment, safety and security concerns, particularly on the part of the seniors' population, mobility trends of younger adults and inaccuracies in the sampling frame.

Cigarette smoking has been linked to certain nutrition behaviours in that smokers tend to have food and nutrient intakes that differ from the dietary guidance recommendations (Berger and Wynder, 1994). The proportion of daily smokers was significantly different between responders and non-responders. However, when compared to the data from the Canadian Tobacco Use Monitoring Survey, the smoking rates of the BCNS participants did not differ from the general B.C. adult population. This suggests that any related bias in the nutrient intake results will probably be small and difficult to detect.

Bread, milk and vitamin and mineral consumption were examined for the responders and non-responders. A significantly higher proportion of responders took a vitamin and mineral supplement. These results suggest that there may be a tendency for the prevalence of milk and supplement consumption to be high from the survey.

The over-representation of university education between BCNS participants and non-respondents as well as the general population may introduce significant bias towards nutrition recommendations and effect the results. It has been reported that groups with higher education will have lower smoking rates, lower alcohol and meat consumption but higher fruit, vegetable and supplement intakes (Berger and Wynder, 1994). For this reason, the effects of education and income on energy and nutrient intakes were examined.

5.0 Demographics

Demographic and Other Characteristics of British Columbians

Summary

Most of the BCNS participants were married, food secure, did not hold a university degree, did not smoke and were not classified as low income. More than half were overweight or obese, similar to what is found nationally. As well, 64% were consuming either nutritional or non-nutritional supplements or both, higher than what has been documented in previous surveys conducted in Canada and the U.S. These results provide more evidence that weight issues are a concern for the B.C. population and that more research is needed to explore consumers' perception about supplement use and to understand the consequences of increased supplement use. Even though most participants were food secure, the Canadian Community Health Survey and the BCNS both show that some British Columbians are dealing with food insecurity.

5.1 Introduction

A description of the B.C. adult population as assessed in the BCNS is provided in this chapter. Some of the characteristics presented here are from information in the Demographic Questionnaire (Appendix D) including sex, aboriginal/First Nations origin, marital status, education level, income level, household size and smoking status. Other information such as body mass index (BMI), supplement use and food security issues are from the Anthropometric Measurements, the 24-hour Dietary Recall (Appendix B) and the Provincial Questionnaire (Appendix E).

5.2 Selected Demographic Characteristics of the BCNS Participants

A number of the demographic characteristics of the BCNS participants are depicted in Table 5.1. There was similar representation of females and males in the BCNS. Two-thirds of the participants were married, 15% had completed a university degree and 17% were smokers. Since aboriginal people living on Indian reserves were excluded from the survey, it is not surprising that only a small proportion (3%) of participants were of Aboriginal or First Nations origin.

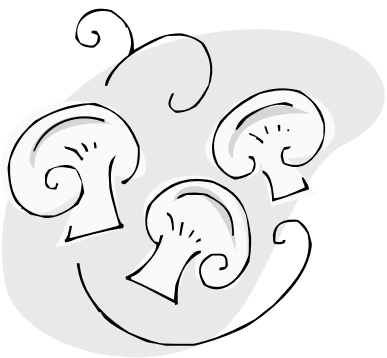
Table 5.1 Demographic characteristics of the BC Nutrition Survey participants (n=1823)*

Characteristic	Total	Males	Females
Gender	n=1823	47.6% (n=868)	52.4% (n= 955)
Education Level:			
Completed high school or less	40.7%	40.3% (n=347)	41.1% (n=390)
Technical school/some university	44.8%	43.5% (n=374)	46.0% (n=436)
University Degree	14.6%	16.2% (n=139)	12.9% (n=122)
Marital Status:			
Married or Common Law	65.2% (n=1806)	70.0% (n=858)	60.8% (n=948)
Divorced/separated	9.6%	7.5%	11.4%
Widowed	10.2%	5.6%	14.3%
Single	15.1%	16.9%	13.5%
Aboriginal/First Nations	2.9% (n=53)	3.1% (n=27)	2.7% (n=26)
Smokers	16.5% (n=301)	16.6% (n=144)	16.4% (n=157)

*Data are unweighted.

5.3 Income Status and Food Security Issues of the B.C. Population

Since lower socio-economic status may influence nutrient intakes and food insecurity, the income levels obtained from the BCNS Demographic Questionnaire were recalculated to determine the proportions of the population who would be classified as low income or not. Of the 1450 participants who answered the income question (20% did not provide a response), 25% were classified as low income (Table 5.2). This proportion is slightly more than the 19.6% reported in the 1996 census for the B.C. population.



In the BCNS, participants were asked three questions associated with food insecurity regarding lack of quantity and/or quality of food and if they were ever "worried" during the past 12 months that they didn't have enough to eat because of lack of money. The findings are presented in Table 5.2. The result for the question on quality and variety of food is similar to what was found for B.C. in the 2001/02 Canadian Community Health Survey (CCHS). However, there are small differences for the "worried" and the "quantity" questions, with fewer BCNS participants answering yes to these questions. The reason for the discrepancy in numbers could be due to sampling variation. The CCHS targeted British Columbians from 12 years and over whereas the

BCNS only targeted the adult population. As well, differences could be due to the interpretation of the different response options for the questions in the two surveys. For instance, in the CCHS respondents were instructed to answer often, sometimes and never to these questions and a positive response was considered if the respondent answered often or sometimes. However, in the BCNS participants were instructed to answer simply yes or no. When income levels were examined, as one might expect, slightly more than half of those who responded yes to the 'worried' (59.8 %) and "quality" (53.7 %) questions were classified low income and the majority of those who said yes to the "quantity" question (73.8 %) were low income. Even though the proportion of the province that has compromised food intakes is low, these results indicate some British Columbians are experiencing food insecurity.

Table 5.2 Income status and food security of the survey participants compared to the BC population.

Characteristic	**BCNS (%)**	**B.C. (%)**
Low income status (n=1450)	25.2	19.6[1]
Received income from income assistance or welfare	5.9	4.3[2] (19-64 years)
Worried that there would not be enough to eat because of lack of money	7.3	11.6[3]
Did not have enough food to eat because of lack of money	3.4	8.2[3]
Did not eat the quality or variety of foods because of lack of money	12.0	14.8[3]
OF THOSE WHO ANSWERED "YES" TO ANY OF THE THREE QUESTIONS ABOVE:		
Skip meals or eat less than you should because there was not enough money for food (at least once per month)[4]	19.2	
Eat cheaper foods or the same foods for several days because there was not enough money for food (at least once per month)[4]	38.1	
Receive food from a food bank, soup kitchen or other charitable agency because there was not enough money for food (at least once per month)[4]	5.6	

Data is weighted.

[1] Statistics Canada, Census 1996.

[2] BC Statistics from Ministry of Human Resources.

[3] BC statistics calculated from positive responses of participants in the Canadian Community Health Survey, 2002.

[4] These questions were asked to participant who answered yes to any of the three food security questions – worrying about not having enough to eat because of lack of money, not having enough to eat because of lack of money and not eating the quality or variety of foods because of lack of money. The response reported is at least monthly.

5.4 Body Mass Index (BMI) of the B.C. Population

The prevalence of overweight and obesity in the adult population is increasing in B.C. and has become a serious health concern. According to Table 5.3, about 37% of the participants were considered overweight (BMI ≥ 25.0 - 29.9) and almost 18% were classified as obese (BMI ≥ 30). This proportion is higher than what was estimated in the 1989 Heart Health Survey for the B.C. population. The results of these two surveys are comparable, since they both used measured heights and weights. In 1989, 45% of the population had a BMI ≥ 25, compared to 55% in the BCNS, resulting in a 10 percentage point increase over the last 10 years. Additional information on BMI will be presented in the *Report on Physical Activity and Body Weight.*

Table 5.3 Percent distribution (%) of Body Mass Index (BMI)[1] by age and sex

BMI	Total	Males 19-30	Males 31-50	Males 51-70	Males 71+	Females 19-30	Females 31-50	Females 51-70	Females 71+
<20	6.3	8.6	1.3	2.6	1.5	13.2	6.3	10.6	4.7
≥20 to <25	39.3	43.1	27.4	29.3	22.4	51.6	53.3	33.6	38.3
≥25 to <27	18.2	15.0	29.4	29.4	22.5	10.4	10.5	12.7	15.7
≥27 to <30	18.4	20.8	22.1	19.0	28.2	13.1	12.9	19.7	20.4
≥30	17.8	12.4	19.9	19.8	25.3	11.6	17.0	23.4	20.9

[1] 87.5% were measured heights and weights.

Source: BBCA E451311-011BV1 - S. Hayward, August 2002.

The shaded area represents the healthy weight range and the proportion of the population that falls within this range.

5.5 Supplement Usage by the B.C. Population

The use of nutritional and non-nutritional supplements is becoming more and more popular in North America. Findings from the recent Food Habits of Canadians survey estimated the prevalence of use of nutritional supplements to be 47% among women and 33% among men, with 41% of the population using at least one vitamin or mineral supplement (Troppmann et al, 2002). In the U.S., the results are similar, with about 40% of the population taking dietary supplements (NHANES III). These studies have found that more women, older adults and households with higher incomes are the groups more likely to take these supplements (Troppmann et al, 2002; NHANES III, Statistics Canada, 2003).

Information about the usage of non-nutritional supplements is limited. Data from NHANES III found that the two most frequently used products were garlic and lecithin (Radimer et al, 2000). As well, use of these supplements was similar across most age groups, however, there seemed to be a higher proportion of users aged 45-74 years. For the BCNS, the most common non-nutritional supplements were glucosamine, echinacea, garlic, ginkgo, lecithin, evening primrose, ginseng, coenzyme Q10 and St John's Wort.

In the BCNS, participants were asked if they consumed supplements yesterday and how often during the past month. Supplements were classified as nutritional (containing recognized vitamins and minerals) and non-nutritional supplements (not containing recognized vitamins and minerals but considered by the respondent to be a supplement). Sixty-four percent of the total population were consuming supplements, with the trend increasing with age for both men and women (Table 5.4). A total of 57% of the population was consuming nutritional supplements, which is appreciably more than the national figure reported (40%). As presented in Table 5.5, the most common supple-

Table 5.4 Proportion of population taking supplements last month by sex and age

Supplement	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Nutritional only	31	33	27	28	29	34	31	29	40
Non-nutritional only	7	9	9	9	4	4	6	4	4
Both nutritional and non-nutritional	26	13	16	23	37	24	32	45	40

Source: BBCA E451311-011CV1-Supplement Tables- S. Hayward, August 2002.

ments consumed were those containing a mixture of vitamins and minerals (31%), vitamin C (24%), herbs and natural products (19%) and vitamin E (17%). The number of supplements taken yesterday by the population was also explored and the results are shown in Table 5.6. One-quarter of the population, who took supplements, consumed four or more nutritional supplements in one day, while almost 39% took four or more of a combination of nutritional and non-nutritional supplements. The proportion of multiple supplement use was highest for men over 70 years of age and all women 31 years and over. Additional information on supplement use will be presented in a separate report.

Table 5.5 Proportion of population taking supplements last month by supplement groups, sex and age

Supplement Group	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+yr
Iron preparations	1	0	0	<1	5	2	3	<1	1
Replacement preparations[1]	2	0	1	1	7	<1	1	5	9
Enzymes	<1	0	0	1	0	<1	0	<1	0
Gastrointestinal products[2]	5	2	2	3	2	4	8	8	7
Vitamin A	2	2	2	4	1	1	<1	3	6
Vitamins A and D	3	0	1	2	8	2	3	7	10
Vitamin B complex	9	2	5	8	15	9	12	16	12
Vitamin C	24	19	22	16	29	25	28	30	24
Vitamin D	1	0	<1	2	1	0	0	3	5
Vitamin E	17	4	9	22	38	6	14	35	40
Multivitamins	9	7	11	4	7	12	8	14	10
Vitamins and minerals	31	23	21	24	29	30	42	37	54
Minerals	13	4	6	12	13	8	18	28	23
Other nutrients[3]	20	11	17	18	25	8	27	33	29
Herbs and natural products	19	10	11	19	25	21	25	25	26
Homeopathic	3	<1	<1	2	3	5	3	4	5

Source: BBCA E451311-011CV1-Supplement Tables- S. Hayward, August 2002.

[1] Contains mostly calcium and potassium.

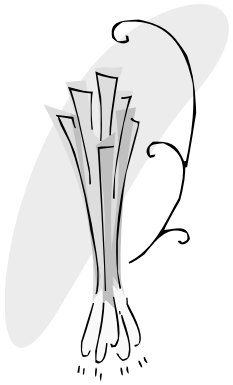
[2] Includes antacids, adsorbents, laxatives, digestants.

[3] Includes glucosamine, amino acids, evening primrose oil, coenzyme Q10, flax seed oil, lactic acid bacteria.

Table 5.6 Number of supplements taken by supplement users in one day by sex and age

Supplement	Total (%)	Males (%)				Females (%)			
		19-30 yr	31-50 yr	51-70 yr	71+yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Nutritional:									
1	34.8	67.9	42.6	41.9	34.7	48.4	35.6	28.3	23.4
2	23.4	14.3	24.6	26.5	24.4	26.7	21.2	21.2	24.0
3	16.5	3.6	13.1	13.7	14.8	14.1	18.6	16.7	22.8
4	10.8	10.7	14.8	8.6	12.5	6.3	5.1	14.7	10.2
5	5.9	3.6	1.6	2.6	8.0	0.0	5.9	8.6	7.2
≥6	8.7	0.0	3.3	6.8	5.7	4.7	13.6	10.6	12.6
Nutritional and Non-nutritional:									
1	26.4	55.9	36.1	29.7	25.7	42.9	23.4	20.1	18.3
2	19.0	17.7	20.8	21.1	16.0	17.1	25.8	16.4	19.4
3	16.0	8.8	15.3	18.0	13.9	17.1	18.6	17.3	14.9
4	10.7	5.9	8.3	11.7	11.2	10.0	3.2	12.6	14.3
5	8.0	2.9	9.7	4.7	11.8	5.7	4.8	6.5	11.4
≥6	19.9	8.8	9.7	14.8	21.4	7.1	24.2	27.1	21.7

Source: BBCA E451311-011CV1-Supplement Tables - S. Hayward, August 2002.



6.0 Energy and Nutrient Intakes

Summary

Energy and nutrient intakes were estimated for British Columbians in eight age and gender groups from the BCNS data. Energy intakes for British Columbians were lower than estimated requirements. Most British Columbians are making progress toward meeting the dietary guidance for macronutrients – fat, carbohydrate and protein. However, about one-fifth were below the lower end of the recommended range for carbohydrates (<45% of calories) and almost one-quarter consumed more than 35% of their calories from total fat. Half of the population were consuming more than 10% of their calories from saturated fats. The majority of the population consumed less than 300 mg of cholesterol per day, indicating that British Columbians have made an attempt to lower their cholesterol levels to what had been recommended previously. In addition, the median fibre and calcium intakes were considerably less than the Adequate Intake (AI), making both priority issues for the public health agenda. Micronutrients that are potential public health concerns due to inadequacy of intake include folate, vitamins B6, B12 and C, magnesium and zinc. Another issue of concern is inadequate iron intake for premenopausal women. Continued monitoring is essential and further research is needed to determine the implications of inadequate and/or excessive intakes of both macro- and micro-nutrients.

6.1 Introduction

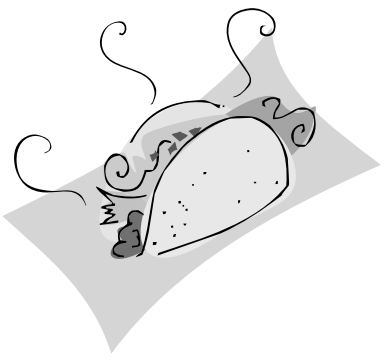
The intent of this chapter is to provide information on the nutrient intakes of British Columbians and to help identify and target potential nutrition concerns in this population. This chapter examines energy and nutrient intakes of the British Columbian adult population according to sex and the age groups used for determining the Dietary Reference Intakes[1] (19-30 years, 31-50 years, 51-70 years and 71 years and over). The effects of educational level, low income status and geographic strata on intakes are not included in this discussion. Appendix O provides the results of analyses that examined the effect of these three factors on the consumption of nutrients of concern. Low income status and geographic strata did not have an effect on consumption of these nutrients. Educational attainment only had an effect on the intakes of vitamins C and B12. It appears that vitamin C intake is higher and vitamin B12 intake is lower for those British Columbians who have a higher level of education. In addition, the lack of an effect of education attainment for most of the other nutrients of concern was partic-

[1] The Dietary Reference Intakes were reviewed in the literature review (Chapter 2).

ularly important, since it has implications for the extent to which the results can be generalized to all British Columbians. Although the sample was better educated than the B.C. population, the lack of a positive association between educational level and consumption of most of the nutrients of concern suggests that this difference does not bias the results.

Tables were generated using data presented in the technical reports provided by Health Canada (BBCA E*A*51311-011BV1, BBCA E*A*31311-011CV1) and following further manipulations of the raw data as determined by the BCNS research team. The 1999 Canadian Nutrient File (CNF) was used for determining the nutrient content of foods consumed by British Columbians. This database is almost 100% complete for energy and macronutrients and 90% or more complete for the other nutrients presented in this report. Those amounts that are missing for the nutrients presented are felt to provide negligible contributions and can be reasonably set at zero (personal communications with Beth Junkins and Josie Deeks, December 2002). Vitamins D and E intakes are not included in this report since the 1999 CNF is incomplete for these two nutrients. Furthermore, vitamin A intakes are not included in this report because comparison of the results to Dietary Reference Intakes is not possible at this time. A different unit is used in the CNF (retinol equivalents, RE) than the one used for the estimation of the EAR (retinol activity equivalents, RAE) and until the RE can be transformed to the RAE, any comparison with the EAR will overestimate adequacy.

The tables presented in this chapter include the mean adjusted nutrient intakes (adjusted for intrasubject variability) and distributions of nutrient intakes from food sources alone and from food sources and supplements where applicable. As well, intakes were assessed against the Estimated Average Requirement (EAR), Adequate Intake (AI) and the Tolerable Upper Intake Level (UL), when possible, to determine inadequacies or issues of over consumption in the B.C. population. For nutrients with an EAR, the percentage below the EAR reflects the prevalence of inadequacy with respect to the criterion used to set the EAR. For nutrients with an AI, the prevalence of nutrient inadequacy cannot be quantitatively determined. However, when median usual intake of a group meets or exceeds the AI, the expected prevalence of inadequacy is low. This is particularly true when the AI was set as the median intake of a healthy group. When reviewing these assessments, the reader should keep in mind that the new Dietary Reference Intakes (DRIs) were established on the basis of reducing the risk of chronic disease and not only to prevent deficiencies as was done previously. Appendix Q provides a list of the criteria used to establish the new DRIs to assist the reader in the understanding of this concept and, thus, the assessments.



Some comparisons are made to the results of the Third National Health and Nutrition Examination Survey[2] (NHANES III) and the Continuing Survey of Food Intakes of Individuals (CSFII). Appendix R includes tables that present median usual intakes of the U.S. adult population from food alone and from food plus supplements according to the data obtained from NHANES III and CSFII. However, comparisons to the findings of the published provincial nutrition surveys are not included since the BCNS used a new coding system, a more recent version of the Canadian Nutrient File, different age groupings and the new DRIs as the reference standards for assessment. Furthermore, there is a separate initiative underway by Health Canada to facilitate inter-provincial comparisons of nutrient intakes. BCNS results will contribute to this initiative.

6.2 Energy and Macronutrients

6.2.1 Energy

Energy intakes and possible estimates of total energy expenditure (TEE) are shown in Table 6.1. For both males and females, energy intakes decreased with age, as one would expect since older individuals tend to have lower energy requirements. The formulas used to determine energy requirements (TEE) are presented in footnotes 2 and 3 of Table 6.1. These formulas are derived from data obtained using the doubly labeled water technique and use participants' measured heights and weights and a physical activity coefficient (PA) assuming that participants are sedentary or engaged in low levels of activity (Institute of Medicine, 2002). These two PAs were used since it has been previously documented that the majority of Canadians are relatively inactive (Katzmarzyk et al, 2000).

When comparing the intakes of British Columbians to their crudely estimated requirements, it was encouraging that mean energy intakes seem to be only slightly under-reported for most of the age groups and in particular for men. Under-reporting of energy intakes is consistent with the literature (Lee and Nieman, 2003). Even when using a standardized method such as the multiple pass 24 hour recall method and providing extensive training to interviewers as was done for the BCNS, research has shown that respondents with low food consumption tend

[2] An ongoing nutrition surveillance system in the US that uses the mulit-pass 24 hour recall was used in the BCNS and assesses intakes using the DRI age groupings.

to overestimate their intake and those with high consumption underestimate intake, a phenomenon known as "flat-slope syndrome". Overall, the literature suggests that recalls tend to underestimate intake by about 10%-20% compared with observed intake (Buzzard, 1998). Underreporting of energy intakes was also observed in NHANES III (Briefel et al, 1997).

Table 6.1 Energy intakes (kcal) by sex and age

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			TEE[2,3] Sedentary Mean ± SEM	TEE[4,5] Low Activity Mean ± SEM
				25th	50th	75th		
Male	19-30	142	2883 ± 105	2167	2824	3452	2664 ± 13	2907 ± 15
	31-50	205	2624 ± 71	2155	2644	2912	2584 ± 15	2837 ± 17
	51-70	249	2342 ± 74	1898	2334	2703	2340 ± 20	2588 ± 22
	71+	271	2013 ± 64	1627	1894	2285	2162 ± 26	2405 ± 29
Female	19-30	176	1971 ± 72	1667	1875	2125	2028 ± 12	2282 ± 13
	31-50	266	1812 ± 49	1515	1763	2012	1901 ± 11	2155 ± 12
	51-70	282	1669 ± 42	1422	1610	1826	1773 ± 13	2029 ± 15
	71+	230	1508 ± 35	1317	1502	1633	1590 ± 17	1837 ± 19

Source: BBCA E451311-011BV1 - S. Hayward, August 2002.

[1] SEM= Standard Error of the Mean.

[2] TEE sedentary for men=Total Energy Expenditure for those who are sedentary, estimated using the following formula=662-9.53 x Age (yr) +PA x (15.91 x Weight [kg] + 539.6 x Height [m]), where PA is the physical activity coefficient and equal to 1.0.

[3] TEE sedentary for women=Total Energy Expenditure for those who are sedentary, estimated using the following formula=354 – 6.91 x Age (yr) +PA x (9.36 x Weight [kg] + 726 x Height [m]), where PA is the physical activity coefficient and equal to 1.0.

[4] TEE low activity for men=Total Energy Expenditure for those whose activity is low (defined as TEE/BEE of 1.4-<1.6), estimated using the following formula=662-9.53 x Age (yr) +PA x (15.91 x Weight [kg] + 539.6 x Height [m]), where PA is the physical activity coefficient and equal to 1.11.

[5] TEE low activity for women=Total Energy Expenditure for those whose activity is low, estimated using the following formula=354 – 6.91 x Age (yr) +PA x (9.36 x Weight [kg] + 726 x Height [m]), where PA is the physical activity coefficient and equal to 1.12.

Mean values for the proportion of energy derived from alcohol and macronutrients for the total population and by age and sex are presented in Table 6.2a. Table 6.2b presents the distribution of energy derived from macronutrients and the shaded areas in the table represent the Acceptable Macronutrient Distribution Ranges (AMDR), where appropriate. The AMDRs are the new dietary guidance recommendations that were based on chronic disease prevention and ensuring adequate intakes of essential nutrients. These are 45 to 65 percent of energy from carbohydrates, 20 to 35 percent from fat and 10 to 35 percent from protein.

The proportion of B.C. adults falling within the AMDR appears to be consistent for the two sexes and across age groups. However, there was an appreciable proportion of the population (about one-fifth) not consuming 45% of their total energy from carbohydrate and almost one-quarter of the population consuming more than 35% of total energy from total fat. In addition three-quarters of the population were consuming less than 5% of their energy from linoleic acid and more than 10% of their calories from saturated fats. Seventy percent were consuming the recommended range for α-linolenic acid. Health implications of having high intakes of total fats, saturated fats and cholesterol (to be discussed in section 6.2.5) include high blood lipid levels and the risk of developing cardiovascular disease.

Table 6.2a Percentage (%) of energy derived from alcohol, carbohydrate, fat and protein by age and sex

Nutrient	Total	Males				Females			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Alcohol	2.7	2.6	3.4	3.1	3.3	2.5	2.0	2.2	1.9
Carbohydrate	49.8	50.0	48.5	49.1	49.9	52.8	48.9	50.0	51.9
Fat	31.9	30.9	32.5	31.8	31.7	30.9	33.5	31.5	29.6
Protein	15.6	16.5	15.5	15.9	15.1	13.8	15.5	16.3	16.6

Source: BBCA E451311-011BV1 S. Hayward, January 2003.

Table 6.2.b Distribution of energy derived from carbohydrate, total fat, linoleic acid, α-linolenic acid, saturated fat and protein for the total population and by sex and age (expressed as a percentage (%) of energy)[1]

Nutrient	Total	Males				Females			
		19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
Carbohydrate									
< 45% of Energy	22	18	34	23	26	9	23	18	14
≥ 45 to < 55	54	60	43	57	48	51	60	57	49
≥ 55 to < 65	22	21	20	16	23	37	16	24	35
≥ 65	2	2	4	4	3	3	0	1	3
Fat									
< 20% of Energy	1	0	1	1	1	0	2	2	7
≥ 20 to < 25	9	4	6	9	16	16	6	16	15
≥ 25 to < 30	29	40	25	24	23	36	26	26	36
≥ 30 to < 35	36	41	41	45	31	29	30	34	29
≥ 35 to < 40	19	12	23	16	23	14	25	16	8
≥ 40	6	3	4	5	6	5	10	7	4
Linoleic Acid									
< 5% of Energy	76	81	67	61	72	84	77	85	90
≥ 5 to < 10	24	19	33	38	28	16	23	16	10
≥ 10	<1	0	0	1	<1	0	0	0	0
α-Linolenic Acid									
< 0.6% of Energy	23	40	23	33	22	32	13	10	10
≥ 0.6 to < 1.2	70	50	71	54	71	66	83	79	85
≥ 1.2	7	10	6	14	7	1	4	11	4
Saturated Fat[2]									
< 5% of Energy	2	0	1	0	5	1	1	2	8
≥ 5 to < 10	51	55	48	49	53	61	44	50	58
≥ 10 to < 15	43	45	49	47	35	33	49	42	27
≥ 15 to < 20	4	0	2	4	5	4	6	5	6
≥ 20	0	0	0	0	2	0	0	1	1
Protein									
<10% of Energy	2	3	2	1	2	7	1	0	0
≥ 10 to < 20	92	87	88	94	95	91	92	98	97
≥ 20to < 30	6	11	10	6	3	2	7	2	3
≥ 30	0	0	0	0	0	0	0	0	0

[1] The shaded areas represent the Acceptable Macronutrient Distribution Ranges (AMDR) where appropriate and the proportion of the population meeting these recommendations.

[2] No AMDR is set for saturated fats.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.2 Carbohydrate

Carbohydrate intakes are presented in Table 6.3. The median intake ranged from 248-342 g/d for men and 197-257 g/d for women and is slightly higher than the U.S. data (Appendix R). The Estimated Average Requirement (EAR) is set at 100 g/d and is based on the amount of carbohydrate needed to produce enough glucose for the brain to function (Institute of Medicine, 2002). As noted in Table 6.3, virtually no one in the B.C. population was below this amount.

Table 6.3 Carbohydrate intakes by sex and age (expressed as g/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	365 ± 17	272	342	423	100	0
	31-50	205	323 ± 10	251	316	381	100	0
	51-70	249	293 ± 10	222	288	343	100	0
	71+	271	254 ± 8	204	248	282	100	0
Female	19-30	176	265 ± 9	231	257	276	100	0
	31-50	266	226 ± 7	189	219	249	100	0
	51-70	282	213 ± 6	178	210	244	100	<1
	71+	230	201 ± 5	176	197	220	100	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.3 Dietary Fibre

Fibre helps promote a healthy digestive system and there is evidence to suggest that it may play a role in the prevention of colon cancer and promotion of weight control, although the data are inconclusive at this point (Institute of Medicine, 2002). An Adequate Intake (AI) for dietary fibre is set at 38 g/d and 25 g/d for men and women aged 19-50 years, respectively and at 30 g/d and 21 g/d for men and women over 50 years of age. These AIs are based on the amounts needed to help protect against coronary heart disease, for which there is the strongest evidence of a protective role (Institute of Medicine, 2002). The median intakes for fibre for both men and women in B.C. (Table 6.4) are similar to what has been reported in the U.S. (Institute of Medicine, 2002). It is important to note that intakes may be underestimated by about 5g/d, since the database for fibre does not include the contributions of inulin and fructo-oligosaccharides. According to the Continuing Food Survey of Intakes by Individuals, these types of fibre could contribute

about 5 g/d in the adult diet (Institute of Medicine, 2002). Even so, median intakes were below the AI for fibre for all age/sex groups in B.C. In addition, the distributions of fibre intakes for B.C. males and for females by age are shown in Tables 6.5 and 6.6, respectively. The data indicate that dietary fibre is a priority nutrient for the public health agenda.

Table 6.4 Dietary fibre intakes by sex and age (expressed as g/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			AI[2]
				25th	50th	75th	
Male	19-30	142	21 ± 1	14	18	23	38
	31-50	205	20 ± 1	14	17	23	38
	51-70	249	20 ± 1	13	18	23	30
	71+	271	21 ± 2	13	18	23	30
Female	19-30	176	16 ± 1	11	13	17	25
	31-50	266	15 ± 1	10	13	18	25
	51-70	282	17 ± 1	12	15	19	21
	71+	230	18 ± 1	12	16	19	21

[1] SEM= Standard Error of the Mean.

[2] AI=Adequate Intake.

Source: BBCA E451311-011BV S. Hayward, August 2002.

Table 6.5 Distribution of fibre intakes for males by age (expressed as a percentage of the population)[1]

Fibre (g)	Males			
	19-30 yr	31-50 yr	51-70 yr	71+ yr
< 10	3	4	7	7
≥ 10 to < 15	27	26	28	24
≥ 15 to < 20	30	35	28	29
≥ 20 to < 25	23	20	23	22
≥ 25 to < 30	6	9	5	7
≥ 30 to < 38	9	3	7	8
≥ 38	1	3	2	3

[1]Adequate Intake (AI) for males 19-50 years of age is 38 g/d and for males 51 years of age and older the AI is 30 g/d.The shaded areas represent the proportion of the population meeting this recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.6 Distribution of fibre intakes for females by age (expressed as a percentage of the population)[1]

Fibre (g)	Females			
	19-30 yr	31-50 yr	51-70 yr	71+ yr
< 10	18	22	17	15
≥ 10 to < 15	45	36	33	25
≥ 15 to < 20	25	26	28	38
≥ 20 to < 25	11	12	12	13
≥ 25 to < 30	0	2	5	6
≥ 30	0	2	4	3

[1] Adequate Intake (AI) for females 19–50 years of age is 25 g/d and for females 51 years of age and older the AI is 21 g/d.The shaded areas represent the proportion of the population metting this recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.4 Dietary Fat

Dietary fats have received much attention in public health programming in recent years, particularly due to their role in the development or prevention of heart disease. Tables 6.7 to 6.12 provide intake data for total fat and the various types of fat.

The median total fat (Table 6.7) and monounsaturated fat (Table 6.9) intakes are similar to what has been reported in the U.S. for both men and women (Appendix R). However, the median saturated fat intakes in B.C. are slightly higher (Table 6.8). According to the new guidelines, a recommended range (AMDR) for saturated fat is not possible since they are not deemed essential and there is no evidence suggesting that they play a role in chronic disease prevention (Institute of Medicine, 2002). It is recommended to consume as little as possible saturated fat without compromising adequate nutrition provided by the foods that contain these fats. Since almost half of the B.C. population are consuming 10% or more of their calories as saturated fats (Table 6.2b), it appears that intakes are not consistent with this guideline and that saturated fats remain a public health issue for the province.

Adequate Intakes (AI) have been established for the two essential polyunsaturated fatty acids, α-linolenic acid and linoleic acid and are based on median intakes in the U.S. From the results shown in Table 6.11, it is apparent that the median intakes of the B.C. population met the AI of 1.6 g/d for males and 1.1 g/d for females for α-linolenic acid. However, the median linoleic acid intakes were well below the AI of 17 g/d for males and 12 g/d for females aged 19-50 years and 14 g/d and 11 g/d for older males and females, respectively. As well, 76% of the popu-

lation was consuming less than the recommended AMDR for this fatty acid. The health implication of this result is unclear. Without biochemical and clinical data for the population, it is difficult to interpret this finding.

Table 6.7 Fat intakes by sex and age (expresses as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	100 ± 5	70	97	120
	31-50	205	96 ± 4	71	89	113
	51-70	249	84 ± 3	62	82	99
	71+	271	73 ± 3	51	64	85
Female	19-30	176	69 ± 4	51	63	80
	31-50	266	69 ± 3	50	63	79
	51-70	282	60 ± 2	46	55	64
	71+	230	51 ± 2	39	48	59

[1] There is no Dietary Reference Intake set for dietary fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.8 Saturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	33 ± 2	21	30	42
	31-50	205	31 ± 2	23	28	37
	51-70	249	27 ± 1	18	25	32
	71+	271	24 ± 1	15	20	28
Female	19-30	176	23 ± 2	13	19	25
	31-50	266	23 ± 1	14	20	26
	51-70	282	20 ± 1	14	18	23
	71+	230	17 ± 1	11	15	20

[1] There is no Dietary Reference Intake set for saturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.9 Monounsaturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	41 ± 2	25	39	50
	31-50	205	39 ± 2	29	36	43
	51-70	249	33 ± 1	24	32	39
	71+	271	29 ± 2	19	25	33
Female	19-30	176	27 ± 2	20	25	30
	31-50	266	27 ± 1	20	24	30
	51-70	282	24 ± 1	18	22	26
	71+	230	20 ± 1	14	18	22

[1] There is no Dietary Reference Intake set for monounsaturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.10 Polyunsaturated fat intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	17 ± 1	11	16	20
	31-50	205	17 ± 1	12	15	20
	51-70	249	15 ± 1	10	14	18
	71+	271	12 ± 1	8	11	14
Female	19-30	176	11 ± 1	9	10	13
	31-50	266	12 ± 1	8	10	13
	51-70	282	10 ± 1	7	9	11
	71+	230	9 ± 1	6	7	10

[1] There is no Dietary Reference Intake set for total polyunsaturated fat.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.11 α-Linolenic acid intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	2.4 ± 0.2	1.3	1.8	2.7
	31-50	205	2.3 ± 0.2	1.4	1.9	2.6
	51-70	249	2.7 ± 0.4	1.2	1.8	2.6
	71+	271	1.9 ± 0.2	1.1	1.4	2.2
Female	19-30	176	1.6 ± 0.1	1.0	1.3	1.6
	31-50	266	1.8 ± 0.1	1.1	1.3	1.7
	51-70	282	2.0 ± 0.2	1.0	1.3	1.6
	71+	230	1.5 ± 0.2	0.9	1.1	1.4

[1] Adequate Inake (AI) for α-linolenic acid is 1.6 g/day for males and 1.1 g/day for females.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.12 Linoleic acid intakes by sex and age (expressed as g/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	13.3 ± 0.8	9.1	12.0	15.0
	31-50	205	14.2 ± 0.7	9.3	12.0	16.0
	51-70	249	13.2 ± 0.8	7.7	11.0	15.0
	71+	271	10.0 ± 0.5	6.6	8.3	12.0
Female	19-30	176	9.2 ± 0.6	6.4	7.9	9.7
	31-50	266	9.5 ± 0.5	6.3	8.1	9.9
	51-70	282	8.6 ± 0.5	6.1	7.3	8.7
	71+	230	6.5 ± 0.4	4.6	5.5	7.1

[1] Adequate Inake (AI) for linoleic acid is 17 g/day for males and 12 g/day for females aged 19-50 years, and 14 g/d and 11 g/d for older males and females, respectively.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.5 Cholesterol

As in the case of saturated fats, there is no DRI established for cholesterol. However, because high cholesterol intakes are associated with high blood lipid levels and a risk for heart disease, the DRI expert panel recommended keeping consumption as low as possible while maintaining a nutritionally adequate diet (Institute of Medicine, 2002).

The median intakes for dietary cholesterol, as shown in Table 6.13, ranged from 161 mg for older females to almost 300 mg in the youngest male age group. These values are less than those found in the U.S. population (Appendix R). According to Table 6.14, the majority of the population (three-quarters) consumed less than 300 mg of cholesterol per day, suggesting that many British Columbians have reduced their cholesterol intakes to what had been recommended previously (i.e., <300 mg/d, Health and Welfare Canada, 1990).

Table 6.13 Cholesterol intakes by sex and age (expressed as mg/d)[1]

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th
Male	19-30	142	383 ± 29	209	294	425
	31-50	205	344 ± 22	196	258	351
	51-70	249	326 ± 23	177	247	374
	71+	271	316 ± 24	158	227	351
Female	19-30	176	243 ± 25	115	166	258
	31-50	266	252 ± 17	139	195	254
	51-70	282	224 ± 13	141	175	213
	71+	230	203 ± 13	131	161	193

[1] There is no Dietary Reference Intake for dietary cholesterol.

[2] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.14 Distribution of cholesterol intake by sex and age (expressed as a percentage of the population)[1]

Cholesterol (mg/d)	Total	Males 19-30 yr	Males 31-50 yr	Males 51-70 yr	Males 71+ yr	Females 19-30 yr	Females 31-50 yr	Females 51-70 yr	Females 71+ yr
<200	45	22	27	37	38	63	53	64	78
≥200 to <300	29	29	36	28	31	21	32	26	20
≥300	26	49	37	34	31	16	16	10	2

[1] There is no Dietary Reference Intake set for dietary cholesterol.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

6.2.6 Protein

As presented previously in Table 6.2, 92% of the B.C. population was consuming 10% or more of their calories from protein, well within the acceptable range and similar to what has been reported in the U.S. (Institute of Medicine, 2002). However, there was still about 8% of the population below the EAR (Table 6.15), which is based on the lowest continuing intake of dietary protein that is sufficient to achieve body nitrogen equilibrium (zero balance) (Institute of Medicine, 2002). At this time, the health implications of having a small proportion of the population not meeting the EAR for protein are unknown and need to be considered for future research.

Table 6.15 Protein intakes by sex and age (expressed as g/kg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	1.50 ± 0.04	1.13	1.44	1.76	0.66	4
	31-50	205	1.19 ± 0.02	0.94	1.17	1.37	0.66	4
	51-70	249	1.17 ± 0.04	0.81	1.09	1.29	0.66	9
	71+	271	0.95 ± 0.03	0.73	0.94	1.14	0.66	13
Female	19-30	176	1.04 ± 0.02	0.82	0.96	1.28	0.66	10
	31-50	266	1.05 ± 0.02	0.85	1.04	1.19	0.66	9
	51-70	282	1.00 ± 0.02	0.82	0.96	1.17	0.66	10
	71+	230	0.96 ± 0.03	0.78	0.94	1.08	0.66	8

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

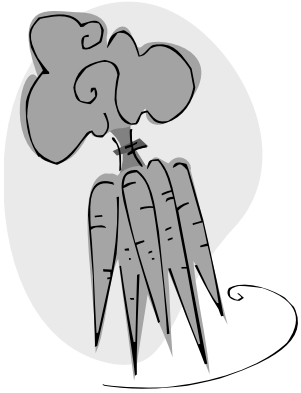
6.3 Vitamins

6.3.1 Folate

Folate functions as a co-enzyme in single carbon transfers in the metabolism of nucleic and amino acids (Institute of Medicine, 1998). The monitoring of folate status for the B.C. population is important since there is a large body of research concluding that low blood folate levels are associated with elevated serum homocysteine levels, a risk factor for cardiovascular disease and may be related to the development of some forms of cancer and depression (Tucker et al, 1996; Bailey et al, 2001; Willett and Stampfer, 2001).

Tables 6.16 and 6.17 present folate intakes from food sources (including fortified foods) and food sources plus supplements, respectively, for the B.C. adult population. Folate intake data are expressed as dietary folate equivalents (DFE). Dietary folate equivalents adjust for the lower bioavailability of naturally occurring folate in foods compared to the synthetic form (i.e., folic acid); 1 mcg DFE=0.6 mcg folic acid from fortified foods and/or supplement taken with a meal=1 mcg food folate = 0.5 mcg of a supplement taken on an empty stomach (Institute of Medicine, 1998). The median intakes for men and women from food sources alone were 496 DFE/d and 340 DFE/d, whereas the median intakes from food and supplements were 539 DFE/d and 422 DFE/d, respectively. Folate data cannot be compared to U.S. data since the U.S. data were collected prior to the fortification of the food supply with folic acid.

The EAR for folate is 320 DFE/d and was based on the amount needed to maintain red blood cell folate levels at 305 nmol/L (140ng/mL), serum folate levels at 7 nmol/L (3ng/mL) and plasma homocysteine levels at or below 14 μmol/L (Institute of Medicine, 1998). Thus, the concern with a high percentage of inadequacy in a population has more to do with the risk for heart disease and not only the risk for folate deficiency anemia. According to Tables 6.16 and 6.17, it is apparent that a large proportion of older males and adult women in all age groups were below the EAR for this vitamin. When supplement intake was included in the estimation (Table 6.17), the percentage below the EAR went down almost half for females and only slightly for the male population. But even when taking into account supplement intake, there was still an appreciable proportion of the total population not meeting the recommendation, indicating that inadequate folate intakes are a public health concern in B.C.



In addition to the relationship of inadequate folate status to heart disease, there is solid evidence relating compromised maternal folate sta-

tus to the development of birth defects known as neural tube defects, with spina bifida being the most common (Hibbard and Smithells, 1965; Smithells et al, 1976; Yates et al, 1987). Studies have shown that periconceptual folic acid supplementation decreases the occurrence and recurrence rates of these birth defects (Smithells et al, 1983; Vergel et al, 1990; Laurence et al, 1981; MRC Vitamin Study Research Group, 1991; Czeizel and Dudas, 1992). For this reason, the U.S. and Canadian governments in 1998, mandated that the food supply (i.e., flours, grains and pastas) be fortified with folic acid by an amount that increases average intake by about 100 mcg/d (Food and Drug Administration, 1996; Health Canada, 1998; Daly et al, 1997). As well, a special recommendation was included in the DRI report for B vitamins (Institute of Medicine, 1998) for all women capable of becoming pregnant to consume 400 mcg of synthetic folic acid (from fortified foods and supplements) daily in order to decrease the risk of neural tube defects. Table 6.18 shows intakes of synthetic folic acid. In the B.C. population, only 21% of women in the 19-30 year age group and 18% of women in the 31-50 year age group met the special recommendation. This result is consistent to what has been reported in the literature (French et al, 2003). Mass public education campaigns conducted elsewhere have shown some increases in the number of women consuming 400 mcg of synthetic folic acid (Quinlivan and Gregory, 2003) and more dramatically, the number of women understanding the relationship between this nutrient and neural tube defects (Sayers et al, 1997). These findings warrant further investigation into potential education efforts to target women of childbearing age in B.C.

One concern for fortifying the food supply with folic acid was the possibility that certain subgroups of the population, such as the elderly, would be consuming too much folic acid and thus lead to a potential risk of masking a vitamin B12 deficiency. Thus, a Tolerable Upper Intake Level (UL) for folic acid (1000 mcg) was established and applies only to synthetic forms of the vitamin (Institute of Medicine, 1998). This UL is based on the examination of case reports of the progression of neurological effects in vitamin B12 deficient patients taking folate supplements. According to Table 6.18, about 4% of the general B.C. population and about 5% of older British Columbians were above the UL. However, because 84% of those with intakes above the UL for folic acid were also taking a vitamin B12 supplement, overconsumption of synthetic folic acid does not appear to be a major concern in the B.C. population.

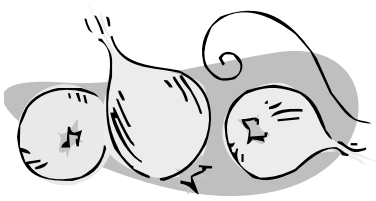


Table 6.16 Folate intakes from food sources (including fortified foods) by sex and age (expressed as dietary folate equivalents[1] (DFE)/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			EAR[3]	%<EAR
				25th	50th	75th		
Male	19-30	142	617 ± 34	453	560	647	320	2
	31-50	205	553 ± 24	406	500	572	320	5
	51-70	249	504 ± 26	335	466	593	320	20
	71+	271	382 ± 14	305	347	408	320	35
Female	19-30	176	393 ± 17	300	368	418	320	32
	31-50	266	385 ± 15	279	344	437	320	40
	51-70	282	364 ± 16	266	327	386	320	47
	71+	230	332 ± 21	237	283	346	320	67

[1] Dietary Folate Equivalents (DFE)= values that adjust for the differences in absorption of food folate and synthetic folic acid. 1 mcg of DFE=0.6 mcg of folic acid from fortified food or as a supplement taken with a meal=1 mcg food folate=0.5 mcg of folic acid from a supplement taken on an empty stomach.

[2] SEM= Standard Error of the Mean.

[3] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.17 Folate intakes from food sources (including fortified foods) and supplements by sex and age (expressed as dietary folate equivalents[1] (DFE)/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			EAR[3]	%<EAR
				25th	50th	75th		
Male	19-30	142	729 ± 30	483	591	764	320	2
	31-50	205	796 ± 60	436	535	748	320	3
	51-70	249	663 ± 35	370	524	745	320	16
	71+	271	720 ± 96	317	392	749	320	27
Female	19-30	176	607 ± 29	342	419	662	320	19
	31-50	266	621 ± 27	330	427	764	320	23
	51-70	282	671 ± 39	313	429	942	320	29
	71+	230	737 ± 77	276	405	1019	320	39

[1] Dietary Folate Equivalents (DFE)= values that adjust for the differences in absorption of food folate and synthetic folic acid. 1 mcg of DFE=0.6 mcg of folic acid from fortified food or as a supplement taken with a meal=1 mcg food folate=0.5 mcg of folic acid from a supplement taken on an empty stomach.

[2] SEM= Standard Error of the Mean.

[3] EAR = Estimated Average Requirement.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

Table 6.18 Folic acid[1] intakes from fortified foods and supplements by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			UL[3]	%>UL
				25th	50th	75th		
Male	19-30	142	264 ± 17	129	176	263	1000	3
	31-50	205	305 ± 36	112	149	227	1000	4
	51-70	249	233 ± 20	94	144	244	1000	2
	71+	271	284 ± 57	55	92	254	1000	7
Female	19-30	176	244 ± 17	96	126	294	1000	4
	31-50	266	244 ± 15	80	119	324	1000	4
	51-70	282	268 ± 22	65	96	453	1000	5
	71+	230	311 ± 46	51	86	469	1000	5

[1] Folic Acid represents the synthetic form of the vitamin.

[2] SEM= Standard Error of the Mean.

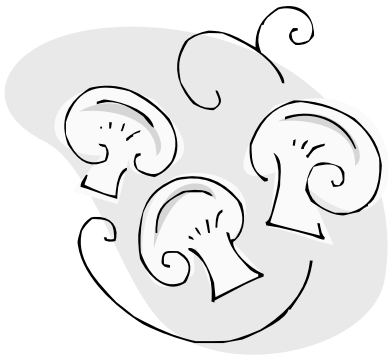
[3] UL= Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.2 Niacin

Niacin, in its co-enzyme form, is involved in many biological reactions, functioning in intracellular respiration and oxidation of fuel molecules, as well as reductive biosynthesis (Institute of Medicine, 1998). The median intakes from food alone and from both food and supplements were well above what was estimated for the U.S. population according to NHANES III data (Appendix R). British Columbians' higher intakes from food are due to the fact that intakes are expressed in Niacin Equivalents, which include both preformed niacin and the contibution of tryptophan to synthesis of niacin coenzymes. In contrast, the U.S. intake date are based on preformed niacin alone.

The UL for niacin is based on the amount of the synthetic form of niacin found in supplements, fortified foods and pharmacological agents, that induces the adverse effect of flushing. In the U.S., a large percentage of the senior population was above the UL (United States Department of Agriculture, 1995). This finding was explained by the fact that many older adults consumed vitamin and mineral supplements and some received pharmacological doses for the management of serum cholesterol levels. In the BCNS, synthetic niacin was estimated using the supplement data only since it would be difficult to determine the amount contributed by fortified foods. Nonetheless, the BCNS results show that 12% of men and 21% of women have niacin levels that exceed the UL,



suggesting that over consumption of niacin may be a concern for the B.C. population and should be earmarked for future monitoring. However, it should also be noted that the adverse effect (flushing) is relatively benign and would not be anticipated to have a serious health impact.

Table 6.19 Niacin intakes from food sources by sex and age (expressed as Niacin Equivalents (NE)/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	55 ± 2	41	50	63	12	0
	31-50	205	47 ± 2	37	45	53	12	0
	51-70	249	44 ± 2	33	41	51	12	0
	71+	271	36 ± 1	30	34	40	12	0
Female	19-30	176	31 ± 1	26	29	34	11	0
	31-50	266	32 ± 1	26	30	34	11	0
	51-70	282	32 ± 1	25	30	34	11	0
	71+	230	29 ± 1	24	27	33	11	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.20 Niacin intakes from food sources and supplements by sex and age (expressed as Niacin Equivalents (NE)/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL[4]
				25th	50th	75th				
Male	19-30	142	61 ± 2	44	57	72	12	0	35	10
	31-50	205	55 ± 1	38	50	64	12	0	35	12
	51-70	249	60 ± 7	36	48	61	12	0	35	12
	71+	271	94 ± 28	33	39	58	12	0	35	19
Female	19-30	176	48 ± 1	28	35	48	11	0	35	12
	31-50	266	50 ± 2	29	36	59	11	0	35	20
	51-70	282	79 ± 21	29	37	63	11	0	35	27
	71+	230	51 ± 3	28	38	68	11	0	35	37

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level, based on the consumption of synthetic niacin in fortified foods, supplements and pharmacologic agents.

[4] Reflects only intake from supplements.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.3 Pantothenic Acid

Pantothenic acid is a vital co-enzyme that is required in reactions that generate energy from food (Institute of Medicine, 1998). The values for pantothenic acid intakes from food sources alone are shown in Table 6.21. According to the median intakes, males met the AI (5 mg/d) for pantothenic acid but females did not. The health implications of this result for the B.C. population are unclear, as intakes below the AI may be adequate. Further, it is known that true pantothenic acid deficiency is rare as this vitamin is found in almost all plant and animal foods (Institute of Medicine, 1998). When supplement intake is included (Table 6.22), women's median intakes for all age groups were approaching the AI.

Table 6.21 Pantothenic acid intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles			AI[1]
				25th	50th	75th	
Male	19-30	142	7.2 ± 0.4	5.3	6.7	7.7	5
	31-50	205	6.0 ± 0.2	4.9	5.6	6.5	5
	51-70	249	5.6 ± 0.2	4.4	5.3	6.3	5
	71+	271	5.4 ± 0.2	3.9	4.9	5.9	5
Female	19-30	176	4.5 ± 0.2	3.4	4.0	4.8	5
	31-50	266	4.3 ± 0.2	3.2	4.0	4.6	5
	51-70	282	4.3 ± 0.1	3.4	4.2	4.7	5
	71+	230	4.2 ± 0.2	3.4	3.9	4.5	5

[1] AI = Adequate Intake.

[2] SEM = Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.22 Pantothenic acid intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[2]	Percentiles 25th	50th	75th	AI[1]
Male	19-30	142	9.8 ± 0.5	5.5	7.1	11.5	5
	31-50	205	10.4 ± 0.7	5.2	5.9	8.0	5
	51-70	249	11.6 ± 2.4	4.6	6.0	9.5	5
	71+	271	9.3 ± 2.6	4.2	5.4	8.4	5
Female	19-30	176	8.8 ± 0.7	3.5	4.9	10.6	5
	31-50	266	14.8 ± 1.7	3.5	5.0	12.7	5
	51-70	282	16.6 ± 2.1	3.9	5.0	14.3	5
	71+	230	10.4 ± 1.5	3.8	4.6	13.7	5

[1] AI = Adequate Intake.

[2] SEM = Standard Error of the Mean.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.4 Riboflavin

Riboflavin functions as a co-enzyme in many metabolic pathways and in energy production (Institute of Medicine, 1998). The median intakes from food sources alone for the B.C. population (Table 6.23) were very similar to what has been reported for the U.S. in NHANES III but the total median intakes including supplements (Table 6.24) were higher in B.C. (Appendix R). This difference could be explained by the fact that British Columbians consume more supplements than the adult population in the U.S. (Refer to Section 5.5.) and the major supplements used are multivitamin types. Tables 6.23 and 6.24 show that riboflavin intakes were generally above the EAR, suggesting that British Columbians have adequate intakes of riboflavin.

Table 6.23 Riboflavin intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	2.6 ± 0.1	1.8	2.3	3.1	1.1	3
	31-50	205	2.3 ± 0.1	1.8	2.1	2.5	1.1	3
	51-70	249	2.2 ± 0.1	1.6	2.0	2.4	1.1	3
	71+	271	2.0 ± 0.1	1.5	1.9	2.2	1.1	5
Female	19-30	176	1.8 ± 0.1	1.4	1.6	2.0	0.9	2
	31-50	266	1.6 ± 0.1	1.3	1.5	1.8	0.9	8
	51-70	282	1.6 ± 0.1	1.3	1.5	1.8	0.9	4
	71+	230	1.6 ± 0.1	1.2	1.4	1.8	0.9	3

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.24 Riboflavin intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	4.6 ± 0.5	1.9	2.8	4.2	1.1	2
	31-50	205	5.9 ± 0.6	1.9	2.4	3.4	1.1	3
	51-70	249	4.6 ± 0.6	1.7	2.2	3.6	1.1	3
	71+	271	5.0 ± 1.3	1.6	2.2	3.4	1.1	4
Female	19-30	176	5.8 ± 0.6	1.5	2.2	5.1	0.9	2
	31-50	266	10.3 ± 1.3	1.4	2.0	5.3	0.9	6
	51-70	282	10.0 ± 1.7	1.5	2.0	5.2	0.9	1
	71+	230	8.4 ± 1.9	1.5	2.6	4.9	0.9	1

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.5 Thiamin

Thiamin functions as a co-enzyme in carbohydrate and branched-chain amino acid metabolism (Institute of Medicine, 1998). Thiamin intakes from food sources and food sources plus supplements are presented in Tables 6.25 and 6.26, respectively. Median thiamin intakes from food sources were higher for British Columbian men but similar for women when compared to U.S. data (Appendix R). However, the B.C. adult population had higher total median intakes when supplements were included in the estimation than adults in the U.S. (Appendix R). Again, this difference could be explained by the higher consumption of nutritional supplements in B.C. than the U.S. (Refer to Section 5.5.) As with riboflavin and niacin, thiamin intakes (Tables 6.25 and 6.26) were generally above the EAR. Thus, British Columbians have adequate intakes of thiamin.

Table 6.25 Thiamin intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	2.4 ± 0.1	1.6	2.2	2.8	1.0	3
	31-50	205	2.1 ± 0.1	1.6	1.9	2.3	1.0	<1
	51-70	249	2.1 ± 0.1	1.4	1.9	2.4	1.0	5
	71+	271	1.7 ± 0.1	1.4	1.6	1.8	1.0	3
Female	19-30	176	1.6 ± 0.1	1.1	1.3	1.7	0.9	7
	31-50	266	1.4 ± 0.1	1.1	1.3	1.6	0.9	14
	51-70	282	1.5 ± 0.1	1.1	1.3	1.7	0.9	14
	71+	230	1.4 ± 0.1	1.1	1.3	1.5	0.9	5

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.26 Thiamin intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR
Male	19-30	142	4.1 ± 0.4	1.8	2.4	3.8	1.0	2
	31-50	205	5.7 ± 0.6	1.7	2.1	3.2	1.0	<1
	51-70	249	5.2 ± 0.9	1.5	2.1	3.3	1.0	4
	71+	271	4.7 ± 1.4	1.5	1.8	2.8	1.0	1
Female	19-30	176	5.5 ± 0.6	1.2	1.9	3.8	0.9	5
	31-50	266	10.4 ± 1.3	1.2	1.7	4.1	0.9	11
	51-70	282	11.2 ± 1.8	1.2	1.9	4.4	0.9	7
	71+	230	8.3 ± 2.0	1.2	2.2	3.7	0.9	1

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.6 Vitamin B6

Vitamin B6 functions as a co-enzyme for more than 100 enzymes involved in the metabolism of amino acids (Institute of Medicine, 1998). Low serum levels of B6 have been associated with high blood homocysteine levels, a known risk factor for heart disease (Institute of Medicine, 1998). According to Tables 6.27 and 6.28, the median intakes for British Columbian men and women from food sources alone and from food plus supplements were 2.1 and 1.4 mg/d and 2.3 and 1.9 mg/d, respectively. U.S. data from NHANES III showed slightly lower median dietary intakes for vitamin B6 (Appendix R).

In the B.C. population, between 19%-20% of males over 50 years of age and 16%-36% of all females had vitamin B6 intakes below the EAR (Table 6.27). As well, appreciable percentages of the older male population and adult females of all ages in the U.S. were below the EAR (Institute of Medicine, 1998). When supplements were included in estimating intake (Table 6.28), the proportion of older females below the EAR was reduced by almost half but only slightly for older males or younger females. The health implications of inadequate vitamin B6 intakes remain unclear. However, the vitamin does remain a potential concern for British Columbians.

Table 6.27 Vitamin B6 intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	2.6 ± 0.2	2.0	2.4	2.9	1.1	2	100	0
	31-50	205	2.2 ± 0.1	1.7	2.1	2.3	1.1	0	100	0
	51-70	249	2.0 ± 0.1	1.5	2.0	2.3	1.4	21	100	0
	71+	271	1.9 ± 0.1	1.5	1.8	2.1	1.4	19	100	0
Female	19-30	176	1.5 ± 0.1	1.2	1.4	1.6	1.1	16	100	0
	31-50	266	1.5 ± 0.1	1.2	1.4	1.6	1.1	19	100	0
	51-70	282	1.7 ± 0.1	1.3	1.5	1.9	1.3	29	100	0
	71+	230	1.5 ± 0.1	1.2	1.5	1.7	1.3	36	100	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.28 Vitamin B6 intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	4.5 ± 0.4	2.0	2.8	3.9	1.1	2	100	0
	31-50	205	5.9 ± 0.7	1.8	2.2	3.3	1.1	0	100	<1
	51-70	249	6.5 ± 1.1	1.6	2.2	3.6	1.4	19	100	2
	71+	271	6.7 ± 1.9	1.6	2.0	3.9	1.4	15	100	2
Female	19-30	176	6.1 ± 0.7	1.3	1.7	4.8	1.1	13	100	0
	31-50	266	10.5 ± 1.4	1.3	1.7	5.3	1.1	15	100	3
	51-70	282	11.8 ± 2.0	1.5	2.1	6.8	1.3	16	100	5
	71+	230	20.9 ± 8.5	1.5	2.1	9.2	1.3	20	100	5

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

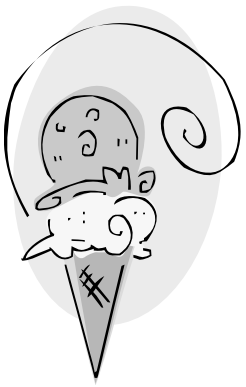
[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.7 Vitamin B12

A vitamin B12 intake level meeting the EAR of 2 mcg/d has been deemed necessary for the maintenance of hematological status (Institute of Medicine, 1998). Vitamin B12 intakes for the B.C. adult population are shown in Tables 6.29 and 6.30. In the U.S., the median intakes for both men and women were much higher than the B.C. data (Appendix R). Unlike Canada, the U.S. fortifies a variety of grains and cereals with vitamin B12, which may account for their higher intakes. In Table 6.30, it appears that the mean intakes are much higher than the median values for all ages and both sexes. This finding is due to the consumption of large amounts of vitamin B12 supplements consumed by a few participants.

As noted in Table 6.29, 7%-13% of males and 18%-38% of females were below the EAR for vitamin B12. The proportion of females below the EAR was reduced substantially when supplements were consumed but there was still 10%-21% of this population inadequate (Table 6.30). Supplements had little effect on the intakes of the male population.



Monitoring B12 intakes and status of individuals over 50 years of age is important because 10%-30% of this population may have decreased absorption of this vitamin resulting in a deficiency. For this reason, the expert DRI panel recommended that older individuals consume B12 fortified foods and/or a supplement (Institute of Medicine, 1998). Since vitamin B12 supplements and/or fortified foods are the recommended forms to increase B12 intake for adults over 50 years of age, estimated

intakes from supplements alone were generated for this age group (data not shown). Fortified foods were not included in the estimate since very few foods are fortified with B12 in Canada. About 72% of men and 58% of women over 50 years of age were below the EAR from supplements alone. The findings indicate that vitamin B12 is an important nutrient to monitor.

Table 6.29 Vitamin B12 intakes from food sources by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	5.9 ± 0.6	3.0	4.3	6.2	2	7
	31-50	205	6.4 ± 0.7	3.0	3.9	5.2	2	10
	51-70	249	6.6 ± 1.1	2.6	3.4	4.6	2	8
	71+	271	5.9 ± 0.7	2.4	3.3	4.6	2	13
Female	19-30	176	4.1 ± 1.0	1.8	2.3	3.2	2	38
	31-50	266	4.1 ± 0.6	2.0	2.5	3.2	2	25
	51-70	282	3.9 ± 0.5	2.1	2.6	3.2	2	20
	71+	230	4.1 ± 0.5	2.1	2.6	3.3	2	18

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.30 Vitamin B12 intakes from food sources and supplements by sex and age (expressed as mcg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	9.9 ± 1.1	3.5	5.4	9.1	2	5
	31-50	205	33.2 ±13.8	3.3	4.9	9.2	2	9
	51-70	249	12.7 ± 2.5	2.8	4.3	11.0	2	7
	71+	271	37.4 ± 15.2	2.5	4.2	16.5	2	12
Female	19-30	176	11.0 ± 1.4	2.0	3.7	11.5	2	21
	31-50	266	26.5 ± 13.0	2.2	3.5	13.0	2	16
	51-70	282	109.5 ± 60	2.3	3.9	22.5	2	13
	71+	230	37.6 ± 15.5	2.5	4.7	27.1	2	10

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

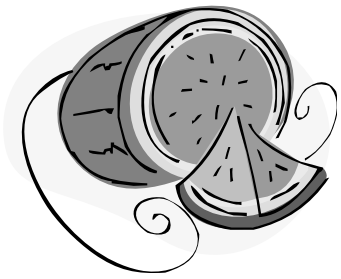
Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.3.8 Vitamin C

Vitamin C functions as an antioxidant providing reducing equivalents for many biochemical reactions (Institute of Medicine, 2000). Studies suggest that anti-oxidants such as vitamin C play a role in lowering the risk for cardiovascular disease, some cancers and conditions such as macular degeneration (Rose et al, 1998). Vitamin C intakes from food sources alone and from food sources and supplements for B.C. are shown in Tables 6.31 and 6.32, respectively. The median intakes from food sources alone for B.C. (Table 6.31) were generally lower than those reported for the U.S. adult population in NHANES III (Appendix R). However, British Columbian males 71 years and older and all female age groups had higher median vitamin C intakes when supplements were included in the total intakes (Table 6.32 and Appendix R). This result may be due to higher nutritional supplement consumption seen in adult British Columbians, especially in the older age groups (refer to section 5.5). As noted in section 5.5, vitamin C was one of the major nutritional supplements that adults in B.C. used.

The EAR for vitamin C was established as the intake that would provide anti-oxidant protection and is set at 75 mg/d for males and 60 mg/d for females. Almost a third of the B.C. population is below the EAR from food sources alone (Table 6.31). This proportion decreases to about 21% once supplements are included in the estimate as seen in Table 6.32. Nonetheless, inadequate intakes of this vitamin are a public health concern for British Columbians because of its anti-oxidant effects in lowering the risk of chronic diseases.

It is important to note that smoking cigarettes can compromise the anti-oxidant property of vitamin C, resulting in a higher requirement of the vitamin for individuals who smoke. Thus, the expert DRI panel (Institute of Medicine, 2000) recommended that smokers consume 35 mg more per day than non-smokers. The BCNS researchers were interested in examining if smokers in B.C. had a higher percentage of inadequate intakes of this vitamin than non-smokers. Since there were too few smokers to determine adjusted distributions accurately, adequacy of vitamin C intakes could not be estimated directly. Instead, mean intakes for smokers versus non-smokers by age and sex were determined. The mean intakes including food and supplements were 344 ± 51 mg/d and 419 ± 16 mg/d for smokers and non-smokers, respectively. No difference in mean intakes (p=.162) was found between the two groups, suggesting that a higher proportion of smokers, who have an increased requirement for vitamin C, have inadequate intakes of this vitamin compared to non-smokers in B.C.



The UL for vitamin C (2000 mg/d) was derived from the amount of the vitamin consumed from food and supplements that resulted in the adverse effect of diarrhea. Over-consumption of vitamin C is not an issue in the B.C. population despite being a frequently consumed supplement (Tables 6.31 and 6.32).

Table 6.31 Vitamin C intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	145 ± 20	71	92	132	75	31	2000	0
	31-50	205	131 ± 10	55	94	155	75	42	2000	0
	51-70	249	122 ± 9	60	98	137	75	34	2000	0
	71+	271	116 ± 8	74	96	123	75	27	2000	0
Female	19-30	176	105 ± 9	52	74	110	60	33	2000	0
	31-50	266	110 ± 11	53	76	118	60	32	2000	0
	51-70	282	121 ± 6	68	101	130	60	20	2000	0
	71+	230	100 ± 6	53	85	122	60	26	2000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.32 Vitamin C intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	214 ± 22	75	119	208	75	25	2000	2
	31-50	205	272 ± 19	61	120	276	75	34	2000	<1
	51-70	249	255 ± 26	72	118	229	75	26	2000	2
	71+	271	350 ± 58	83	136	361	75	16	2000	1
Female	19-30	176	207 ± 18	63	126	219	60	23	2000	1
	31-50	266	352 ± 33	67	129	370	60	21	2000	3
	51-70	282	356 ± 33	98	185	427	60	11	2000	2
	71+	230	361 ± 70	88	165	409	60	13	2000	1

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4 Minerals

6.4.1 Calcium

The main function of calcium is to provide structural support for a healthy skeletal system. Calcium is also required for muscle contractions, vaso-dilation and constriction, nerve transmission and glandular secretions (Institute of Medicine, 1997). Adequate intakes of calcium and vitamin D throughout life along with regular physical activity are needed to build and maintain strong bones and prevent osteoporosis (Osteoporosis Society of Canada, 1993). Peak bone mass is achieved between the ages of 19 and 30 years, after which time gradual bone demineralization occurs (Institute of Medicine, 1997). Thus, the current AIs for calcium are based on calcium retention in bone for all age groups.

Calcium intakes and their distribution in the B.C. population are presented in Tables 6.33 to 6.36. Except for men aged 19-30 years, the median calcium intakes in B.C. were well below the AI (Tables 6.33 and 6.35). Median intakes for the adult B.C. population appear to be slightly higher than the intakes reported in the U.S. from food sources alone (Appendix R) for reasons unknown. Usual intake data from the U.S. were not available from the combination of food plus supplements for calcium and, thus, no comparisons could be made.

When looking at the distribution of calcium intakes from food sources alone (Table 6.34), about 45% of men from 19-50 years of age were above the AI and for those 51 and over only about 10% were above the AI. For women aged 19-50 years, about 19% were over the AI and for those over 50 years of age, the proportion dropped to 4%-8%. Supplements contributed greatly to calcium intakes (Table 6.36) for men over 70 years of age and women over 30.

Few adults were above the UL for calcium from food sources and when supplements were included in the estimation (Tables 6.33 and 6.35). However, low calcium intakes are a problem for both sexes and worsen with age. Given the high burden of morbidity and mortality attributable to osteoporosis and the possibility that calcium may also decrease the risk of other conditions such as hypertension and colon cancer, increasing calcium intakes is another priority for the public health agenda.

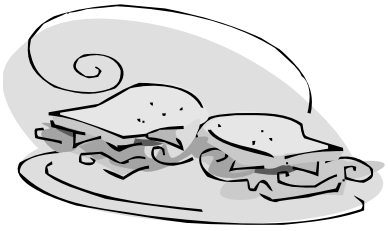


Table 6.33 Calcium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			AI[2]	UL[3]	% > UL
				25th	50th	75th			
Male	19-30	142	1193 ± 74	724	1030	1377	1000	2500	1
	31-50	205	980 ± 48	652	883	1143	1000	2500	0
	51-70	249	858 ± 35	618	771	1062	1200	2500	0
	71+	271	796 ± 35	567	726	951	1200	2500	0
Female	19-30	176	876 ± 48	589	758	1007	1000	2500	0
	31-50	266	750 ± 31	526	679	876	1000	2500	0
	51-70	282	726 ± 32	489	666	863	1200	2500	0
	71+	230	742 ± 37	516	662	843	1200	2500	0

[1] SEM= Standard Error of the Mean.

[2] AI= Adequate Intake.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.34 Distribution of calcium intakes from food sources by sex and age (expressed as a percentage of the population)[1]

Calcium (mg)	Males				Females			
	19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
<400	2	4	6	8	8	13	12	12
≥400 to <600	9	15	16	21	18	20	32	25
≥600 to <800	20	22	30	34	30	36	25	34
≥800 to <1000	17	22	18	18	18	18	18	14
≥1000 to <1200	12	13	18	9	15	10	9	6
≥1200	41	24	12	9	11	3	4	8

[1] Adequate Intake (AI) for males and females from 19-50 years of age is 1000 mg. AI for males and females over 50 years of age is 1200 mg. The shaded areas represent the proportion of the population meeting the recommendation.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.35 Calcium intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	AI[2]	UL[3]	% > UL
Male	19-30	142	1179 ± 34	735	1049	1446	1000	2500	1
	31-50	205	994 ± 21	721	906	1244	1000	2500	0
	51-70	249	917 ± 25	661	885	1123	1200	2500	0
	71+	271	915 ± 42	626	847	1159	1200	2500	0
Female	19-30	176	889 ± 27	619	852	1067	1000	2500	<1
	31-50	266	873 ± 20	606	827	1096	1000	2500	0
	51-70	282	1012 ± 43	593	863	1272	1200	2500	3
	71+	230	1056 ± 49	641	948	1404	1200	2500	<1

[1] SEM= Standard Error of the Mean.

[2] AI=Adequate Intake.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

Table 6.36 Distribution of Calcium intakes from food sources and supplements by sex and age (expressed as a percentage of the population)[1]

Calcium (mg)	Males				Females			
	19-30 yr	31-50 yr	51-70 yr	71+ yr	19-30 yr	31-50 yr	51-70 yr	71+ yr
<400	2	3	6	4	7	10	6	4
≥400 to <600	6	14	11	16	14	14	19	16
≥600 to <800	21	21	24	26	21	25	20	19
≥800 to <1000	18	21	21	22	24	20	15	17
≥1000 to <1200	11	13	20	10	17	12	12	10
≥1200	43	29	19	22	16	19	28	34

[1] Adequate Intake (AI) for males and females from 19-50 years of age is 1000 mg. AI for males and females over 50 years of age is 1200 mg. The shaded areas represent the proportion of the population meeting the recommendations.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4.2 Iron

As a component of many proteins, iron functions mainly to deliver oxygen to body tissues for metabolic reactions. Inadequate iron intakes can lead to a decrease in iron stores and eventually iron deficiency anemia (Institute of Medicine, 2001).

Iron intakes from food sources and foods plus supplements are shown in Tables 6.37 and 6.38. Median iron intakes in B.C. were comparable to what was estimated for the U.S. adult population (Appendix R).

The proportion of a population that falls below the requirement for iron is determined by the full probability method as explained in Appendices M and N. As noted in both Tables 6.37 and 6.38, the only group at risk for inadequate iron intakes was females from 19-50 years of age, representing pre-menopausal women. This result is not surprising, since women are known to be at risk for iron deficiency anemia because of low dietary intakes and the loss of blood each month due to menstruation (Institute of Medicine, 2001). However, optimal iron status is critical during childbearing years, as adequate iron stores are important for healthy pregnancy and lactation. Thus, the iron status of women of childbearing age should be closely monitored.

The Tolerable Upper Intake Level (UL) for iron is set at 45 mg/d for all adults. As shown in Tables 6.37 and 6.38, excessive iron intakes were not found to be a problem in the B.C. adult population.

Table 6.37 Iron intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			% < Requirement[2]	UL[3]	% > UL
				25th	50th	75th			
Male	19-30	142	19.7 ± 0.9	15.0	19.0	23.0	0	45	0
	31-50	205	18.0 ± 0.6	13.0	17.0	21.0	0	45	0
	51-70	249	17.3 ± 0.7	13.0	16.0	20.0	1	45	<1
	71+	271	15.0 ± 0.6	12.0	14.0	17.0	1	45	0
Female	19-30	176	13.4 ± 0.6	10.0	12.0	15.0	14	45	0
	31-50	266	12.8 ± 0.4	9.7	12.0	15.0	20	45	0
	51-70	282	12.7 ± 0.6	9.6	12.0	14.0	1	45	0
	71+	230	12.2 ± 0.5	9.5	12.0	13.0	1	45	0

[1] SEM= Standard Error of the Mean.

[2] Requirement estimated using the full probability model (Appendix M).

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.38 Iron intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	% < Requirement	UL[3]	% > UL
Male	19-30	142	21.0 ± 0.5	15.4	18.9	24.4	0	45	1
	31-50	205	18.7 ± 0.4	14.0	17.4	22.5	0	45	<1
	51-70	249	17.8 ± 0.4	13.5	17.0	20.4	1	45	<1
	71+	271	19.6 ± 1.9	12.1	15.7	20.2	1	45	4
Female	19-30	176	16.3 ± 0.7	10.9	13.2	17.6	12	45	3
	31-50	266	17.0 ± 0.8	10.2	13.7	19.0	16	45	3
	51-70	282	13.6 ± 0.3	10.6	12.2	16.4	1	45	0
	71+	230	15.1 ± 1.1	10.7	13.5	16.6	1	45	2

[1] SEM= Standard Error of the Mean.

[2] Requirement estimated using the full probability model (Appendix N).

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4.3 Magnesium

Magnesium plays a role in maintaining normal blood pressure and is a co-factor for over 300 enzyme systems. The disorders associated with magnesium deficiency are complex and usually accompanied by multiple metabolic and nutritional disturbances (Institute of Medicine, 1997).

Magnesium intakes from food sources and food sources plus supplements are provided in Tables 6.39 and 6.40, respectively. The median intakes of magnesium from food sources alone were similar to the results from NHANES III, showing low intakes of this mineral (Appendix R). Usual intake data from the U.S. were not available from the combination of food plus supplements for magnesium and, thus, no comparisons could be made.

The percentage below the EAR is very high for both sexes and all ages, with a range of 32%-62% from food alone and 26%-52% from food and supplements. It is apparent that supplement use had an impact on magnesium intakes for older males and females of all ages, but there was still an appreciable proportion of the population below the EAR even when supplements were included in the estimation (Table 6.40). The health implications of these findings are unclear and further research is needed to better understand the meaning of these results.

The UL for magnesium is based on adverse gastrointestinal effects such as diarrhea that accompanies the consumption of 350 mg or more of a

synthetic form of the mineral. A small fraction of the B.C. adult population was above the UL for magnesium. But it is important to note that this estimation was based on supplement intake only and did not take into account magnesium intake from other agents such as laxatives or antacids.

Table 6.39 Magnesium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR
				25th	50th	75th		
Male	19-30	142	410 ± 17	323	396	475	330	32
	31-50	205	404 ± 13	343	383	430	350	33
	51-70	249	374 ± 12	303	371	426	350	44
	71+	271	352 ± 16	282	331	407	350	62
Female	19-30	176	304 ± 13	246	286	323	255	37
	31-50	266	296 ± 10	234	287	324	265	43
	51-70	282	308 ± 11	237	283	343	265	40
	71+	230	296 ± 11	242	273	320	265	45

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.40 Magnesium intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles			EAR[2]	%<EAR	UL[3]	% > UL
				25th	50th	75th				
Male	19-30	142	414 ± 9	323	410	482	330	31	350	1
	31-50	205	402 ± 6	336	384	449	350	31	350	<1
	51-70	249	391 ± 8	307	382	467	350	37	350	1
	71+	271	373 ± 14	288	340	436	350	52	350	<1
Female	19-30	176	305 ± 6	242	295	348	255	31	350	1
	31-50	266	336 ± 8	234	301	374	265	36	350	3
	51-70	282	386 ± 13	264	326	447	265	27	350	8
	71+	230	342 ± 13	260	313	392	265	26	350	3

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level which is based only on the synthetic form from pharmacological agents and is equal to 350mg.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4.4 Phosphorus

Phosphorus plays a role in bone health along with calcium, vitamin D, magnesium and fluoride (Institute of Medicine, 2000). Tables 6.41 and 6.42 show the phosphorus intakes from food sources and food and supplements, respectively. The median intake levels of phosphorus reported for the U.S. in NHANES III is similar to B.C. median intakes overall (Appendix R). As with calcium and magnesium, usual intake data from the U.S. were not available from the combination of food plus supplements for phosphorus and, thus, comparisons are not possible. Inadequate and excessive phosphorus intakes are not a problem for British Columbians as indicated in Tables 6.41 and 6.42.

Table 6.41 Phosphorus intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	1850 ± 79	1371	1723	2127	580	0	4000	<1
	31-50	205	1625 ± 50	1327	1589	1786	580	0	4000	0
	51-70	249	1492 ± 51	1183	1457	1696	580	2	4000	0
	71+	271	1333 ± 55	1046	1275	1461	580	0	3000	<1
Female	19-30	176	1230 ± 55	997	1120	1277	580	0	4000	0
	31-50	266	1151 ± 50	917	1069	1240	580	2	4000	0
	51-70	282	1134 ± 36	927	1065	1315	580	3	4000	0
	71+	230	1147 ± 38	901	1066	1292	580	2	3000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.42 Phosphorus intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	1831 ± 43	1406	1725	2149	580	0	4000	<1
	31-50	205	1595 ± 21	1352	1596	1789	580	0	4000	0
	51-70	249	1500 ± 31	1212	1483	1715	580	2	4000	0
	71+	271	1333 ± 45	1067	1294	1511	580	0	3000	<1
Female	19-30	176	1156 ± 16	1004	1130	1294	580	0	4000	0
	31-50	266	1122 ± 17	919	1098	1260	580	2	4000	0
	51-70	282	1128 ± 21	931	1102	1321	580	3	4000	0
	71+	230	1148 ± 31	942	1119	1361	580	2	3000	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.4.5 Zinc

Zinc functions as a component of various enzymes in the maintenance of protein structure and the regulation of gene expression (Institute of Medicine, 2000). Inadequate zinc intakes are a concern for older British Columbians. Currently, there is interest in the potential role of zinc in the prevention and treatment of age-related eye disease (Hammond and Johnson, 2002). Because of zinc's role in proper immune system functioning and DNA synthesis, zinc supplementation is also being investigated in relation to prevention of some cancers.

Zinc intakes as estimated by the BCNS are found in Tables 6.43 and 6.44. Overall, the median intakes were similar to what has been observed in the U.S. for the adult population (Appendix R). However, slightly higher median intakes are reported for B.C. women over 50 years of age when supplement intake is included in the estimation than women in the U.S. in the same age group (Appendix R).

According to Table 6.43, a large proportion of British Columbians (7%-42%), especially those over 50 years of age, was below the EAR. Supplements helped to reduce the proportion below the EAR for the older age groups but essentially had no impact for the population under 50 (Table 6.44).

The UL for zinc is established at 40 mg per day. Even though excessive intakes of this nutrient are not a major problem for British Columbians, supplement use did contribute to a rise in the percentage above the UL (Tables 6.43 and 6.44).

Table 6.43 Zinc intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	15.6 ± 0.8	11.0	14.0	17.0	9.4	7	40	0
	31-50	205	15.1 ± 0.9	11.0	13.0	16.0	9.4	11	40	<1
	51-70	249	14.8 ± 2.0	9.4	12.0	15.0	9.4	26	40	3
	71+	271	11.3 ± 0.7	8.2	10.0	12.0	9.4	42	40	0
Female	19-30	176	9.6 ± 0.4	8.0	9.0	10.0	6.8	11	40	0
	31-50	266	9.8 ± 0.4	7.6	8.8	11.0	6.8	11	40	0
	51-70	282	11.1 ± 1.5	7.3	8.7	10.0	6.8	20	40	1
	71+	230	9.3 ± 0.4	7.1	8.1	9.8	6.8	19	40	0

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.44 Zinc intakes from food sources and supplements by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th	EAR[2]	%<EAR	UL[3]	% > UL
Male	19-30	142	19.1 ± 0.8	11.5	15.5	22.9	9.4	7	40	4
	31-50	205	15.7 ± 0.4	11.3	13.5	18.0	9.4	11	40	2
	51-70	249	17.1 ± 0.8	10.3	13.7	18.0	9.4	18	40	6
	71+	271	15.8 ± 1.3	8.7	11.3	18.0	9.4	33	40	6
Female	19-30	176	13.3 ± 0.9	8.2	9.5	12.4	6.8	8	40	3
	31-50	266	13.0 ± 0.5	7.8	9.8	14.7	6.8	10	40	1
	51-70	282	14.4 ± 0.8	8.0	10.1	17.0	6.8	13	40	3
	71+	230	16.3 ± 1.3	7.9	10.7	22.2	6.8	10	40	6

[1] SEM= Standard Error of the Mean.

[2] EAR = Estimated Average Requirement.

[3] UL=Tolerable Upper Intake Level.

Source: BBCA E431311-011CV1 Supplement Tables- S. Hayward, August 2002.

6.5 Electrolytes

6.5.1 Potassium and Sodium

Both potassium and sodium play important roles in maintaining normal blood pressure. The results for these two nutrients are included in the BCNS report (Tables 6.45 and 6.46) in anticipation of the release of the DRI report on electrolytes. However, current dietary guidance recommends that Canadians should limit their sodium intake (Health and Welfare Canada, 1990).

Table 6.45 Potassium intakes from food sources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th
Male	19-30	142	3800 ± 184	2846	3536	4231
	31-50	205	3594 ± 109	2944	3456	4057
	51-70	249	3509 ± 120	2653	3443	4159
	71+	271	3284± 100	2659	3181	3712
Female	19-30	176	2695 ± 117	2242	2502	2824
	31-50	266	2719 ± 95	2145	2568	2954
	51-70	282	2940 ± 88	2354	2786	3354
	71+	230	2726 ± 80	2211	2637	3113

[1] SEM= Standard Error of the Mean.

Source: BBCA E451311-011BV1 S. Hayward, August 2002.

Table 6.46 Sodium intakes from food fources by sex and age (expressed as mg/d)

Sex	Age (years)	n	Mean ± SEM[1]	Percentiles 25th	50th	75th
Male	19-30	142	4096 ± 172	3062	3855	4628
	31-50	205	3674 ± 146	2830	3534	4174
	51-70	249	3501 ± 187	2468	3034	3866
	71+	271	2637 ± 99	2001	2616	3019
Female	19-30	176	2695 ± 117	2129	2605	2898
	31-50	266	2593 ± 85	1908	2442	2960
	51-70	282	2271 ± 99	1722	2092	2507
	71+	230	2230 ± 178	1585	1870	2273

[1] SEM= Standard Error of the Mean.

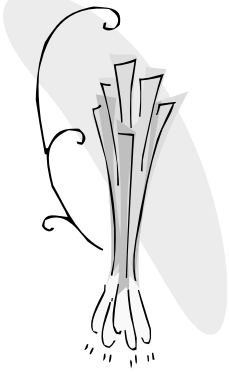
Source: BBCA E451311-011BV1 S. Hayward, August 2002.

7.0 Conclusions

The BCNS was a major research undertaking that has contributed greatly to the knowledge and understanding of dietary intakes of adult British Columbians. The goal of the BCNS was to provide information that would guide policy development and service delivery in order to improve the nutritional health of British Columbians. The results of the BCNS provide, for the first time in over three decades, important information to assist health decision makers and program planners at the federal, provincial and regional levels to establish priorities and set public health and research agendas. Health educators will benefit from the findings by being able to target nutrition related interventions and consumers will benefit from the applications of these interventions. The results will help inform major health initiatives related to chronic disease prevention and health promotion and will be invaluable to the various stakeholders of B.C.

Estimates of usual nutrient intakes in this report represent intakes from food sources as well as supplements. The major findings on nutrient intakes of the B.C. adult population are highlighted below.

- Usual median intakes for food energy reported were slightly below recommended levels for most age-sex groups, suggesting that intakes were under-reported. These lower energy levels reported are doubtful, since more than 50% of the adult population were classified as being overweight or obese. This high prevalence of overweight and obesity indicates that energy balance is a major public health problem in B.C. As a result of slightly under-reported energy intakes, nutrient intakes may also have been slightly under-reported. This supports the need for future research to obtain biological confirmation of apparent dietary inadequacy.
- Two-thirds of British Columbians regularly consumed supplements, including nutritional and non-nutritional supplements. The major supplements taken in descending order were a combination of vitamins and minerals, vitamin C, vitamin E and various natural and herbal types. Nutritional supplements contributed to decreasing the proportion of inadequacy for several nutrients across age-sex groups.
- Most British Columbians fell in the acceptable macronutrient distribution ranges for carbohydrates (45%-65%), total fat (20%-35%) and protein (10%-35%). Even though most British Columbians fell within the acceptable range for total fat, about one-quarter were consuming more than 35% of their energy from fat sources.
- Overall, British Columbians had adequate intakes of thiamin, riboflavin, niacin and phosphorus.
- A substantial percentage of the population had inadequate intakes of folate, vitamin B12, vitamin B6, vitamin C, magnesium and zinc, identifying these nutrients as potential public health concerns.



- Median intakes of fibre and calcium were below recommendations for almost all age/sex groups, identifying these nutrients as potential public health concerns.
- Inadequate iron intakes were only a concern for pre-menopausal women.
- Excessive intakes of synthetic niacin were identified across all age-sex groups.

The BCNS served as an alert, identifying that the population is becoming more overweight and that supplement use including multiple supplement use is high. Food insecurity remains an issue for some. British Columbians appear to be consuming foods that are high in energy and low in several nutrients. Nutrients of concern include fibre, calcium, folate, vitamins B6, B12 and C, magnesium, zinc, iron (for pre-menopausal women) and niacin and saturated fat (due to excessive intake).

The BCNS will provide an important foundation for building public health policy and programs. In particular, the *Report on Food Group Use,* together with this report, will contribute to our understanding of the inadequacies observed for some of the nutrients of concern.

However, there is still considerable progress to be made in nutrition surveillance in Canada. While dietary intake data are useful, including physical measures and biochemical indices in a comprehensive nutrition surveillance and monitoring system will enhance the utility of the intake data. Currently, comparisons among other provinces cannot be made and thus, a national picture of dietary intakes still eludes us. Moreover, the BCNS was a general population study that surveyed the adult population and did not examine vulnerable subgroups of the population, most notably Aboriginal/First Nations people and children. The knowledge that the BCNS researchers have acquired from conducting this survey will be beneficial in guiding and partnering with other groups, such as Aboriginal groups in order to carry out complementary studies. Plans by Statistics Canada with CCHS, cycle 2.2 in 2004, to survey all age groups including children, for whom there is a striking paucity of data, are to be applauded.

A national surveillance system in Canada is imperative. McAmmond (2000) states that, "The gaps in Canada's food and nutrition surveillance capacity are extremely serious and must be remedied to promote and protect health. A systematic approach that improves and links existing data sources and develops new data sources is urgently needed." Health Canada and the provincial ministries must work together to ensure this initiative is brought to fruition.

8.0 References

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