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Food group contribution to the energy and nutrient intake of the adult Canadian population

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ABSTRACT

Food group contributions to energy, carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, calcium, iron, folate, zinc, vitamins A and C were evaluated for Canadian adults aged 18-65 years. Twenty four hour recall data from the 1997-98 Food Habits of Canadians survey were used. Mean nutrient intakes exceeded the RNI for all age-gender groups except, calcium for older women. Mean iron (women 18-49 years) and zinc (men and women 50-65 years) intakes were borderline. The differences in food group contribution to nutrient intake among smokers and non-smokers indicated that smokers generally obtained nutrients from foods higher in energy and fat and lower in other nutrients. Important food sources for individuals meeting the RNI for calcium were fluid milk and cheese. Important sources of folate were citrus fruit juices, breads, and lettuce/cabbages/greens as were cereals and beef/veal for iron. Zinc sources were primarily other beef cuts or ground beef.

RÉSUMÉ

La contribution des groupes alimentaires à l'énergie ainsi qu'aux glucides, protéines, lipides, gras saturés, cholestérol, fibres alimentaires, calcium, fer, folacine, zinc et vitamines A et C ont été évaluées pour les Canadiennes âgés de 18 à 65 ans. Les données (rappels de 24 heures) de l'étude des Habitudes Alimentaires de la Population canadienne (1997-98) ont été utilisées. Les apports moyens de tous les nutriments ont été plus élevés que l'ANR sauf pour le calcium (femmes 50-65 ans). Les apports moyens en fer (femmes 18-49 ans) et en zinc (hommes et femmes 50-65 ans) se situaient à la limite inférieure. Les résultats montrent que les fumeurs obtiennent plus de nutriments des aliments plus riches en énergie et en lipides mais plus faibles en d'autres nutriments. Deux sources importantes de calcium pour les gens ayant un apport adéquat sont le lait et le fromage. Les aliments qui contribuaient à l'apport de folate étaient les jus de fruits, pains, et laitue/chou/légumes verts. Le fer a été obtenu par les céréales, et boeuf/veau. Le zinc a été obtenu par les autres coupes de boeuf et le boeuf haché.

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CHAPTER 1: INTRODUCTION

A nutrition survey provides much needed information on the nutrient and food intake of a population. One can derive the proportion of individuals above or below a specific cut-off point for nutrient requirements, as well as determine the food sources of nutrients for the population as a whole or for age-gender specific subgroups. This information has important implications to the food industry to help them in identifying the marketing potential of foods. Public health nutritionists can use the information to identify needs for education and government can use it for the development of public policy. The first and only Canadian national nutrition survey was conducted in 1970-1972. Since then, provincial surveys were done in Nova Scotia, Québec, Saskatchewan, Ontario, Prince Edward Island, Newfoundland, New Brunswick, Alberta, and Manitoba. These surveys have been the result of a joint effort between Health and Welfare Canada, provincial Ministries of Health, and Heart Health Programs. British Columbia is in the process of conducting their provincial survey, and Manitoba conducted a simple nutrition survey and will be conducting a more detailed nutrition survey in the future. Provinces other than Ontario, Québec, Manitoba and Nova Scotia have yet to publish results. The lack of recent national data on Canadian nutrient intake reinforces the need for an updated look at what Canadians eat. Evaluating the nutrient and food intake of a population allows one to observe trends and changes in nutrient and food intake over time. It identifies potential problem nutrients and helps to evaluate the need for food fortification. It also guides dietitians and nutritionists in identifying foods that contribute to nutrient intake and enables them to encourage foods that are acceptable to the public. The objectives of this study are as follows:

1) To describe the mean nutrient intake (g, mg, mcg) and nutrient intake per 1000 kcal of energy for Canadians 18-65 years of age.

2) To develop detailed food groupings and sub-groupings.

3) To determine the percent contribution of each food group and subgroup to the mean intake of energy, carbohydrate, protein, total fat, saturated fat, total fiber, cholesterol, calcium, iron, zinc, vitamin A, vitamin C, and folate, by age and gender subgroups.

4) To determine differences in nutrient intake among smokers and non-smokers, and subsequent differences in the percent contribution of food groups to nutrient intake.

5) To describe the differences in percent contribution of food groups to nutrient intake of potential problem nutrients for individuals above or below the Recommended Nutrient Intake (1990) on a given day. Potential problem nutrients (calcium, iron and folate) have been previously identified in other Canadian surveys (Santé Québec 1990, Nova Scotia 1993).

All of the data used for the evaluation of these objectives is from the 1997-98 Food Habits of Canadians survey which is the most recent national nutrition survey conducted since the initial Nutrition Canada survey.

CHAPTER 2: REVIEW OF THE LITERATURE

I. Provincial Nutrition Surveys Using the Food Frequency Questionnaire Assessment Tool

The 1970-72 Nutrition Canada survey was succeeded many years later by several provincial surveys. Of the four provincial surveys published, two have used food frequency questionnaires as the primary dietary assessment tool.

1) Manitoba Nutrition Survey

The Manitoba survey (Sevenhuysen et al, 1991) was conducted with 2,459 (2,115 returned questionnaires) non-pregnant 18 to 75 year old individuals. This survey was an adjunct of the Manitoba Heart Health Project which was a survey on the prevalence, knowledge and risk factors associated with heart disease in the Manitoba population. Using a semi-quantitative food frequency questionnaire (95 food items), average intakes of energy, carbohydrate, protein, total fat, and calcium were evaluated separately by age-gender groupings (18-34, 35-64, 65-74) and stratum (urban, rural, metropolitan). Protein intake averaged at 16-17% of energy intake. Mean calcium intake was between 1134 mg-1813 mg/d, with higher intakes for men and younger individuals. The overall percentage of energy from fat ranged from 35% to 40%. Men tended to consume a higher proportions of fat than women. Total fat (grams) and percent energy from fat intake were also evaluated by employment status, occupation, education, marital status, household size, geographical stratum, and income. The results demonstrated a significant difference in percent fat intake by stratum with rural individuals consuming greater amounts of fat. There was a significantly lower amount of fat eaten by homemakers and retired individuals compared to unemployed or full time employed people.

2) Ontario Nutrition Survey

Ontario conducted their provincial survey form January to December 1990. The sample consisted of 61,239 (49,164 completed questionnaires) respondents selected from a multistage stratified cluster sample based on boundaries surrounding public health units. Within each random household selected, all individuals aged 12 and older (including

pregnant women) were asked to participate by completing a validated semi-quantitative food frequency questionnaire including 90 food items (Bright-See et al, 1994). The goal of the survey was to determine the number of servings of each of eight food groups (CFGHE four food groups plus mixed dishes, desserts/added sugars, coffee/tea & added fats) consumed based on age, gender, income and activity level. Food group sources of energy, protein, carbohydrate, fat, fiber, iron, vitamin C and calcium (including supplements) were analyzed. Energy from alcohol was not considered in this report. The average intake of fiber was 19.3 g/d with a trend towards increased fiber intake with age and a greater mean intake by men. The proportion of fat exceeded 30% of energy for all groups (mean 37%), with a higher percentage intake in men.

Among potential problem nutrients identified, those of particular interest to women were calcium and iron. Forty-two percent of men and 47% of women had less than two servings of milk and milk products per day. The average intake of calcium overall, however, was found to be 141-202% of the RNI for both genders. Despite lower than recommended intakes from the milk and milk product groups, overall needs appeared to be met most likely due to the contribution of mixed dishes to calcium intakes. Iron intake appeared to be a potential problem for women in the 20 to 44 year age group as 66% of them had an intake below the RNI, and 50% of all women sampled had less than the RNI for iron. Sixty percent of all women had less than two servings of meat /fish/poultry & alternatives per day. Again this may be somewhat misleading as "mixed dishes" were not included in this category and they may contribute significantly to iron intake. Another interesting finding was that 40% of the iron came from non-heme sources in which iron is less available to the body compared with heme sources. The main source of iron was breads and cereals (27%) with the second source being meat/fish/poultry & alternatives (23%) for females. Males had an equal contribution to iron from breads and cereals and from meat/fish/poultry & alternatives (26% each). Food group intake showed little variation for different income and occupation groups although there were some exceptions. There was a tendency for lower income groups to report higher dessert and added sugar intake, greater intake of breads and cereals, and less intake of added fats than higher income groups. The percentage of energy from fat was the same for low income

and other income groups (37%), with a tendency to decrease with age. Due to a limited number of food groups, it may have been more difficult to see the differences between income groups and food group sources of nutrients. With more food groups there would have been a greater distinction of intake from food items within each major food group.

The Manitoba and Ontario studies both assessed intake using a food frequency questionnaire which is not generally used to provide quantitative information on food and nutrient intake and is more often used to assess frequency of food consumption (Gibson, 1990). The food frequency questionnaire can, however, be used to estimate intakes of large groups (Bright-See et al, 1994). The food frequency questionnaires used were semi-quantitative which may under or overestimate the actual portion size consumed. It is difficult to make direct comparisons between data collected from a food frequency questionnaire and a 24 hour recall, the method used in the other Canadian and many American surveys. Some food items may not be accounted for in the food frequency questionnaire.

II Canadian National and Provincial Nutrition Surveys Using the 24 Hour Recall Assessment Tool

Table 1 summarizes some characteristics and global results of these studies.

Table 1: Canadian National and Provincial Nutrition Surveys Using the 24-hour Recall Method of Dietary Assessment
(Health & Welfare Canada, 1975; Nova Scotia Dept. of Health, 1993; Santé Québec, 1990)

Name	Nutrition Canada	Nova Scotia	Québec
Data Collection	Sep.1970- Dec. 1972	March-Dec. 1990	Sept.-Dec. 1990
# Subjects	12 795	2 212	2 118
Age Range	All ages	18-74	18-74
Method	24 hr. recall, FFQ	24 hr. recall, FFQ	24 hr. recall, FFQ
Day of Week	Monday-Friday	All	All
# Nutrients	13 (incl. energy)	18 (incl. energy)	30 (incl. energy)
# Food Groups	7	13 (Candi)	16 (Candi)
Potential Problem Nutrients	Ca, Fe, folate, vit A, thiamin, vit D, t. fat, fiber *	Ca, Fe, folate, t. fat, sat. fat, fiber, chol. **	Ca, Fe, folate, Zn, Na, t. fat, sat. fat, fiber, chol.

Abbreviations: Ca= calcium, Fe= iron, Zn= zinc, Na= sodium, vit D= vitamin D, vit A= vitamin A, chol= cholesterol, t. fat= total fat, sat. fat= saturated fat
* Analysis for cholesterol, saturated fat, monounsaturated fat, polyunsaturated fat & sodium not reported
** Analysis for sodium and zinc not reported

1) Nutrition Canada Survey

The goal of the Nutrition Canada survey was to evaluate the nutritional status of the Canadian population including aboriginals, Inuit and pregnant women, by region, population type, income and season. The quantity and patterns of foods consumed, the intake of nutrients in relation to recommended amounts, and food group sources of nutrients were evaluated. A probability sample of individuals was obtained by a three stage stratified random sample using the 1961 and 1966 census. Enumeration areas were primarily stratified by population type and income level and paired by season. From these strata a random sample of households was selected using lists of households within an enumeration area obtained from Statistics Canada. A random sample of individuals was selected from these households, and categorized into 10 age-gender groups. Aboriginal, Inuit and pregnant women did not represent a probability sample and were not obtained by the same method of sampling.

Table 2 summarizes potential problem nutrients found in 1970-72.

Table 2: Potential Problem Nutrients - Nutrition Canada Survey 1970-72 (Health & Welfare Canada, 1977)

12-19 years	***Folate***
	Iron
	Thiamin (borderline)
20-39 years	***Folate***
	Iron
	Calcium (borderline)
	Thiamin (borderline)
	Vitamin D (median)
40-64 years	***Folate***
	Thiamin
	Iron (borderline)
	Calcium
	Vitamin A (median)
	Vitamin D (median)

Note: Bold italicized nutrients apply to both men and women, non italicized nutrients apply only to women.

Mean calcium intake was identified as borderline (709 mg) for women aged 20 to 39 years, and low (613 mg) for women 40 to 64 years. Mean iron intake was low (11-12

mg) for women 12 to 39 years and borderline (11 mg) for women 40 to 64 years. Mean free folate intake was low for women and men 12 to 64 years (83-118 mcg). Thiamin was borderline (1.02-1.07 mg) for women 12 to 39 years and low (0.90-1.32 mg) for women and men 40 to 64 years (Health and Welfare Canada, 1977).

The food group contributions to select nutrients were analyzed by age group. The age groups comparable to the adults sampled in the present 1997-1998 Food Habits of Canadians survey were 20 to 39 year olds and 40 to 64 year olds (Health and Welfare Canada, 1977). Individuals younger than 13 years and older than 65 years of age were not evaluated in the Food Habits of Canadians report, and therefore cannot be compared to findings from the Nutrition Canada survey. For individuals in the 20 to 39 year age group, food group contribution to nutrient intake was similar for both genders except for the intake of energy, vitamin A, thiamin and vitamin C. Energy was provided mainly by meat/poultry/fish/egg (26%) and cereal products (23%) for men. For women the main contribution to energy was from cereal products (26%) and then from meat/poultry/fish/egg (23%). For men, vitamin A was obtained mainly from meat/fish/poultry/egg (37%) and next equally from dairy, vegetables/potatoes, and fats/oils (17 % each). Women obtained vitamin A mainly from meat/fish/poultry/egg (42%) and vegetable/potatoes (20%). Vitamin C was provided in slightly greater quantities from vegetables/potatoes (46%) for men compared to women (40%) for whom fruit and fruit products provided a greater proportion (52%). For both genders the main contributor to protein (48-52%), fat (38-43%), iron (37-43%), and niacin (51%) was the meat/fish/poultry/egg group. The main contributor to carbohydrate was cereal products (39-40%). Fiber (20-21%) and folate (25-26%) came mainly from the vegetable and potato group, and calcium (59-61%) from the dairy product group. The food group contribution to zinc was not evaluated.

There were differences in food group contribution to thiamin and free folate for older men compared to younger men, for adults ranging in age from 40-64 years. Differences in percent food group contribution to protein, fiber, thiamin, and free folate existed for older compared to younger women. Thiamin was provided in greater amounts by cereal products (34% vs. 29%) and less by meat/fish/poultry/egg (27% vs. 33%) in

older compared to younger men. Vegetables and potatoes were still the major source of folate in older men (26%), however cereal products were the next major source (20%) for this group compared to fruit and fruit products (18%) in younger men.

Women in the 40 to 64 year age group obtained protein from meat/fish/poultry/egg as a first source (49%) and obtained protein from cereal products (18%) as a second source rather than dairy products. A change in food group contribution to protein intake occurred with age. A shift away from dairy products, towards cereal products, occurred as women aged. These differences reflect the lower milk product consumption in the older group.

Fiber was obtained predominantly from vegetables and potatoes (43%), with fruits and fruit products being a greater source (25%) than cereal products. The lower contribution of cereal products to fiber intake could be due to a preference for white or refined cereal products compared to whole grain products, or the types of fruits and vegetables selected.

Free folate was obtained mainly from fruit and fruit products (31%) and secondly from vegetables and potatoes (26%) compared to the reverse for younger women. It would be of interest to see the types of food choices which affected the contribution to each nutrient. It appears that older women consumed either greater quantities of fruit or fruit containing higher amounts of folate and possibly more whole fruit. The consumption of whole fruit would partly explain a higher fiber intake. These assumptions are only speculations as food contribution within food groups is not known.

The mean percentage of energy from fat for adults aged 20 to 64 years in 1970-72 was 39-41%. Protein provided 13-14% of energy, with similar intakes for both genders. Fiber intake was quite low averaging at 4.3 to 4.9 g per day across the nation. This undoubtedly reflects the lack of nutrient analysis data available and the limitations with the methods of analysis for dietary fiber (Gibson, 1990). The order of contribution of foods by weight in the meat group was meat, eggs, poultry, and fish which was similar for younger men and women. For older men and women the intake of foods by weight in the meat group was meat, poultry, fish and eggs. The cereal group contribution was "similar for both sexes as well as for the younger (and older) adults: 55% (50%) from bread, rolls

& pasta, 39% (38%) from grains, and flour mixtures, and 6% (12%) from breakfast cereals" (Health and Welfare Canada, 1977).

Some seasonal variation in food item intake was found between spring, summer, autumn and winter which could impact the nutrient quantity in the diet or the contribution of food items to nutrient intake. The inclusion of all seasons in dietary surveys should be considered to avoid bias due to seasonal intake. Some of the seasonal variations in food group selection by respondents from the Nutrition Canada survey are listed in Table 3.

Table 3: Nutrition Canada Survey 1970-72: Seasonal Variation in Food Group Intake by Age (Health and Welfare Canada, 1977)

Season	Age Group		
	12-19 years	20-39 years	40-64 years
Spring		⇩ breakfast cereals (M&F) ⇧ fruit (M) ⇧ sugary foods (M)	⇧ breakfast cereals (F)
Summer	⇧ soft drinks (M&F)	⇧ soft drinks (M&F)	
Autumn	⇩ soft drinks (M&F) ⇧ dairy (M) ⇧ breakfast cereals (M)	⇧ breakfast cereals (M&F)	⇩ potatoes (M)
Winter	⇩ fruit (F)	⇩ vegetables (M&F) ⇧ sugary foods (F) ⇩ potatoes (M)	⇧ margarine (F) ⇩ oils/other fats (F) ⇧ fruit (F) ⇩ vegetables (F)

M= Male F= Female ⇧= higher than other seasons ⇩= lower than other seasons

2) Nova Scotia Nutrition Survey

The Nova Scotia Nutrition survey used a seasonally balanced (spring and fall) stratified probability sample. Stratification was done by age and gender prior to the second level of sampling. The initial 24 hour recall was followed by a repeat 24 hour recall for 38% of the sample in order to assess intra-individual variability in intake.

Knowledge of intra-individual variability is essential when assessing the proportion of individuals falling above or below a recommended level of nutrient intake (Guenther et al, 1997). Overall, 79% of respondents consumed more than 30% of energy from fat and a similar proportion had saturated fat intake above 10% of energy. The average intake of saturated fat was 13% of mean energy intake (higher percent intake in men versus women for some age groups). The percentage of energy from fat tended to decrease with age. Fiber intake was greater or equal to 15g per day in 30% of respondents and tended to increase with age. Overweight was assessed by BMI, which was above 27 for 42% of respondents. Potential problem nutrients aside from fat, fiber and cholesterol were calcium, iron and folate. Zinc and sodium were not evaluated. Mean vitamin A intake was assessed and met recommended levels of intake for all age-gender groups. Calcium intakes on average were below the RNI for men 65-74 years old and women 35-74 years of age. Iron was below the RNI for women only between 18-49 years. Mean folate intake was below the RNI for women aged 18-34 and 50-74 years. The mean folate intakes of women during potential childbearing years were below 400 micrograms per day (162-176 micrograms). Table 4 provides a summary of potential problem nutrients.

Table 4: Potential Problem Nutrients - Provincial Surveys
(Santé Québec, 1990; Nova Scotia Dept. of Health, 1993)

Nutrient	Nova Scotia Survey	Québec Survey
Calcium	35-74 yrs (marginal < 50 yrs) **65-74 yrs (marginal)**	35-74 yrs **50-74 yrs**
Iron	18-49 yrs (marginal)	18-49 yrs
Folate	18-34 yrs (marginal) 50-74 yrs (marginal)	65-74 yrs
Zinc	N/A	65-74 yrs (borderline)

Note: Bold age groups indicate men only, other age groups indicate females only.

The contribution of food groups to nutrient intake was evaluated using all individuals combined, therefore no age-gender specific contributions exist.

3) Santé Québec Nutrition Survey

The Québec survey used 24 hour recalls with a repeat recall for 10% of the initial sample. The findings for food group contribution to nutrient intake were similar to those of the Nova Scotia survey for protein, fiber, calcium and iron but differed for energy and folate. The third contributor to energy in the Québec survey was pastries rather than fats and oils. Dietary folate was obtained primarily from vegetables (27%) and secondly from breads/cereals/pasta (22.9%), the reverse was true for the Nova Scotia survey (22% and 24%). This discrepancy may result from differences in choices within food groups, differences in quantities of food items consumed, or differences in food grouping between studies (Appendix A). A change in food intake within individual food groups was observed when comparing Québec data from 1970 to data from 1990. In the breads and cereal group, there was a trend towards more whole wheat bread, dinner rolls, pasta and rice intake and a decrease in bakery items. An increase in tomatoes, broccoli, celery and green pepper and a decrease in fried/boiled potatoes and vegetable soups since 1970 demonstrated an alteration in the types of vegetables consumed. An increase in consumption of apples, fruit juice, and a decrease in citrus fruit and peaches may be reflective of seasonal variations, as Santé Québec was conducted over 4 months (September-December) of the year (Santé Québec, 1990) as opposed to all seasons. The sources of meat and alternatives have varied over the years. The order of popularity of meats in 1970 was other beef cuts, ground beef, pork, chicken then ham. In 1990, ground beef took over as the leader, while chicken, lean beef, fish and lean/fat beef followed behind. A decrease in contribution from eggs and an increase in contribution from nuts (peanut butter) to the meat and alternative group has also occurred.

The mean percent of energy from fat (32-36%), saturated fat (12-13%) for both genders and cholesterol for men (354-405 mg/d) were above recommended levels in the Santé Québec survey. Although absolute intake of cholesterol in men was above 300 mg/d, it is of interest to note that cholesterol intake per 1000 kilocalories was similar for men and women. Mean fiber intake was low at 12.6-18.7 g/d and tended to be higher in

men. Some trends in intake were found with relation to age and gender. For both men and women, the percentage of energy coming from fat and saturated fat decreased with age, as did calcium (absolute levels and per 1000 kcal) intake for most age groups. Fiber intake (absolute and per 1000 kcal) tended to increase with age, with the exception of women 65-74 years. Mean calcium, iron and folate intakes were found to be below the RNI for specific groups of the population. Zinc intake which had not been previously looked at in any of the provincial and national surveys was also found to be below the RNI for older individuals (Table 4).

The average calcium intake was below the RNI for women aged 35-74 years and men aged 50-74 years, which was similar to findings from the Nova Scotia study. Mean iron consumption for women 18-49 years of age, and mean folate intake for women 65-74 years of age were below the RNI. Women of childbearing age had an average folate intake of 189-203 micrograms per day. Mean zinc intake was below the recommended level for women aged 65-74 years.

A relationship between income, education and nutrient intakes was found as well. Income was evaluated using both household income and number of individuals within each household. Higher income individuals had greater intakes of calcium and vitamin C, while other nutrients did not vary as much with income level. Education was positively associated with overall intake of vitamin A and calcium.

4) Potential Problem Nutrients Identified

There are similarities in the nutrients which were identified as being potentially "problematic", particularly for women, in each of these studies. Along with low intakes of several nutrients, there is a consistent intake of fat above the recommended 30% of energy as per the Nutrition Recommendations (Health and Welfare Canada, 1990). The Department of National Health and Welfare published guidelines regarding the addition of nutrients to food items (Health Canada, 1994). Among the nutrients included in the policy was the fortification of foods with vitamin D, vitamin A, restoration and fortification of foods with thiamin, riboflavin, niacin, folate and iron. These additions aid in the prevention of nutrient deficiencies (Health Canada, 1994). The restoration and

fortification of foods are a likely reason that vitamin A and thiamin were no longer found to be "problem" nutrients in more recent studies. Folic acid remains a voluntary nutrient addition to flour in Canada, unlike the United States where in 1998 it became a mandatory addition (Herbert et al, 1997).

II. American Nutrition Surveys

1) Nutrition Monitoring in the United States

Unlike Canada, the United States has a system in place to monitor the nutritional status of the population as a whole and of groups of individuals nutritionally at risk (Guthrie, 1989). These groups include Hispanics, pregnant women, children and the elderly. The U.S. Department of Agriculture (USDA) conducts the Nationwide Food Consumption survey (NFCS) on individual and household intakes every ten years and has published results for the 1977-78 and 1987-88 surveys. The USDA conducts an annual Continuing Survey of Food Intake of Individuals (CSFII). This survey is an adjunct to the NFCS and assesses only the intake of individuals. In 1965, the first survey was conducted to assess individual food intake within a household, rather than assessing household consumption alone. The survey of individuals provided interesting and more detailed results. This lead to the 1977-78 NFCS survey which included one 24 hour recall and a two day food record of randomly selected individuals over all seasons of the year as well as household consumption. As the usefulness of the surveys on individuals became more apparent it was decided to conduct them on a yearly basis between the ten year span of the NFCS. In 1985, the USDA conducted the first Continuing Survey of Food Intake of Individuals on a multistage stratified national probability sample of women and their children (1-5 years).

Biochemical and medical information is required in order to asses the nutritional status of a population. The nutritional status of Americans is evaluated by the National Centre for Health and Statistics (NCHS) which conducts the National Health and Nutrition Examination Survey (NHANES) on a stratified multistage probability sample of individuals of varying ages roughly every ten years. Intake is assessed using the 24 hour recall method with the aid of three dimensional food models, geometric shapes, plates, spoons,

and cups. Respondents are given a medical evaluation for all NHANES surveys and provide blood and urine samples to be assessed for any possible nutrient deficiencies. Nutrient contribution to food groups was evaluated for both the NFCS (1977-78 & 1987-88) and CSFII (1985). Food groups were developed for the NHANES surveys; however available data list only the percentage of respondents consuming a particular food group and does not link food groups with nutrient intakes. The first NHANES was conducted in 1971-74, NHANES II in 1976-1980 and NHANES III in 1988-1994 (U.S. Dept. of Agriculture, 1989).

2) Nationwide Food Consumption Survey

The NFCS of 1977-78 provided some early indications of potential problems in adequacy of nutritional intake for specific subgroups of the population. The sample was drawn as a self weighted multistage stratified probability sample (stratified for demographic, geographic divisions and urbanization). A total of 14,930 households were sampled which provided data for 30,770 individuals of all ages (U.S. Dept. of Agriculture, 1989). Potential problem nutrients identified were total fat, cholesterol, saturated fat, folate, calcium, iron, zinc, fiber and sodium. The mean percentage of energy from fat and total cholesterol, like in other studies, was above the recommended amount (41% and 385 mg/d). Of all respondents, 94% obtained more than 30% of their energy intake from fat and amounts tended to be greater for males compared to females. Cholesterol intake was above 300 mg/d for 58% of respondents. Folate intake required further investigation as 1977 nutrient composition tables lacked data making actual intakes difficult to assess. The same was true for zinc. The average calcium intake of respondents was 87% of the RDA, which does not necessarily indicate deficiency but indicates an increased risk. The intakes were particularly low for adolescent girls and adult women. Food group contributors to calcium intake were found to be primarily milk, cheese, and cream products (60%), secondly grain products (16%) and thirdly vegetables (7%). It was not specified which food items within the milk product group contributed the most to calcium intake. Iron intake, as in other American and Canadian studies, was below the recommended intake for teenage girls and boys 12-18 years and women aged 19-64 years. Overall grain products contributed the most to iron (non-heme source) intake (35%), then meat, fish, poultry

(32%), followed by vegetables (12%) for all age-gender groups averaged. Sodium has been shown to be difficult to estimate. Results in this survey include only sodium found in food items, not sodium added in cooking or at the table. Despite these omissions, the intake of sodium overall was high.

Some gender differences in levels of absolute nutrient intake were apparent. Generally men had higher intakes of all nutrients compared to women, due mainly to a higher energy intake. The differences in nutrient intake between genders tended to decrease in individuals above 65 years of age.

Specific nutrients varied more with respect to income levels. Nutrients showing a positive association with income were protein, niacin, vitamin B-12, vitamin C, phosphorous, magnesium and calcium. Calcium also showed a positive association with income in the 1987-88 NFCS (Fleming et al, 1994). A negative association between income and carbohydrate intake was noted. Iron showed an inconsistent association with income level (U.S. Dept. of Health and Human Services, 1986).

Ganji et al. (1995) estimated total fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber and sodium intakes of respondents age eleven years and older from the 1987-88 NFCS. Data from both genders were combined but respondents were separated by age group. The mean percentage of energy coming from fat decreased from the 1977-78 survey (41% to 37-38%). Average saturated fat intake was 13-14% of energy, cholesterol was 273-317 mg/d, and fiber ranged from 12.3-13.4 g/d. These intakes appear somewhat improved compared to previous years, yet remain outside of recommended levels. The percent of energy from total fat, saturated fat, and polyunsaturated fat was not significantly different between age groups. There was a slight increase in fiber and cholesterol intake per 1000 kilocalories in the oldest group.

Fleming et al. (1994) examined calcium intakes and food sources of respondents of all ages from the 1987-88 NFCS. The average calcium intake was 738 mg/d, with a trend towards decreased intake with age. Among observed trends was a decrease in proportion of calcium from milk products and an increase in proportion from fruits and vegetables as one aged. Calcium intake was found to be at its worst during the age period when bone development occurs (12-29 years). This age group, on average, had a calcium intake

below 60% of the RDA. Overall, milk products contributed 50% of calcium intake. Milk or cheese as an ingredient contributed 20%, grain products 12%, and fruit and vegetables 6%. The milk product group included cheese, yogourt, ice cream and other milk products. Despite our fear of fat contribution from dairy products it is of interest to note that "users" of fluid milk consumed 41 g of fat per 1000 kilocalories whereas "non-users" of fluid milk consumed 42 g per 1000 kilocalories. The milk users however ingested 44% more calcium than non-users. This reinforces the advantages of encouraging milk intake despite our "phobia" of dietary fat .

An analysis of the change in the contribution of 22 food groups to energy, fat and fiber intake in elderly Americans was done by Popkin et al. (1992). High fat desserts (8.1%) and medium fat beef/pork (5.3%) were the greatest contributors to energy intake in 1977-78 and 1987-88. High fat beef and eggs ranked lower (less than 3% each) in the 1987-88 survey. Sources of fiber were similar in both studies with non-citrus fruit (11.1%) contributing the greatest amount. High fiber cereals (9.3%) appeared to replace low fat high fiber bread (9.1%) as the second contributor to fiber in 1987-88. In 1987, butter & margarine (9.5%), high fat desserts (9.2%), and medium fat beef/pork (8.2%) ranked as the top three contributors to fat intake with medium fat beef/pork ranking first in 1977. There was an overall decrease in the proportion of individuals consuming eggs, bacon, high fat beef and pork and high fat milk products. There was an increase in the proportion of individuals consuming lower fat beef and pork, "other" fruits, and high fat grain based mixtures. These results are limited to individuals above the age of 65, however they still represent changes in trends of food consumption over time, and demonstrate changes in our choice of meat towards lower fat cuts.

3) Continuing Survey of Food Intake by Individuals

The first multistage stratified probability sample survey conducted on individuals, independent of household intake, was the Continuing Survey of Food Intakes by Individuals (1985). This first survey sampled 1,088 women aged 19-50 years and their children aged 1-5 years (n=371). As only 47% of women completed all six recalls the following data represent only four days of intake. Nutrient intakes compared to RDAs and

nutrient contribution to 15 food groups were evaluated as well as percent contribution of food groups by income level. Nutrients found to be below the RDA for the adult women were vitamin E, B-6, folate, calcium, magnesium, iron and zinc (U.S. Dept. of Agriculture, 1987). As with other surveys, the women in this study showed an elevated level of total fat (37% of energy) and saturated fat (13% of energy) intake. Some of the calculated intakes may underestimate actual intakes due to deficiencies in nutrient content tables (Anderson et al. 1996). Intakes of vitamin B-6 and magnesium showed a link with elevated homocysteine levels and a link with hypertension respectively. Despite this link, there is still a need to determine "criteria to link monitoring data to functional outcomes or health outcomes" (Anderson et al, 1996).

Six food groups were added since the 1977-1978 NFCS. Separate groups for eggs and legumes were created. The vegetable group was broken down into citrus fruit & tomatoes, non-citrus fruit, dark green & deep yellow vegetables, white potatoes and other vegetables. With these changes, the main contributors to vitamin A, folate and iron were foods from the vegetable and fruit group. Vitamin A was predominantly derived from vegetables and fruits (46.3%) with the main contributors being dark green & yellow vegetables followed by "other" fruit. The high contribution of dark green and yellow vegetables is expected since carrots, which are part of this group, are frequently consumed and high in carotenes. Folate was also found to come mainly from vegetables and fruit (35.5%). The main contributors were not primarily dark green vegetables as might be expected but rather "other" vegetables followed by citrus fruit & tomatoes. Dark green leafy vegetables tend to be high in folate, however the frequency and volume of their consumption must be lower than that of other types of vegetables. The intake of iron was still predominantly from grain products but the percentage of their contribution had increased since 1977 (35% to 42.4%). One must remember that the 1977 data included men as well as women, therefore the contribution from women alone may have been different. Vegetables and fruit were the third contributors to iron intake (15%) and from this group, "other" vegetables were the highest contributors followed by potatoes. Again, dark green leafy vegetables which are generally higher in iron, did not contribute greatly to iron intake.

Lower income groups were found to have lower intakes of most food groups but had greater intakes of grain products, possibly due to the lower cost of grains.

4) National Health and Nutrition Examination Survey

The most recent National Health and Nutrition Examination Survey (NHANES) took place in 1988-1991 with some changes in the methodology compared to the first two NHANES surveys. For the first time, all days of the week were included in the dietary analysis, and a repeat 24 hour recall was done on a subgroup of the population (Sempos et al, 1992). Changes in food coding and changes in the nutrient composition database make it difficult to compare results between each NHANES study. Some problem nutrients were the same as in previous surveys for the most part and are outlined in Table 5.

Table 5: Summary of Methodology and Findings from NHANES I, II, and III (McDowell et al. 1994, Alaimo et al. 1994, Sempos et al. 1992, Kant et al. 1991, Woteki et al. 1990, Murphy et al. 1986, Lowenstein et al. 1981, Abraham et al. 1979, Abraham et al. 1977)

Name	NHANES I	NHANES II	NHANES III
Data Collection	1971-75	1976-80	1988-94
# Subjects	20 749	20 322	15 409
Age Range	1-74 yrs	6 mo-74 yrs	2 mo and over
Method	24 hr recall	24 hr recall	24 hr recall/FFQ/R
Day of Week	Monday-Friday	Monday-Friday	All
Problem Nutrients	Ca, Fe, vit A, t. fat, sat. fat, chol	Ca, Fe, Zn, Cu, I, vit E, B-6, fiber	Ca, Fe, fiber, Na, t. fat, sat. fat, chol, Zn, Cu, B-6, vit E

Ca= calcium, Fe= iron, Zn= zinc, Cu= copper, I= iodine, Na= sodium, vit E= vitamin E, B-6= vitamin B-6, vit A= vitamin A, chol= cholesterol, t. fat= total fat, sat. fat= saturated fat

As usual, mean intakes of fat, saturated fat, cholesterol and sodium were found to be above the RDA, while mean intakes of calcium, iron and fiber were found to be below the RDA. The average percent of energy from fat for the adult group was 34% in 1988-91

which was an overall decrease of 2% since 1976-1980. Mean saturated fat intake was 12% of energy. Cholesterol consumption was within the recommended range for women but above for men (372-395 mg/d) and was highest for the 16-39 year age group, decreasing for older adults. Fiber intake averaged at 17 g/d for men and 13 g/d for women. Mean iron intake was below the RDA for females aged 12-59 years. Mean zinc intake was below the 1980 RDA for females of all ages, males 1-15 years and 40 years and over. Mean calcium intake was below the RDA for females above the age of twelve, boys 12-15 years, and men eighty years and over. Intake of folate for women of childbearing age was below the recommended 0.4 mg/d (Alaimo et al, 1994; McDowell et al, 1994).

Similar potential problem nutrients, to those in the most recent NHANES survey, were found by Lowenstein et al. (1981) from the first NHANES study. The median intake of vitamin A was found to be 46-75% of the standard for black women and men aged 12-34 years. Murphy et al. (1986) found that mean iron, zinc, copper and iodine intakes were below the RDA for women 18-24 years of age from the NHANES II data. Mean zinc intake was also found to be below the RDA for women 19 years and older, black men 19 years and older and white men 35 years and over (Mares-Perlman et al, 1995). Meat and meat product intake contributed the most to zinc intake. The proportion of zinc from this food group appears to be decreasing possibly due to a shift away from red meat towards poultry (Mares-Perlman et al, 1995). Kant et al. (1991) found intakes of vitamin E and B-6 to be below recommended levels for most patterns of food group intake in individuals 19-74 years of age.

Block et al. (1985) used NHANES II data to demonstrate top food item contributors to the nutrient intake of a sample of respondents. The highest contributors to iron were white breads, rolls, crackers (11.43%), beef steaks & roasts (9.04%) and hamburgers, cheeseburgers, meat loaf (6.9%). Green leafy vegetables did not find a spot on the list and green salads contributed only 1.8% and prunes a mere 0.4% of iron intake. The main sources of calcium were whole milks & whole milk beverages (21.97%), cheeses excluding cottage cheese (12.01%), and 2% milk (10.55%). Yogourt only contributed 0.9%, and cottage cheese only 0.48% of mean calcium intake, and broccoli although sometimes recommended as an alternative calcium source did not appear as a contributor

to calcium intake. Many contributors to carbohydrates, other than the primary contributor, were of the "empty calorie" type. The primary contributors were white breads, rolls, crackers (15.03%) followed by "empty calorie" food such as regular soft drinks (8.55%) and doughnuts, cookies, cake (7.52%). This study shows the need to continue nutrition education to encourage the consumption of nutrient dense food items. It also illustrates the importance of encouraging intake of foods that may be lower in a particular nutrient but which contribute greatly to the overall nutrient intake of the population due to frequency and volume of intake.

The NHANES I results showed that calcium, iron and vitamin A were potential problems while zinc was not evaluated. Calcium only approached recommended levels of intake for women aged 45-74 years. Iron was below the RDA for all females except those 6-9 years and 55 years and older. Vitamin A was found to be below the recommended level of intake for lower income white women 20-24 years, lower income black adolescents 15-17 years and higher income black adolescents 12-14 years of age (Abraham et al, 1979).

IV. Trends In Food Intake and Nutrient Sources in Canadian and American Populations

Over the past 25 years there have been several changes in food and nutrient intake trends. Food trends can identified using Food Consumption and Expenditure data (Agriculture Canada, 1991) as well as surveys such as the National Institute of Nutrition "Tracking Nutrition Trends". Food expenditure data is collected every two years by Statistics Canada and illustrates weekly food purchases by families. A factor is used to estimate meals eaten in food establishments (Robbins et al, 1986). There are obvious limitations with food expenditure and consumption data in that they do not reflect food waste and do not measure intake by specific age-gender groups. Nevertheless, they can provide a global view of changes over time and aid in evaluating whether or not nutrition and health related messages are being followed by the general population. Food habits change over time due to lifestyle factors and changes in household income levels. An increase in dual income families, greater availability of food items, and an aging population all have an impact on the types of foods that are eaten (Robbins et al, 1986).

1) Per Capita Food Consumption and Household Food Expenditure

The nutrients available for consumption can be estimated using per capita food expenditure along with nutrient composition tables. Agriculture Canada has tabulated the trends in available nutrients from 1963 to 1988 (Robbins, 1991). Positive trends over that period were an increase in available calcium, folacin, vitamin A, vitamin C and a decrease in available fat, saturated fat, cholesterol and sodium. Among negative trends seen was the decrease in available iron which has already been identified as a potential "problem" nutrient for women in Canadian and American surveys (Ontario Survey, Nova Scotia, Santé Québec, NHANES, CSFII). One must be aware that total energy intake also decreased by 1.4% during this time period which can impact the overall nutrient intake (Robbins, 1991). Along with the changes in available nutrients, the food group contribution to these nutrients in the Canadian diet has also changed from 1963 to 1988. The sources of vitamins has shifted. Vitamin A availability has shifted from meat towards vegetable and milk products (Robbins, 1991). This shift may have positive health benefits since vegetable sources of vitamin A provide beta-carotene which is reputed to have antioxidant properties (Hercberg et al, 1998). There has also been a shift in contribution to iron intake from meat sources towards vegetable sources with a slight increase in poultry and fish contributions (Robbins, 1991). Despite the slight increase in poultry and fish there remains an overall reduction in the percent contribution from meat, fish & poultry to iron as a whole. The availability of iron in our diets appears to be changing with a switch from heme to non-heme sources. Another interesting finding is the decrease in contribution to fat from meat, fish & poultry with an increase in the contribution of dairy products, despite an apparent switch away from whole milk towards 2% milk. This trend is most likely due to the increase in cheese consumption, much of which is related to "fast food" items such as pizza (Robbins, 1991).

Some of the trends in per-capita food consumption in Canada from 1963-1988 are listed in Table 6.

Table 6: Trends in Per-Capita Food Consumption in Canada from 1963-1988

(Duncan et al., 1986; Agriculture Canada)

Food Group	Changes in Food Consumption within a Food Group
Milk Products	⇧ cheese (processed & variety) ⇩ whole milk ⇧ 2% milk ⇧ yogourt ⇩ skim milk powder/canned milk
Meat & Alternatives	⇩ pork since 1980 ⇩ beef since 1981 ⇧ poultry ⇔ fish (1973-1981) ⇧ pulses & nuts ⇩ eggs
Fruits & Vegetables	⇔ citrus fruit & juice ⇩ canned & frozen fruit ⇧ non-citrus fruit juice ⇔ tomatoes ⇔ potatoes ⇧ mushrooms ⇧ other vegetables ⇧ fresh & frozen (other vegetables) ⇩ canned (other vegetables)
Cereals	⇧ breakfast cereal ⇧ rice
Fats & Oils	⇩ animal fat ⇧ vegetable fat

⇧= increase ⇩= decrease ⇔= stable

American reports on trends in food available for consumption show findings similar to Canadian data. Availability of higher fat milk decreased whereas that of lower fat milk increased. At the same time, however, availability of cheese and cream products

increased. As in Canada, beef and egg consumption in the United States have shown a decline from 1972 to 1992 and chicken and turkey have shown an increase in availability. Other meat intake such as fish and pork, have remained more stable. Soft drink availability continues to increase in the United States (Anderson et al, 1996).

American household food expenditure data show similar trends for meat and milk products as food availability data. Expenditure for fresh vegetables and fresh fruit has declined 11% and 22% respectively from 1980 to 1992, likely due to a decrease in their consumption. The purchase of snack foods (chips, nuts etc.), carbonated beverages and frozen prepared foods has increased during the same time frame (Anderson et al, 1996).

2) Tracking Nutrition Trends Survey

The National Institute of Nutrition conducted a nutrition survey on a random sample of 1,956 adult Canadians to determine their perceptions and understanding of nutrition related topics. The survey was designed as a probability sample including all Canadians except those residing in the Northwest Territories. A gap in the perceived importance of nutrition between men (78%) and women (92%) may explain differences in food choices between the sexes. It was reported that more women than men claimed to be eating fruits and vegetables and selecting lower fat products (National Institute of Nutrition, 1997). Nutrition played a greater role for those who were 35 years old and over compared to those under 35 years of age (National Institute of Nutrition, 1997). These trends may be directly observed in the contribution of food groups to nutrient intake which will likely vary by gender and age groups.

V. Food Group Contribution to Nutrient Intake

Various methods of food grouping exist. Two methods that will not be used in the present study are known as "factor analysis" and "cluster analysis". Factor analysis is used to group foods into "eating patterns". For example Schwerin et al. (1982) used data from the Ten State Nutrition Survey (1968-70), NHANES I (1971-74) and the Nationwide Food Consumption Survey (1977-78) to identify "seven factors or patterns to describe the characteristic eating habits of the sample" (Schwerin et al, 1982). These patterns of food

consumption can in turn be compared with health status indicators and sociodemographic or economic variables to determine if any relationship exists. Cluster analysis deals more with "grouping individuals on the basis of similarities in patterns of food consumption" (Akin et al, 1986).

Food groups were created for the present study in part by grouping foods with similar nutrient contents.

1) "Good" vs. "Important" Food Group Sources of Nutrients

Contribution to nutrient intake depends on the frequency and quantity of consumption of food items as well as the quantity of macro or micronutrients found within the food item. A study by Batcher et al. (1984) looked at identifying "good" sources compared to "important" sources of nutrients using the 1977-78 NFCS. Good sources of a nutrient were defined "on the basis of the amount of nutrient in a given quantity of food", whereas important sources were foods which supplied specific nutrients due to the frequency and quantity of use (Batcher et al, 1984). The findings for contribution to calcium, iron and vitamin A were of interest. As expected, calcium came predominantly from milk products (60%) with the second contributor being grain products (19.1%). Interestingly, ice cream and yogourt, although considered good sources of calcium, contributed little to calcium intake due to infrequent consumption. Typical "good" sources of iron are meats, prune juice, oysters, dark green leafy vegetables (Somer, 1992). Grain products (35.3%) however, contributed more to iron intake than the meat/poultry/seafood group (33.6%) probably due to the addition of iron to various food items within the grain group such as cereals and pre-cooked rice. There was negligible contribution to iron from dark green vegetables which are often encouraged as a source of iron. Beta-carotene came mainly from vegetables (40.6%), mostly from dark yellow vegetables and carrots.

2) Other Studies Illustrating the Uses of Food Group Contribution to Nutrient Intake

Several studies relating the intake of food groups to nutrient contribution exist. Many of these studies evaluated nutrients implicated in heart health such as total fat,

saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber, sodium, and the percent contribution of macronutrients to total energy intake.

Gorder et al. (1986) analyzed 24 hour recall data from the Multiple Risk Factor Intervention Trial (MRFIT 1973-82) of men at increased risk for heart disease. The men were randomized into control or special intervention groups. The purpose of this study was to compare the change in percent contribution of food groups to various nutrients. Mixed dishes appeared to be entered under the subgroups for which the dish contributed the greatest amount of fat/cholesterol. The major contributors to fat intake were meats (36%), fats/oils (20%), dairy (15%) and baked goods/desserts (9%). High fat meats contributed the greatest amount of fat and saturated fat at baseline, as was found in NHANES I. Following dietary intervention, the percent contribution to energy from breads/cereals and fruits/vegetables increased significantly and the contribution of high fat meats and dairy products decreased significantly. There was a small significant increase in the intake of legumes. The change in contribution to energy intake over time was accompanied by changes in contribution to total fat, saturated fat, PUFA, MUFA and cholesterol intakes. These findings are of interest since they show how food groupings can be used to observe changes in intake over time and they demonstrate the difficulty in changing patterns of food intake. Legumes may never contribute greatly to the nutrient intake of the American or Canadian population despite encouragement to increase their consumption. The twenty food groupings in this study showed positive attributes for evaluating the percent contribution to fat intake, but lacked the necessary detail to determine the contribution of specific types of fruits and vegetables.

A study by Dolecek et al. (1997) evaluated the effect of a fat modified diet on the adequacy of vitamin and mineral intakes. This can demonstrate the possible effect that dietary recommendations have on the overall micronutrient intake of a population. The data used was from the MRFIT trial. Suggestions to consume lower fat meats, such as fish and poultry, were made in order to decrease overall fat intake. These changes may also have had an impact on zinc intake due to its lower concentration in poultry and fish compared to red meat. Absolute intake of zinc decreased between baseline and follow up but nutrient density increased. A decrease in the contribution of the meat group to zinc

intake was observed. This study shows that one must be aware of the effect nutrition recommendations have on the general population and consider the importance of zinc and iron intake as well as overall fat intake.

A study looking at the effect of two methods of classifying food mixtures using data from the 1985 Continuing Survey of Food Intake demonstrated a difference in percent contribution to nutrients (Krebs-Smith et al, 1990). The first method used to analyze the data included food mixtures within the food groups. For example, omelets and pizza were entered in the "egg" and "grain product" categories respectively. The second method separated foods into component parts. For example pizza would have been broken down into its individual components. The percent contribution of 14 food groups to energy, carbohydrate, protein, fat, saturated fat and fiber was calculated. The most evident changes were the lower contributions of meat, fish, poultry and grain products and higher contributions of milk products, fats and oils (to the nutrients studied) when food mixtures were entered as individual food items rather than mixtures (Krebs-Smith, 1990). The main differences occurred when food mixtures were classified in food groups by main ingredient. The primary contributor to fat, saturated fat and cholesterol switched from meat/fish/poultry to fats/oils, milk and milk products and eggs respectively once mixtures were entered as individual components. These differences emphasize the importance of looking at how food mixtures are dealt with when comparing results of studies. Studies using varying methods of grouping foods are often difficult to compare directly.

The above mentioned studies illustrate the potential uses of food group data and the various methods of grouping foods.

VI. Sociodemographic and Other Factors Affecting Food and Nutrient Intake

Numerous factors affect individual food intake. Among these factors are food supply, food prices, income, demographic factors (age, gender, race, education), environmental factors, biologic factors, and sociocultural factors (religion, place of origin) (Boyle, 1994). Day of the week and season can influence dietary intake as well. For the purpose of this study only age, gender, and smoking status will be examined.

1) Day of the Week and Seasonal Variation

Day of the week effect may cause variance in an individual's intake. Beaton et al. (1979) examined the sources of variance in dietary intake of men and women who took part in the Lipid Research Clinic program of the National Heart, Lung and Blood Institute. This group found variance in intake due to gender when absolute nutrient intake was reported, however not when nutrient density (per 1000 kcal) was reported. No seasonal effect was found due to the short time period of the study and a day of week effect was seen in women only when absolute intakes were described. No day of the week effect was found for either gender when nutrient densities were reported. Some nutrients have greater day to day variability than others. For example, vitamin A (Beaton et al, 1983; Sempos et al, 1985) and vitamin B12 (Sempos et al, 1985) have a large daily variability. Due to the large variability in nutrient intake it is important to include all days of the week when reporting dietary intakes. "Random sampling of all days of the week" appears to be better than weighting days of the week to equally represent the distribution of weekdays to weekends as is done in some studies. Day of the week variation may not be the same for all individuals (Beaton, 1994).

Seasonal effect on food intake is another possible cause of variation in intake. The intake of specific food items may vary due to seasonal availability. For example, certain fruits are harvested at specific times of the year. Lower intakes of vitamin A in spring/winter and higher intakes of vitamin C in spring/summer were found by Pao et al. (1985). Despite the intake of different types of foods during the different seasons "once food intake is converted to estimated energy and nutrient intakes, true seasonal effects are hard to find" (Beaton, 1994). It is best to include a random sample of all seasons of the year to avoid any bias due to seasonal effect (Gibson, 1990).

2) Income and Socioeconomic Status

Food consumption patterns and family income were looked at by Myres et al. (1978) using Nutrition Canada data from 1970. Sampling for the Nutrition Canada survey was done in part based on income which provided the required proportion of individuals at various income levels. For adults the intake of meat/fish/poultry, fruits and vegetables

(except in women 20-39 yrs.), along with dairy (except in men 20-64 & women >20) tended to increase with increased income. Butter contributed more to fats, eggs more to vitamin A, breakfast cereals more to iron and B vitamins, and potatoes less to vegetables in higher income groups. This in turn could affect saturated fat intake and fiber or vitamin C intake with respect to income level. Lower income groups had a greater contribution of liver to the meat group than higher income groups and a greater contribution of fats to vitamin A.

Popkin et al. (1996) compared dietary trends in a sample of blacks and whites of varying socio-economic levels over time. The sample was from the NFCS of 1965, 1977-78 and the CSFII of 1989-91. According to a "diet quality" score, improvements in diet were seen for all groups and the "differences among racial and socio-economic groups narrowed" but improvements in dietary intake were still more evident in higher socio-economic groups.

3) Smoking Status

Tillotson et al. (1997) examined coronary heart disease risk factors, including smoking, and other sociodemographic factors at baseline with respect to effect on food group intake of MRFIT subjects. Although the male volunteers represented a population at risk for heart disease, it provided some interesting information. Smokers were found to use significantly more saturated fats, refined sugars and alcohol than non-smokers. Carbohydrate, fiber, vitamin C and beta-carotene intakes were lower in smokers.

Smoking was also found to have an impact on dietary intake in women from the CSFII 1985. "Smokers had significantly lower intakes of protein, fiber, vitamin C, thiamin, carotenes and significantly higher intakes of cholesterol per 1000 kilocalories" (Larkin et al, 1990). Fruit and vegetable intakes were found to be lower in smokers. Coffee, alcohol, sugar, soft drink, and egg intakes were higher in smokers. These findings emphasize the association between dietary habits and smoking status. It appears smokers have poorer dietary habits than non-smokers. Smokers are advised to increase their intake of vitamin C by 50% above recommended levels in order to maintain body pool size of

vitamin C since the half life is decreased in heavy smokers (Health and Welfare Canada, 1990).

CHAPTER 3: METHODS

The following description of methods used for the sampling strategy, subject recruitment, sample size calculation, data collection and quality control pertain to the Food Habits of Canadians 1997-98 study. The sections pertaining to data analysis, food group development and statistical analysis describe the methods used specifically for the analysis of food group contribution to nutrient intake in the Canadian population.

I. Study Design and Subject Recruitment

1) Sampling Strategy:

The sampling of respondents was done using a multi-stage random sample of 85% of adult Canadians between the ages of 18 and 65 years. From this sample a sub-sample of adolescents 13-17 years of age was drawn. Fifteen percent of the Canadian population was eliminated due to the inaccessibility and increased cost associated with sending an interviewer to remote locations. Those also eliminated from the sample were institutionalized individuals and pregnant/lactating women. Canada was divided into five regions: Québec, Ontario, Maritimes (New Brunswick, Nova Scotia, P.E.I., Newfoundland), Prairies (Manitoba, Saskatchewan, Alberta), and British Columbia. For each region the population of each geographical division within the region was added cumulatively. From this point four divisions were randomly chosen for each region based on a random number and a cumulative population size corresponding to that number. This provided a total of 20 divisions across the country. This method of sampling was continued at the subdivision and enumeration area levels. For each division a random sample of two subdivisions were selected providing 40 subdivisions across the country. Two enumeration areas were randomly chosen for each subdivision creating 80 enumeration areas within the country. The 1991 census was used for the sampling as it was the most recent census with complete data at the time of the sampling. The sampling for individual random households from within each enumeration area was done using the most recent Pro-CD telephone directory from 1996. Boundaries of enumeration areas were identified using Statistics Canada maps and street indices which listed address ranges within an enumeration area. A total of 200 households were randomly selected from the

directory for each enumeration area. A call list including these households was developed for interviewers to use in contacting potential respondents.

2) Subject Recruitment:

Each potential respondent received a letter prior to telephone contact from the interviewer. The letter outlined the purpose of the study and requested participation. Interviewers attempted to obtain 20 adult respondents from each enumeration area. A total of six attempts, at different times of the day, on weekdays and weekends were made to contact subjects prior to indicating that a subject could not be reached. Each adult subject responding to the interview was asked whether there was an adolescent between the age of 13-17 years who would be able to participate. Subjects were randomly selected within a household. This was done by requesting an interview from the adult having the next birthday. Appointments for interviews were made on different days of the week including weekends to ensure all days of the week were represented. Interviews were held in the respondents' home or at another convenient public place, and interviews were done during all seasons of the year.

For the purpose of this report, only adult 24 hour recalls were used in the evaluation of food group contribution to nutrient intake. Repeat 24 hour recalls will be used for the purpose of another report to evaluate intra-individual variability.

3) Sample Size Calculation

The sample size required was calculated by the principal investigator (Dr. Katherine Gray-Donald) using standard deviations per 1000 kilocalories intake of protein, iron and zinc derived from standard errors published in the Santé Québec survey. The sample sizes for males and females (35-49 years) were calculated separately. A 95% confidence interval was used with a coefficient of variation of 10% around the mean. As an example, the mean intake of protein in women per 1000 kilocalories was 42.1 g. The standard deviation (1.05) was from the Santé Québec study. A sample size of 196 was derived using $N = 4z_{\alpha}^2 s^2 \div w^2$. The sample size required would thus be approximately

160-200 individuals for each gender group per region to provide a total of approximately 1600 individuals throughout the country.

II. Data Collection

1) Interviewer Training & Data Collection Period

Dietitians throughout Canada were selected by the investigators to contact potential respondents and conduct in person dietary interviews for their respective enumeration areas. A two day training session was provided by the principal investigator (Dr. Katherine Gray-Donald), co-investigator (Dr. Linda Jacobs-Starkey) and study coordinator (Louise Johnson-Down, P.Dt., M.Sc.) to ensure uniformity among data collectors and adequate detail in data obtained. Training consisted of a description of the goals and objectives of the study and sampling strategy and instruction for all forms used for the data collection. Practice 24 hour recalls were conducted in pairs among dietitians and discussed in a group in order to insure proper data collection. Food portion models were used in these sessions to familiarize interviewers with their use. Food portion model kits consisted of a graduated cup, bowls, plate, spoons and a ruler.

Data collection commenced in September, 1997 and ended August, 1998, thus covering all seasons of the year. The masters student (H.R.) was able to partake in the interview process during autumn 1997, completing interviews in two enumeration areas. Upon completion of all interviews, interviewers returned all copies of forms used as well as participant contact sheets and signed letters of consent to the study coordinator.

2) Dietary Intake & Sociodemographic Information

Several methods exist for the evaluation of dietary intake of individuals and groups. Food consumption can be measured by 24 hour recalls, weighed food records, dietary histories, food diaries and food frequency questionnaires (Gibson, 1990). Respondent burden is quite high for weighed food records and food diaries and subjects may have a tendency to alter their usual food intake, making them an undesirable choice for a national survey. Dietary histories can take 1 to 1 1/2 hours per respondent to complete which requires a greater budget for a large sample size. Twenty-four hour

recalls are commonly used for national and other large scale surveys such as NHANES, Nutrition Canada Survey and the Nova Scotia and Québec provincial nutrition surveys. A single twenty-four hour recall is inadequate to assess an individual's usual intake. It is recognized, however, as an appropriate method to assess the average intake of a large group of individuals, provided various days of the week and various seasons are covered (Gibson, 1990; Guenther et al, 1997; Pao et al, 1985; Beaton et al, 1979). The 24 hour recall was selected as a cost effective and appropriate method of assessing the average intake of a group. A repeat 24 hour recall was conducted on 30% of the adult sample, in order to estimate intra-individual variability for purposes of another report. Intake of vitamin and mineral supplements were not analyzed for this study, however intake of tap water was included in the analysis. Vitamin and mineral supplements were not evaluated since the goal of this study was to evaluate food items only.

A sociodemographic questionnaire was completed at the time of the interview (Appendix E). Questions pertained to the country of origin, language of interview (english, french, other), civil status (single, married/common law, widowed, divorced/separated), birth date, educational level (elementary incomplete, elementary complete, secondary incomplete, secondary complete, technical/ trade school, junior college/CEGEP, University, Post-graduate education), smoking status ($\leq$ 5 cigarettes/day, >5 cigarettes/day), number of adults and children in the household and perceived health status as well as reported height and weight. The level of physical activity and household income was not questionned. The average income per enumeration area was obtained from the 1991 census. The data on income available from the census is an average income for each enumeration area and thus does not necessarily reflect the income of a particular household. For this reason, differences in nutrient intake among income levels was not assessed. Income was only used as a variable to compare smokers and non-smokers. This was done to determine whether factors other than smoking may be influencing differences in nutrient intake between smokers and non-smokers. Educational level was not utilized in the present report, except again to test for differences between smokers and non-smokers. The educational level of an individual 25 years of age may not be equivalent to that of an individual 65 years of age, since younger generations tend to have more years of

schooling. Differences in nutrient intake between country of origin were not evaluated due to the limited number of individuals (13.7% of sample from "other countries") from countries other than Canada.

III. Quality Control of the Data

Quality control procedures included interviewer training as mentioned above to ensure consistency between interviewers. Twenty four hour recalls were also evaluated upon receipt, by the study coordinator, for accuracy. Quality control of data entry was accomplished by double verification of all 24 hour recalls entered into the nutrient analysis program. The first verification was done by the individual entering the respective recall, the second verification was done by a peer who was also trained in data entry. Bimonthly meetings with those entering data and the study coordinator took place during the data entry period to decide on standard procedures to be used for all data entered and to discuss any questions regarding the 24 hour recalls. Each individual entering data had guidelines for methods of data entry and portion size calculation to ensure uniformity of data entry for all recalls.

IV. Data Analysis

1) Rationale for Nutrients Selected for Analysis

Food group contribution to energy and to the following nutrients were evaluated: carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, folate, iron, zinc, calcium, and vitamins A and C. The contributions were evaluated separately by six age-gender groupings (18-34, 35-49, and 50-64 years). Iron and calcium have been identified by several studies to be consumed at levels below the RNI, specifically for women. Results from NHANES III data (1988-1994) showed a 9-11% iron deficiency rate in adolescent girls and women of childbearing age and 2-5% iron deficiency anemia rate in the same age group (Looker et al, 1997). The absorption of iron depends on the source and is estimated to be 40% from heme iron and lower for non-heme sources. It can be as low as 1.5% from spinach (Gibson, 1994). The change in contribution from meat towards breads, cereals and pasta as sources of iron further illustrates the need to assess which foods are

contributing significantly to intakes of both iron and zinc (Nova Scotia Survey, Quebec Survey). The trend towards declining consumption of beef with increasing consumption of poultry (Agriculture Canada, 1990) may further compromise our intake of iron and zinc. Both poultry and beef are indicated as sources of iron and zinc. When comparing equal weights of cooked composite beef and cooked chicken, the chicken contains approximately 40% of the iron and 30% of the zinc content of beef (Brault-Dubuc, Caron-Lahaie, 1994).

Osteoporosis is a health concern which is believed to affect 25-30% of women and 12-15% of men (Dairy Bureau of Canada, 1994). It is known that the intake of calcium is particularly important during the years of bone development in early adolescents up to the age of approximately 25 years (Schaafsma, 1992). Factors other than calcium play a role in the risk of developing osteoporosis such as physical activity, genetics, and other nutritional factors such as protein, alcohol, caffeine, sodium, phosphorous, vitamin D, oxalate and phytate intakes (Schaafsma, 1992). Despite other factors, calcium remains of great importance since adequate intake is needed throughout life and particularly at menopause in order to maintain bone mass. The recommendations for calcium intake have recently come under debate with the development of Dietary Reference Intakes for Canada and the United States (Food and Nutrition Board Institute of Medicine, 1997). The recommended adequate intakes have increased for adolescents and senior adults (National Institute of Nutrition, 1998). This underscores the need to determine how best to encourage increased calcium intake since many women and adolescents will be even further below recommended levels of intake and more individuals will be considered "at risk".

Folate intake in women is another public health issue which has caused changes in dietary fortification of foods in the United States as of January 1998. It has been suggested that women of childbearing age consume 400 micrograms/d of folate in order to decrease the risk of neural tube defects in their offspring (Tucker et al, 1996; Glanville, 1997). Higher dietary folate intake is also linked to lower plasma homocysteine levels which may in turn reduce the risk of atherosclerotic heart disease (Rimm et al, 1998; Glanville, 1997).

The type and quantity of dietary fat has been associated with varying degrees of risk for several disease entities such as cardiovascular disease and cancer. Fat intake has also been associated with comorbidities of diabetes mellitus. The intake of saturated fat, the percentage of energy from fat, and dietary cholesterol all have recommended levels of intake and are some of the key players in the etiology of various disease (Lichtenstein et al, 1998).

Fiber, folate, vitamin C and vitamin A are dietary components that have been postulated as having anticarcinogenic effects (Steinmetz et al, 1996). Increasing total dietary fiber intake by increasing fruit and vegetable consumption as well as whole grain foods is recommended for cancer prevention. Increased fiber intake is recommended for decreasing the risk of cardiovascular disease as well. Other anticarcinogenic nutrients such as selenium, carotenes will not be considered in the present research.

Some nutrients appear in a limited number of food items or data on their presence in foods is incomplete. Among these nutrients are selenium, vitamin E, vitamin D, vitamin K, biotin, folate and caffeine. Other nutrients such as potassium, magnesium, niacin, riboflavin, thiamin and others have not been recently found to be a public health concern for the general population, and therefore will not be evaluated.

2) Food Group Development

The food groupings chosen by the masters student (H.R.) to be evaluated were based in part on previous studies which have grouped foods for analysis of contribution to various nutrients (Brewer et al, 1987; Fanelli et al, 1986; Santé Québec, 1990). For the initial analysis, 123 food groups were created. It is not always desirable to group foods by their nutrient content alone as their contribution depends not only on the nutrient content but on the frequency and quantity of consumption. Forming vegetable and fruit groups according to certain characteristics such as colour or botanical classification provides an alternative method for grouping these foods. Typical vegetable groupings used in other studies were white potatoes, dark green leafy vegetables, dark green non-leafy vegetables, deep yellow vegetables, carrots, tomatoes and finally other vegetables (Fanelli et al, 1986). Other studies used only one group for vegetables (Gorbach et al, 1990; Dolecek et al,

1997; Leaman et al, 1997), and assessed vitamin A contribution of food groups (Borrud et al, 1989; Leaman et al, 1997). This allows little interpretation as to the types of vegetables contributing to vitamin A intake. It is generally accepted that dark green leafy vegetables contain more beta-carotene, more iron and more calcium than other non dark green/orange vegetables. Dark yellow/orange vegetables are a known source of vitamin A as well as folate. For this reason it is important to define more distinct groupings for vegetables.

In order to further divide the vegetable group to allow a clearer analysis of foods contributing within the vegetable group it was decided to use botanical sub-groupings. As a result groups called "other root vegetables" and "other botanical fruits/flowers/sprouts/fungi" and "other green vegetables" form additional vegetable sub-groups (Appendix A). Roots, tubers and bulbs generally have a higher carbohydrate content than other vegetables, much being in the form of starch (Freeland-Graves, Peckham, 1996) and thus have been separated from flowers, sprouts and fungi.

The fruit group has been separated on the basis of citrus and non-citrus fruits as well as by whole fresh fruits, and juices, since differences in vitamin C and fiber contents exist. Canned fruits formed another category since the sugar content is often greater, and to determine whether these types of fruits contribute more or less to nutrient intake compared to fresh fruits. Tomatoes although botanically a fruit were included in the vegetable group along with tomato sauce.

The milk and milk product group was divided mainly by fat and calcium content and type of milk product. The meat and alternatives were kept separate by type of meat and type of alternative. The fat content of meat was more difficult to divide up by group, as respondents did not always know the cut of meat they had. The breads and cereals were divided into different groups by fiber content. All food groupings are found in Appendix A.

Once the initial analysis of the 123 food groups to the nutrient intake of specific age-gender groups was done, the food groups were reduced to form a smaller number of food groups. The decision to reduce food groups was based on the contribution of the initial 123 groups. Groups contributing minimally to nutrient intake were combined together to form larger food groups and groups contributing more to nutrient intake were

kept separate to form a total of 51 groups (Appendix A). The 123 groups were also reduced to form 17 food groups which were similar to those used in the Santé Québec survey, with the addition of a "mixed group" in the present study. The 123 groups provided the necessary detail for specific categories of foods within food groups that were contributing to nutrient intake, while the 51 and 17 food groups provided a more general overview.

3) Nutrient Analysis Program

Candat nutrient analysis program (Godin, 1991) was used for the analysis of all 24 hour recalls. The program had been previously used in two Canadian studies: the Ontario Health Survey and a study with Ontario pre-school children (Leaman et al, 1997). Other Canadian studies used the Candi nutrient analysis program which also contains data for both Canadian and American food items. Technical support is no longer available for the Candi program. Candat contains the most recent Canadian Nutrient File (1997) which consists of 4,668 food items as well as an "institute file". The institute file is an empty file in the program in which the user can enter the nutrient content of food items which do not exist in the master file. A total of 280 food items were added (H.R.) to the institute file using nutrient information obtained from Food Manufacturer's data when possible or from the FoodProcessor or Candi databases. Recent updates to the 1997 Canadian Nutrient file include the addition of 584 food items (Barr et al, 1994). The user has the capability of defining and creating food groupings as desired using the Candat software.

4) Limitations of Nutrient Composition Databases

The Canadian Nutrient File is derived from the USDA Handbook No. 8, with modifications for levels of food fortification in Canada, and the addition of foods found only in Canada. Data available on the nutrient data base is from various sources: academic laboratories, food industry, scientific literature and government agencies (Haytowitz, 1995). Thus the method of analysis may vary from source to source. All data is updated as it becomes available.

Several limitations exist with the nutrient composition data. Some values on the nutrient data base are imputed, or estimated from the nutrient content in other foods, and may not represent the actual content of a particular food item. The amount of nutrient within a food item can vary greatly depending on season, processing, and other factors (Gibson, 1990). Folate variability was estimated to be as much as 100% for some vegetables (Bailey, 1992). The amount of each nutrient identified in the database is not representative of how much will be absorbed by the body. An example of this is heme vs. non-heme iron, heme iron being the form more easily absorbed. The bioavailability of folate also depends on its source. Synthetic folate is better absorbed than non-synthetic forms (Lewis et al, 1999). Thus the folate from fortified foods is better absorbed than the naturally occurring form. Nutrients such as folate, vitamin C and others are lost in cooking (Bailey, 1992). The analytical methods, particularly for folate, carotenoids, vitamins A, C, B-6 and B-12 are imperfect. The present microbial assays used for the determination of folate content of food items are deemed "unsatisfactory" in that they do not measure all active forms of folate and often evaluate only free rather than total folate content (Gibson, 1990; Bailey, 1992). As a result, the folate content of foods is underestimated. A recent change to fortification in the United States (since 1998), is the mandatory addition of folate to flour, presently in Canada the addition remains optional. These changes would not be reflected in the 1997 Canadian Nutrient file and may cause further underestimation of folate intake. The level of nutrient addition to food items may vary from one manufacturer to another and the exact brand name of foods consumed by subjects is not always known. Despite these limitations, the Canadian Nutrient File is presently the best database available for such a large survey. One must keep the inherent limitations of food composition data in mind when using results from nutrition surveys.

5) Statistical Analysis

The mean nutrient intakes by age-gender groups were calculated both in absolute amounts and per 1000 kcal of energy intake. The correlations between energy, calcium, iron, and folate were evaluated.

The percent contribution of each food group (123 groups) and each collapsed group (17 and 51 groups) to the intake of selected nutrients was determined by age and gender groups.

A t-test was used to determine significant differences in mean nutrient intake of energy, carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, calcium, iron, zinc, folate, vitamin A, and vitamin C between smokers and non-smokers ($p < 0.05$). The percent contributions of 51 and 123 food groups were evaluated for nutrients where mean intakes were significantly different between smokers and non-smokers.

The percent contribution of 51 food groups to nutrient intake in individuals meeting the RNI for calcium, iron, and folate on a given day and those not meeting the RNI was calculated. The mean differences in absolute and per 1000 kcal of energy intake of other nutrients was evaluated to determine whether differences in calcium, iron and folate intakes were due to differences in energy intake and whether differences in other nutrient intakes existed.

One must recognize the limitations of using the mean values when utilizing the results from dietary studies. It is known that the mean can be infleunced by outlying values.

V. Ethics

Ethical approval was obtained from the ethics committee of McGill University. Each subject in the study gave consent by signing a letter describing the study.

CHAPTER 4: RESULTS AND DISCUSSION

A recent evaluation of the energy and nutrient intake of the Canadian population as a whole is not available. Due to the amount of time, approximately 30 years, which has passed since the first national nutrition survey, we can no longer rely on the information provided by that survey to reflect the present day intake of the Canadian population. The provincial surveys which have been completed provide interesting yet province specific information on dietary intake. Most of the provinces have yet to publish results, and thus, only part of the whole national picture on current dietary intake exists. In addition to providing information on the mean intake of specific age and gender groups in the population, it is of interest to determine specific food group contribution to nutrients of interest in the public health domain. This enables one to determine which foods are important contributors to the nutrient intake of the population. Food group contributions provide information on food trends and potential avenues for food fortification. This type of information is of importance to practitioners in the field of nutrition as well as to individuals working on public health issues and policies.

Previous American and Canadian studies have presented the contribution of a limited number of larger food groups. This results in a lack of specific information such as the type of fluid milk or type of dairy product contributing the most to calcium intake, and whether poultry or ground beef contributes more to protein intake. Information as to whether calcium enriched fruit juices for example contribute to the calcium intake of Americans or Canadians is also lacking. The advantage of showing the contribution of larger food groups such as milk products, meat and alternatives, and fruits and vegetables to nutrient intake is to demonstrate the overall contribution of these groups to energy, macro and micronutrient intake. This allows one to asses the contribution of foods on a more global level and to compare present findings with past surveys which have used similar food groupings. The advantage of dividing food groups down into smaller categories such as dividing cheeses into higher fat and lower fat groups, breaking a general meat group into poultry, ground beef, other beef cuts and so on, is to present a more detailed picture of the foods contributing to nutrient intakes. With more specific food

groupings, one can see whether present food intake reflects the trends seen in the Food Consumption and Expenditure surveys (Agriculture Canada, 1991), and whether there are differences in the types of foods consumed by different age and gender groups in the population. It is important to provide both a global and more specific picture of the foods contributing to nutrient intake. For this reason, the food group contribution using 17, 51, and 123 food groups to the energy and nutrient intake of adults will be presented using data from the 1997-98 Food Habits of Canadians survey.

The nutrients chosen for evaluation were energy, carbohydrate, protein, total fat, saturated fat, fiber, cholesterol, and micronutrients of specific interest in the public health domain. The contribution of food groups to macronutrient intake will help to describe main food groups contributing to energy intake. The micronutrients chosen for evaluation were calcium, iron, folate, zinc, vitamin A and vitamin C. As previously mentioned, calcium, iron, zinc, and vitamin A have been identified as being potential problem nutrients in past surveys, particularly for women. Folate is of public health interest since the recommended intake surpasses the mean intake of women of childbearing age and there is discussion of folate fortification of foods. The mean vitamin C intake exceeds recommended intakes and thus is not a concern, however, its antioxidant potential makes it a nutrient of interest.

The results and discussion section will commence with a sociodemographic description of the adult subjects from the 1997-98 Food Habits of Canadians survey and a comparison to the Canadian population. This description will be followed by an evaluation of the present day mean nutrient intake (absolute and per 1000 kcal) of Canadian males and females aged 18-65 years. A description and discussion of the contribution of 17, 51, and 123 food groups to the nutrient intake of males and females 18-65 years will follow. The next section will be an evaluation of the differences in the mean nutrient intake of smokers and non-smokers and the resulting differences in food group contribution to nutrient intake. Finally, calcium, iron and folate, will be discussed by comparing individuals meeting the RNI for each nutrient on a given day to those not meeting the RNI. The differences in contribution of 51 food groups will be presented and discussed.

I. Sociodemographic Description of Survey Respondents from the 1997-98 Food Habits of Canadians Survey

1) Comparison of Respondent Sociodemographic Characteristics to Sociodemographic Characteristics of the Canadian Population

A sample of 1,721 Canadians age 13-65 years was interviewed during 1997-98. Of this sample, 1,543 were adults aged 18-65 years. The data from these subjects were used for the present analysis and results. Several factors including age, country of origin, educational level, and smoking status can affect food choice. For this reason, questions relating to these factors were included on a sociodemographic questionnaire used during the interview (Appendix E). The comparison of results from this sociodemographic questionnaire to 1991 census information was done in order to determine the similarities between the recruited subjects and the Canadian population. Younger individuals from the 18-34 year age group are more difficult to recruit. As a result, the proportion of males and females in the 18-34 year age group was lower (21.2-21.9%), than the proportion in the Canadian population (43.4-48.4%). The proportion of individuals sampled in the 35-49 year age group was higher (46.5-47.3% vs. 31.1-34.4%), and those in the 50-65 year age group lower (20.5-22.1% vs. 31.5-31.6%) than the proportions in the Canadian population. The country of origin can have an impact on food habits, and types of foods consumed. The sample of individuals obtained for this study was comparable to the Canadian population in terms of place of birth. In the sample, 84.3% of males 18-65 years and 86.2% of females 18-65 years were born in Canada, compared to 84.1% overall for the Canadian population. The educational level of the Canadian population overall was lower than the educational level of respondents sampled. Ten to twelve percent of respondents "did not complete high school" compared to 26.3% in the Canadian population. The number of individuals who "completed college/university" was greater (39.9-46.9% % of respondents vs. 27.9% of Canadian population). These differences may be due to the fact that the sample included only individuals 18-65 years of age, whereas the census data included individuals younger than 18 years of age. The addition of younger individuals causes the educational level to become lower. The proportion of smokers in

the sample was slightly lower than the proportion existing in Canada (18.6-22.2% vs. 25-28%). Despite some differences in sociodemographic status between the sample and the Canadian population, the study sample still provided a variety of individuals from across the country.

2) Dietary Intake of Canadian Adults Aged 18-65 years

The mean energy and nutrient intake for males is presented in Table 7 and for females in Table 8. Mean protein, calcium, iron, folate, zinc, vitamin A and vitamin C intakes were compared to the Recommended Nutrient Intake (RNI) for each age-gender group (Tables 7 & 8).

Mean intakes of protein, vitamin A, vitamin C, folate, calcium, iron and zinc exceed the RNI for all age-gender groups with the exception of calcium (746 mg) which was below the RNI for women 50-65 years of age (Table 8).

The mean intake of iron in women 18-49 years of age was borderline (13.2-13.8 mg), as was the mean intake of zinc for men and women 50-65 years of age (Tables 7 & 8). These results demonstrate that calcium and iron continue to be potential problem nutrients for women only. Mean vitamin A and folate intakes, which have been previously identified as potential problem nutrients, met the RNIs. Mean folate intake in women of childbearing age, however, was only approximately half (224-241 mcg) of what is suggested to avoid potential malformations of the fetus. The mean intake may actually be lower due to limitations in food composition data.

Table 7: Mean Nutrient Intakes and Recommended Nutrient Intakes (RNI) for Canadian Males Aged 18-65 yrs (Health and Welfare Canada, 1990)

	Males					
Age	**18-34**		**35-49**		**50-65**	
N	**125**		**266**		**181**	
	Mean Intake	**RNI**	**Mean Intake**	**RNI**	**Mean Intake**	**RNI**
Nutrients						
Energy (kcal)	3066		2653		2289	
Carbohydrate (g)	391		338		283	
% Total energy carbohydrate	51.0		51.0		49.5	
Protein (g)	130	58-64	111	64	96.0	63
% Total energy protein	17.0		16.7		16.8	
Fat (g)	103		91.2		81.0	
% Total energy fat	30.2		30.9		31.8	
Saturated fat (g)	36.5		28.7		25.2	
% Total energy saturated fat	10.7		9.74		9.91	
Cholesterol (mg)	375		326		309	
Total fiber (g)	17.3		18.0		16.6	
Vitamin A (RE)	1491	1000	1464	1000	1429	1000
Vitamin C (mg)	199	40	151	40	135	40
Folacin (mcg)	335	220-230	304	230	293	230
Calcium (mg)	1307	800-900 (AI=1000)	975	800 (AI=1000)	869	800 (AI= 1200)
Iron (mg)	21.8	9-10	18.6	9	16.9	9
Zinc (mg)	17.0	12	15.3	12	12.5	12

AI= Adequate intake according to Dietary Reference Intakes (Food & Nutrition Board Institute of Medicine, 1997)

Table 6: Mean Nutrient Intakes and Recommended Nutrient Intakes (RNI) for Canadian Females Aged 18-65 yrs (Health and Welfare Canada, 1990)

	Females					
Age	**18-34**		**35-49**		**50-65**	
N	**286**		**459**		**306**	
	Mean Intake	**RNI**	**Mean Intake**	**RNI**	**Mean Intake**	**RNI**
Nutrients						
Energy (kcal)	1938		1819		1687	
Carbohydrate (g)	265		237		227	
% Total energy carbohydrate	54.7		52.1		53.8	
Protein (g)	75.6	47-51	75.7	51	70.9	54
% Total energy protein	15.6		16.6		16.8	
Fat (g)	64.2		62.2		55.5	
% Total energy fat	29.8		30.8		29.6	
Saturated fat (g)	21.4		20.3		18.0	
% Total energy saturated fat	9.94		10.0		9.60	
Cholesterol (mg)	215		222		212	
Total fiber (g)	12.9		14.0		14.9	
Vitamin A (RE)	1056	800	1181	800	1275	800
Vitamin C (mg)	134	30	133	30	138	30
Folacin (mcg)	224	180-190	241	185	246	195
Calcium (mg)	813	700 (AI= 1000)	787	700 (AI= 1000)	746	800 (AI= 1200)
Iron (mg)	13.8	12-13	13.2	13	13.0	8
Zinc (mg)	10.5	9	10.3	9	9.69	9

AI= Adequate intake according to Dietary Reference Intakes (Food & Nutrition Board Institute of Medicine, 1997)

Mean intakes of carbohydrate, protein and total fat as a percentage of energy were close to the recommended levels (Health and Welfare Canada, 1990). The mean intake of fat as a percentage of energy intake was 29.6-30.8% for females and 30.2-31.8% for males 18-65 years. The percent of energy coming from fat and saturated fat has been decreasing over the years (Health and Welfare Canada, 1977; Santé Québec, 1990). The mean cholesterol intake has decreased over the years as well, but remains above the recommended 300 mg/d for men 18-65 years (309-375 mg). Adult women 18-65 years of age continue to consume cholesterol levels within the recommended range (212-222 mg).

Trends of nutrient intake in women showed a decrease in absolute energy, calcium, iron and zinc intakes with age (Table 8). Fiber, vitamin A, vitamin C and folate tended to increase with age. For men, mean energy, total fiber, vitamin A, vitamin C, folate, calcium, iron and zinc tended to decrease with age (Table 7). The increase of fiber, vitamin A, vitamin C, and folate intake may reflect an increase in fruit and vegetable intake in the older female. Food group sources of nutrient intake will help to verify this. A decrease in nutrient intake is often the result of a decreased energy intake. Nutrient densities help to determine whether differences in intake between age-gender groups are due to differences in the quantity or in the types of foods eaten (Table 9).

In the present study, only carbohydrate, vitamin C and calcium per 1000 kcal tended to decrease with age in men. Other macro and micronutrients were either similar among age groups or increased slightly with age. Most nutrient densities evaluated increased with age in women, except carbohydrate, total fat, and saturated fat. Despite a decrease in energy intake with age, it appears that older individuals maintain similar patterns of micronutrient intake as younger adults. These findings are similar to Santé Québec findings and show the probable effect that appropriate food choices can have on nutrient intake.

Table 2: Mean Nutrient Intake per 1000 kcal for Canadian Males and Females Aged 18-65 yrs						
	Males			Females		
Age	18-34	35-49	50-65	18-34	35-49	50-65
N	125	266	181	286	459	306
	Intake/ 1000 kcal			Intake/ 1000 kcal		
Nutrients						
Carbohydrate (g)	128	127	124	137	130	135
Protein (g)	42.4	41.8	41.9	39.0	41.6	42.0
Fat (g)	33.6	34.4	35.4	33.1	34.2	32.9
Saturated fat (g)	11.9	10.8	11.0	11.0	11.2	10.7
Cholesterol (mg)	122	123	135	111	122	126
Total fiber (g)	5.64	6.78	7.25	6.66	7.70	8.83
Vitamin A (RE)	486	552	624	545	649	756
Vitamin C (mg)	64.9	56.9	59.0	69.1	73.1	81.8
Folacin (mcg)	109	115	128	116	132	146
Calcium (mg)	426	368	380	420	433	442
Iron (mg)	7.11	7.01	7.38	7.12	7.26	7.71
Zinc (mg)	5.54	5.77	5.46	5.42	5.66	5.74

II. Food Group Contribution to Nutrient Intake

1) Contribution of 17 Collapsed Food Groups to the Nutrient Intake of Males and Females 18-65 years Combined

The food group contribution to nutrient intake of 17 collapsed food groups is outlined in graph format for males and females 18-65 years of age combined (Figures 1-13 Appendix B). The 17 food groups are similar to the 16 groups used in the Santé Québec survey except for the addition of a mixed dish group. In the Santé Québec survey, combined foods were broken down into individual components, while in the present study some combination foods such as hamburgers, for example, were left as a mixed dish

including meat and bread. Differences in data entry may explain some of the differences in food group contribution to nutrient intake in the present survey compared to Santé Québec findings. As an example, the total percent contribution of meats to protein intake was lower (39% vs. 45.6%) compared the Santé Québec survey. The addition of a mixed dish group displaced other groups, slightly changing the order of contribution of food groups. As an example, the mixed dish group became the third contributor to protein intake instead of milk which became the fourth contributor in the present survey.

The predominant source of energy (19.1%), carbohydrate (28.4%), fiber (33.2%), and iron (34.2%) in the present survey was the bread/cereal/pasta/grain group (Figures 1, 2, 7 & 10 Appendix B). Without detailed food groups it was impossible to determine whether whole grain breads and cereals contributed more to fiber intake compared with refined breads and cereals. Foods which are less nutrient dense such as cakes/pies, coffee/tea/fruit drinks, alcohol and candies/chocolate combined contributed close to a quarter (20.7%) of the mean energy intake in adult men and women (Figure 1 Appendix B). All of these groups, except cakes/pies, contributed minimally to the intake of micronutrients evaluated in this study. Empty calorie foods provide an additional risk of excess energy intake and of inadequate micronutrient intake. Cakes/pies contributed a relatively small amount (7.5%) to the mean iron intake, but contributed a considerable amount to fat intake (10.6%).

The leading source of protein (39%), total fat (20.9%), saturated fat (22%), cholesterol (40.4%), and zinc (35.5%) was the meat/fish/poultry group (Figures 3-6 & 11 Appendix B). Meat alternatives, such as legumes, although recommended as a higher fiber, lower fat protein source contributed very little (2.3% which included nuts/seeds) to the mean protein intake of men and women 18-65 years of age. Ironically, legumes/nuts/seeds contributed a similar proportion (4.8%) to fiber intake as cakes/pies (4.1%). One would think that legumes would contribute a greater amount to fiber intake since they are generally higher in fiber content than cakes/pies. It appears that public acceptance of higher fiber protein alternatives such as legumes is not widespread since their percent contribution to fiber intake is similar to that of cakes/pies.

Milk products are sometimes wrongly avoided for fear of increasing fat intake. Cakes/pies, although not the main contributor to energy, total fat, and cholesterol, provided a comparable or greater amount of these nutrients compared to other more nutrient dense food groups such as milk/yogourt and cheese. The contribution of fluid milk and yogourt to total fat intake was only 5.1% whereas the contribution of cakes/pies was 10.6%. Public awareness should thus focus more on avoiding higher fat dessert items rather than milk products which also contribute essential nutrients such as calcium and vitamin D.

The first contributor to calcium (36%) was the milk/yogourt group. The importance of milk products as a source of calcium is emphasized since 49.7% of calcium was obtained from milk, yogourt, and cheese combined. Without these sources of calcium, the mean intake of calcium would have been 430 mg/d compared to an actual mean of 866 mg/d. Vegetable contribution to mean calcium consumption was only 6.6% (Figure 8 Appendix B). Broccoli is sometimes suggested as an alternative calcium source for individuals to increase calcium intake. Due to the small contribution of vegetables as a calcium source in the Canadian diet, suggesting these foods to the general population as a means of increasing the mean calcium intake would not be effective. Higher levels of calcium intake are proposed in the Dietary Reference Intakes, recently published by a joint Canada/United States committee (Food and Nutrition Board Institute of Medicine, 1997). Without the consumption of milk products, obtaining a greater intake of calcium will be difficult.

The first contributor to mean folate (28.3%) and vitamin A (54.4%) intake was the vegetable group. Using only 17 food groups, one cannot determine whether the population was obtaining these nutrients from dark green leafy vegetables and dark yellow/orange vegetables, which are typically high in folate and in vitamin A. More detailed food groupings helped to clarify these questions (see section II, 3). The importance of vegetables as a source of pro-vitamin A intake became clearer when considering the amount of this vitamin, in the form of carotenes, that was provided by this food group. The potential antioxidant effect of carotenes further emphasizes the importance of adequate vegetable consumption. Without vegetable intake the mean

vitamin A consumption would have dropped from 1286 RE to 586 RE, and subgroups of the population, such as smokers, may be at greater risk for low vitamin A intakes since they are known to consume fewer vegetables (Subar et al, 1990).

Lastly, the main contributor to vitamin C (54.1%) intake was the fruit/fruit juice group. Other potential sources such as fruit "drinks" provided only 7.4% of mean vitamin C intake when combined with coffee/tea (Figure 13 Appendix B). Due to the lack of information one could not determine whether the main contributors to vitamin C were whole fruit, or as would be more likely, fruit juices.

The primary food group contributor of energy, and of all other nutrients mentioned above was identical to those found in the Santé Québec survey, with some differences in the percent contribution.

2) Contribution of 51 Collapsed and 123 Food Groups to the Energy, Carbohydrate, Protein, Total Fat, Saturated Fat, Cholesterol, and Fiber Intake of Males and Females 18-65 years

In order to better understand the contribution of more detailed food groups, the contribution of 123 specific food groups was evaluated for males and females 18-65 years of age. The collapsed groups, totaling 51 in number, provided more general information (Figures 14-39 Appendix C). The figures present the contribution of 51 food groups to the mean energy, carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, calcium, folate, iron, zinc, vitamin A and vitamin C intake for men 18-65 years of age and women 18-65 years separately. Tables 10 and 11 (Appendix D) present the food group contribution of 123 food groups to the mean nutrient intake (for all nutrients specified above) for age-gender groups. In order to avoid lengthy tables, only the food groups contributing the most to each nutrient are shown. Food groups were listed in descending order, according to percent contribution to each specific nutrient, until 50% of the mean nutrient intake was reached. The remaining food groups were not included.

The contribution of "empty calorie" foods is important to consider when evaluating dietary intake. These foods tended to contribute to energy intake but contributed less to micronutrient intake. One study by Kant et al. (1994) found that as

much as one third of energy intake was due to "other foods" in individuals sampled for the NHANES II survey. These authors also found that individuals consuming more foods from the "other food" group were more likely to exclude one of the 5 main food groups (meat, dairy, grain, fruit, vegetable). In the current survey, empty calorie food groups which appeared on the top contributor list (using 123 groups) were carbonated beverages, cakes/cookies, pies/pastries, and salty snacks, none of which appeared as top contributors to the mean intakes of calcium, zinc, vitamin A or vitamin C (Tables 10 & 11 Appendix D). The energy contribution of foods which would fall under the "other foods" category of the Canada's Food Guide to Healthy Eating (cakes/pies/cookies, margarines/oils/salad dressings/mayonnaise/butter, carbonated beverages, alcohol, candies/chocolate, salty snacks, sugar/syrups/gelatins/cocoa mixes) approached 25% of the mean energy intake in both men (23.2% of mean energy) and women (21.8% of mean energy) 18-65 years of age (Figures 14 & 27 Appendix C). The cakes/cookies group was one exception to a typical "empty calorie" food in that, as seen previously, it contributed to the iron intake in both males and females due to the addition of iron to flour.

Similarities between males and females 18-65 years of age existed in the top contributors to energy and carbohydrate intake. When evaluating the contribution of 51 food groups to the energy intake of males and females 18-65 years of age (Figures 14 & 27 Appendix C), the order of the top 5 food groups was identical for both males and females. The top 5 contributors to energy intake appeared in the following order; 1) breads, 2) cakes/pies/cookies/granola bars, 3) pasta/rice/grain, 4) milk/chocolate milk, and 5) beef/veal. Some other differences, however, did exist between genders. Differences included the higher contribution of both alcohol and carbonated beverages to energy intake in men (Figure 14 Appendix C; Table 10 Appendix D). The intake of alcohol was primarily in the form of beer and was highest in males 18-34 years (2.88% of energy; Table 10 Appendix D). Differences related to age also existed in the contribution of food groups. The contribution of carbonated beverages to energy and carbohydrate intake decreased with age in both males (5.02-1.97% and 10.0-4.06% respectively) and females (3.64-1.68% and 6.75-3.19% respectively) (Tables 10 & 11 Appendix D). Fruit drinks/juice drinks contributed more to the energy and carbohydrate intake in younger

males and females 18-34 years, as did fried potatoes, pizza, and hamburgers/cheeseburgers. Sugars/jams/syrups contributed more energy (1.98% for females, 2.52% for males) and carbohydrate (3.86% for females, 5.34% for males) in the older age group 50-65 years. The contribution of fruit, particularly non-orange non-citrus fruit (3.32% to 6.26% for females, 2.71% to 4.88% for males), to carbohydrate intake increased with age as the contribution of other foods such as sweetened carbonated beverages decreased (Tables 10 & 11 Appendix D).

The contribution of meats to mean protein intake in the present study was slightly higher in males compared to females who obtained slightly more protein from cheeses (5.3% vs. 4.5%) and milk (9.4% vs 8.6%) (Figures 16 & 29 Appendix C). Among other main differences in protein contributors between males and females was the higher contribution of poultry (13% vs 11.8%), mainly chicken, compared to beef/veal (11.7% vs. 13.8% in females) (Figures 16 & 29 Appendix C). When the contribution of smaller groups of meat was evaluated (using 123 food groups), chicken was the primary contributor to protein intake in men and women of all ages (Tables 10 & 11 Appendix D). Other beef cuts contributed more to protein than ground beef in all age-gender groups; ground beef, however, did not include hamburgers/cheeseburgers and mixed dishes. When considering chicken (including mixed chicken dishes) and beef (including hamburgers, ground beef, other beef cuts and mixed beef dishes), chicken as a whole contributed more to the protein intake than beef in women, while the opposite was true for men (data not shown). The trend of increased consumption of chicken and cheese and decreased consumption of beef over time, as shown by Food Consumption Trend reports, was reflected in the present data particularly for women (Danielson et al, 1984). Differences between age groups were shown by the greater contribution of pizza, mixed dishes and high fat natural cheese to the protein intake of younger men and women, and the higher contribution of lunchmeats in men 50-65 years and turkey in women 50-65 years (Tables 10 & 11 Appendix D).

The mean intake of total fat was primarily due to cakes/cookies/pies/granola bars for women 18-65 years (8.2% of total fat), and to beef/veal in men 18-65 years (8.1% of total fat) when 51 food groups were considered (Figures 17 & 30 Appendix C). The

"empty calorie" cake group contributed greatly to energy and total fat intake in both adult men and women. The cake/pie/cookie/granola bar contributed more as a group than other high fat foods such as sausages/lunchmeats/bacon (6.7% of total fat in males, 4.6% of total fat in females) when considering 51 food groups (Figures 17 & 30 Appendix C). When evaluating 123 food groups by age and gender, beef, which is often feared as a source of fat in the diet, provided a lower contribution to fat intake compared with high fat natural cheeses and cakes/cookies (Tables 10 & 11 Appendix D). It is of interest to note that while meats contributed to the total fat intake, they also made a high contribution to important micronutrients such as iron and zinc compared to cakes/pies/cookies/granola bars (Figures 23-24 & 36-37 Appendix C, Tables 10 & 11 Appendix D) with the exception of females 50-65 years who had a higher contribution of iron from the cake group. These results show that it is important to encourage the population to consume lean meats as a good source of iron, and moderate the use of cakes/pies/cookies/granola bars, to limit total fat intake. Health concerns related to beef must be kept in perspective and the general population should be made aware of the impact this food group has in providing adequate levels of iron and zinc in their diets. Decreasing risks for heart disease is a public health issue where the type of fat eaten plays a key role. In the present survey, soft margarines contributed more to fat intake than butter, oils and salad dressings for all age-gender groups except women 35-49 years where oils contributed more (Tables 10 & 11 Appendix D). The decreasing consumption of animal fats is a trend also demonstrated in the Per Capita Food Consumption surveys (Danielson et al, 1984). There remains concern with the use of some margarines due to their content of trans fatty acids. The use of oils and/or non-hydrogenated margarines offer an alternative. The present study does not allow for the evaluation of the amount of hydrogenated vs. non-hydrogenated fat intake.

The primary contributor to cholesterol was the eggs group (16.3-16.6% of cholesterol) in males and females 18-65 years when considering 51 collapsed food groups (Figures 19 & 32 Appendix C). This group included boiled and fried eggs as well as egg substitute. Poultry (11.8-13.1% of cholesterol) and beef/veal (10.9-12.0% of cholesterol) fell close behind, with poultry contributing more than beef in women 18-65 years of age (Figures 19 & 32 Appendix C). Differences in the type of egg contributing to cholesterol

intake among age and gender groups were seen. A greater contribution to cholesterol intake from fried eggs compared to boiled eggs (7.41% vs. 5.87%) was observed in males 18-34 years (Table 10 Appendix D). In other age-gender groups, boiled eggs contributed a greater amount to the mean cholesterol intake. Organ meats only contributed 1.5-1.8% to cholesterol intake in all men and women 18-65 years, despite being a high source of cholesterol (Figures 19 & 32 Appendix C). Organ meat contribution increased slightly with age in men and women, with the exception of women 50-65 years of age who had lower intakes. Despite this overall increase with age, organ meats were not among the top food contributors to the mean cholesterol intake for any age-gender groups (except men aged 50-65 years) (Tables 10 & 11 Appendix D). This is most likely a result of the infrequent consumption of organ meats. Higher cholesterol foods such as organ meats, shellfish and eggs are often feared and avoided by individuals due to their perceived contribution to high serum cholesterol levels and heart disease (National Institute of Nutrition, 1997). The contribution of more commonly eaten foods such as chicken, beef, pork, and higher fat cheeses was much greater than that of organ meats. The decrease in egg intake shown in food consumption trends reflects the decrease in their contribution to cholesterol intake in the present study (20.7-21.2% of cholesterol) compared to the Nutrition Canada survey (35% of cholesterol from eggs). The change in serum cholesterol levels is a result of several factors such as obesity, dietary saturated fat, and to a smaller extent dietary cholesterol intake (Grundy, 1990). These facts demonstrate that eggs, even if they are the most important source of cholesterol, can continue to be incorporated in moderation into a healthy diet for most individuals.

The primary source of dietary fiber in men and women was the breads group, mainly due to whole grain yeast breads (8.45-16.0% of fiber) in all age-gender groups (Figures 20 & 33 Appendix C; Tables 10 & 11 Appendix D). This was expected after looking at Santé Québec results. There has been a shift in fiber sources since the 1970's when vegetables were the primary contributor to fiber intake (Santé Québec, 1990). An unlikely contributor to the top 50% of mean fiber intake was the salty snacks group, which contributed 3.93-5.58% of fiber in females 18-49 years, and 4.0% in males 35-49 years of age (Tables 10 & 11 Appendix D). Although salty snacks are typically lower in fiber than

many other foods, their contribution was due most likely to the frequency of consumption. Interestingly, salty snacks contributed more to fiber intake than refined yeast breads in women 18-49 years of age (Table 11 Appendix D). The contribution of whole grain yeast breads and non-orange non-citrus fruits increased with age in both genders (except for a slight decrease in older men). This trend paralleled the decreasing contribution of low fiber cold cereals and preference for high fiber cold cereals as men and women age (Tables 10 & 11 Appendix D). These changes may reflect the greater perceived importance of high fiber foods in the diets of individuals as they age, or an overall decrease in food consumption leading to shifts in the contribution of specific foods. The message to consume higher fiber food items needs to be encouraged among younger individuals.

3) Contribution of 51 Collapsed and 123 Food Groups to the Intake of Calcium, Iron, Zinc, Folate, Vitamin A, and Vitamin C in Males and Females 18-65 years

The percent food group contributions of 51 and 123 food groups were evaluated for calcium, iron, zinc, folate, vitamin A, and vitamin C. The results using 51 food groups for males and females 18-65 years are presented in Figures 21-26 & 34-39 (Appendix C). The percent contribution of the top contributors to mean calcium, iron, zinc, and folate intakes among 123 food groups are presented in Tables 10 and 11 (Appendix D).

As expected, milk/chocolate milk was the highest contributor to calcium intake in men (33.8%) and women (32.4%) 18-65 years of age when using 51 food groups (Figures 21 & 34 Appendix C). Fluid milk has a high concentration of calcium compared to other potential sources of calcium. Fluid milk and milk beverages have been the primary contributors to calcium intake in previous studies where milk and milk products were separated into subgroups such as fluid milk, cheeses and yogourts (Batcher et al, 1984; Block et al, 1985). The primary contributor to calcium intake in the present study was similar for all age-gender groups when considering 123 food groups. The calcium contribution was primarily from 2% milk in all age-gender groups, except males 18-34 years and females 35-49 years where high fat natural cheeses were the primary sources (Tables 10 & 11 Appendix D). The contribution from fluid milk alone came primarily from 2% milk, followed by 1%, skim, then whole milk. The exception to this was men and

women 50-65 years, where the order of contribution was 2% milk followed by skim, 1%, then whole milk (Tables 10 & 11 Appendix D). Among differences in calcium sources between genders was the contribution of water (2.53-2.97% of calcium) to the top 50% of mean calcium intake in women 18-65 years only (Table 11 Appendix D). The contribution of water may be a result of the default in data entry. Water which was not obviously from the tap or fountain was entered as mineral water which contains more calcium than tap water (Godin, 1991). It was also observed that many individuals had a considerable intake of tap water, often up to 1-2 liters per day which resulted in a calcium intake of 20-40 mg/d. The contribution of water was 2.53-2.97% of mean calcium intake (787-813 mg/d) which is equivalent to a calcium intake of 21-23 mg (Tables 10 & 11 Appendix D).

These results showed a shift away from higher to lower fat fluid milk choices, which was also contributing to the decrease in percentage of energy coming from fat in recent, compared to earlier nutrition surveys (Santé Québec, 1990; Health and Welfare Canada, 1977). In the NHANES II survey, whole milk was the primary calcium contributor, followed by 2% and then skim milk (Block et al, 1985). The order of contribution of different milk products in the present survey was fluid milk/chocolate milk, cheese, then yogourts for women and ice-creams/puddings for men (Figures 21 & 34 Appendix C). Higher fat cheeses contributed more to calcium intake than lower fat cheeses, and processed cheese contributed less than natural cheese. Yogourts had a minimal contribution (1.6-4.1% of calcium in men and women respectively) to mean calcium intake despite being a good source of calcium. The minimal contribution is presumably due to a lower consumption of yogourt. Refined yeast breads which are generally a poor calcium source contributed due to the frequency and quantity of intake (Figures 21 & 34 Appendix C). Lower fat yogourts (<1% m.f.) tended to contribute more than higher fat yogourts in men and women 18-65 combined (data not shown). Calcium enriched milk, although relatively new on the market, had a negligible contribution to calcium intake as a whole. The 51 and 123 food groups provided more detail as to the type of milk product contributing to calcium intake compared to the previous analysis using 17 food groups. The evaluation of detailed food groupings supports the need for including fluid milk in the diet in order to obtain adequate amounts of calcium. The

findings from the present study also support the fact that milk products can be included in the diet without exceeding the recommended level of fat as a percentage of energy. These facts need to be emphasized to the general population to avoid misinformation and to encourage adequate calcium intake to maintain bone health. Further changes which could be recommended are a switch from higher fat to lower fat cheeses. These suggestions are often difficult to implement as lower fat cheeses are often less palatable than higher fat varieties, and the selection of lower fat cheeses is often limited.

Iron is another nutrient which was consumed in quantities above the RNI by men of all ages but is often a potential problem nutrient for women 18-49 years of age who have mean intakes often scarcely meeting the RNI (Santé Québec, 1990; Nova Scotia Department of Health, 1993). It is known that breads and cereals are the greatest contributors to iron intake in all individuals (Santé Québec, 1990; Block et al, 1985; Health and Welfare Canada, 1977, Batcher et al, 1984). The same was found to be true in the present study (Figures 23 & 36 Appendix C) where breads and cereals, combined, provided 31.3% of the mean iron intake in men and women 18-65 years of age. Differences in sources of iron were found between gender groups. In the present study, women had a higher percent contribution of non-heme sources of iron, which are more poorly absorbed, compared to heme sources. Women may therefore be at greater risk not only due to borderline mean intakes, but also due to the poorer quality of iron in their diets. Meat/fish/poultry contributed 14.3% (1.89 mg of iron) in females and 16.2% (3.03 mg iron) in males. The contribution of mixed dishes which contained meat, was also lower in females (Figures 23 & 36 Appendix C). The contribution of typical non-heme iron sources such as lettuce/cabbages/greens was 1.2% (0.22 mg iron) in men and 2.4% (0.32 mg of iron) of mean iron intake in women (Figures 23 & 36 Appendix C). The dark green leafy vegetables often recommended as an iron source contributed minimally to the overall iron intake in both adult men and women. It is of interest to note that when all vegetables were considered together, their percent contribution to iron intake was higher in women (13.6% of iron) than men (10.8% of iron). The absolute iron contribution from vegetables was, however, lower in women (1.80 mg iron) than men (2.02 mg iron) due to their lower mean intake of iron (Figures 23 & 26 Appendix C).

Differences in iron sources between age groups were evaluated in the present study. Younger individuals obtained a greater percent contribution to iron from low fiber cold cereals (10.4% males, 11.2% females) compared to older adults who obtained more from refined yeast breads (10.4% males, 8.92% females) (Tables 10 & 11 Appendix D). Younger adults also obtained a greater percent of iron from hamburgers/cheeseburgers (2.25-2.89% of iron) than adults 35-65 years of age (Tables 10 & 11 Appendix D). In individuals 35-65 years of age, coffee/tea was found to be an alternative source of iron (1.94-2.50% of iron or 0.32-0.41 mg of iron). The contribution of coffee/tea was not due to the high iron content of these items but rather the frequency and volume of intake. The mean amount of iron (mg) that coffee/tea contributed was equivalent to the amount of iron in 2.5-3 cups of coffee or 6.5-8 cups of brewed tea (Brault-Dubuc, Caron-Lahaie, 1994). Due to the relatively large amount of coffee/tea intake this group contributed to the mean iron intake in some age groups. Coffee and tea were found to have a greater percent contribution (4.05% of iron) in the evaluation of NHANES II data by Block et al. (1984). Differences in the contribution of other food items in younger individuals compared to the older adult generally reflect the differences in food choices between age groups.

Zinc has previously been identified as a potential problem nutrient in the Santé Québec survey for women 65-74 years of age and in the NHANES III survey for both men and women (Santé Québec, 1990; Alaimo et al, 1994). This age group was not included in the present survey but identifying sources of zinc in younger age groups may help to promote acceptable foods to the older Canadian population. Zinc intake in the diet was mainly due to meats/fish/poultry as identified in the present study and previous NHANES II data (Figure 11 Appendix B; Mares-Perlman et al, 1995). Other beef cuts (excluding ground beef, hamburgers and mixed dishes) were the primary contributor of zinc in all age-gender groups (8.86-13.7% of zinc) in the present study, except in men 18-34 years of age where ground beef (10.9% of zinc) was the primary contributor (Tables 10 & 11 Appendix D). Differences in percent and absolute zinc contribution of foods between genders were apparent when using 123 food groups. Chicken tended to contribute more zinc in women (4.19-4.56% of zinc) in general compared to men (3.18-5.16%), except in women 35-49 years where the contribution was lower than in men. This difference

demonstrates the preference of many Canadian women for chicken compared to beef. An unexpected contributor to zinc intake was water which contributed 2.86-3.41% of mean intake in women and may be due to the use of municipal water (Table 11 Appendix D). Although the mean zinc requirements of all age-gender groups were met in the present survey, men tended to surpass the RNI more than women (Table 7 & 8). This may be due to a greater consumption of beef which is generally a higher source of zinc (Brault-Dubuc, Caron-Lahaie., 1994). Beef, particularly "other beef cuts" continue to play an important role in the dietary intake of both iron and zinc in all age-gender groups. The results shown in the present study further support the importance of obtaining good sources of iron and zinc, such as beef, to provide the necessary intake of these nutrients in our diet.

Overall, 28.3% of folate was obtained from vegetables (Figure 9 Appendix B). Slight differences between men and women existed in the contribution of 51 food groups to folate intake. More typical sources of folate such as dark green leafy vegetables contributed more to folate intake in women than in men. The highest contributor (from 51 groups) in women 18-65 years was lettuce/cabbage/greens (12.6%), whereas breads (11.3%) were the highest contributor in men. Citrus fruit juices were the second contributor for both men (10.5% of folate) and women (11.0% of folate) 18-65 years, providing similar amounts of folate as the first contributor (Figures 22 & 35 Appendix C). The first and second contributors to folate provided close to a quarter of the mean daily intake, and thus can both be considered as important sources. Evaluating the order of contribution of different types of vegetables was of interest considering that vegetables are often recommended as a folate source. Following lettuce/cabbage/greens, vegetable sources of folate were as follows: other dark green vegetables (4.2%), other non-dark green vegetables (3.9%), tomatoes/tomato juice/tomato sauce (2.8%), dark yellow/orange vegetables (2.2%), boiled potatoes (2.1%) then fried potatoes/mixed potato dish (1.4%) in men. The order was similar in women, except for other non-dark green vegetables which contributed more than other dark green vegetables (Figures 22 & 35 Appendix C). A difference in folate contribution related to age was the greater percent and absolute contribution of coffee/tea (mostly due to brewed tea which contains more folate), whole

grain yeast breads in older individuals and the smaller contribution from beer and pizza (Brault-Dubuc, Caron-Lahaie, 1994).

These findings demonstrate the importance of particular food items such as citrus fruit juices, lettuce/cabbage/greens, as well as breads to the folate intake of Canadian adults. Differences in contribution due to gender are most likely a consequence of women typically consuming more vegetables than men (National Institute of Nutrition, 1997).

More education needs to be done in order to insure adequate intake prior to pregnancy. The fortification of foods is another option, but individuals, particularly those consuming large amounts of citrus juice as well as fortified foods, may exceed recommended levels of intake. In order to better assess actual folate intake, improvements in methods of food composition analysis are required.

Vitamin A was mainly obtained from dark yellow/orange vegetables (39.9-45.2%), primarily carrots (29.4-47.8%) in men and women 18-65 years. The contribution of fluid milk to vitamin A intake was higher in males (10.8% vs. 9.7%) than in females. Conversely, the contribution of vegetables was higher in females. Organ meats contributed considerably more vitamin A in males compared to females as a whole (7.8% vs. 1.6%), mainly due to higher intakes in men 35-65 years of age (Figures 25 & 38 Appendix C; Tables 10 & 11 Appendix D).

As expected, vitamin C intake was due mainly to fruits/fruit juices (54.1%), followed by vegetables (31.0%) (Figure 13 Appendix B). The contribution of fruit drinks/juice-drinks to vitamin C intake tended to decrease with age in all age-gender groups (9.78-14.0% in young women and men, 4.41-5.75% in older women and men) (Tables 10 & 11 Appendix D).

III. Correlation of Calcium, Iron and Folate with Energy Intake

The correlation coefficients of calcium, iron, folate and energy intakes for males and females 18-65 years of age are displayed on Table 12. Calcium, iron, and folate were significantly correlated with energy. Iron showed the highest correlation (r=0.65-0.71), when evaluating the correlation by age-gender group, with energy in all groups except in males 18-34 years where calcium was found to be more highly correlated (r=0.66) with

energy intake (data not shown). Calcium had the next strongest correlation with energy intake (r=0.41-0.54) in all other age-gender groups except males age 18-34 years where the iron correlation with energy was second to calcium. These results help to support the fact that higher energy intakes generally lead to higher calcium, iron, and folate intakes. Encouraging the Canadian population to increase energy intake to meet nutrient requirements would not be wise. Both Canadian and American populations have an increase in the prevalence of obesity. Lack of exercise and higher energy intake compared to needs are two of the causes of this rising problem. Nutrition education needs to focus on encouraging nutrient dense dietary intake along with increasing levels of physical activity.

Table 12: Correlation of Energy, Calcium, Iron and Folate Intakes in Males and Females Aged 18-65 yrs

Nutrients	Energy		Calcium		Iron	
Gender	M	F	M	F	M	F
Calcium	0.57	0.53				
Iron	0.73	0.68	0.47	0.43		
Folate	0.51	0.41	0.44	0.42	0.58	0.51

IV. Mean Nutrient Intakes and the Resulting Differences in Food Group Contribution to Nutrient Intake Among Smokers Compared to Non-Smokers

1) Data Transformation to Obtain Normal Distribution Curves

Energy, carbohydrate, protein, total fat, saturated fat, cholesterol, total fiber, calcium, iron, zinc, folate, vitamin A and vitamin C distributions were evaluated for women 18-65 years and men 18-65 years. The curves created using untransformed data, logarithmically transformed data, logarithm to the base ten and square root transformations were compared. This was done in order to identify which transformation produced the most normally distributed curve for each nutrient. The distributions were identified as being closest to normal by looking at the shape of the curve and the similarity

between the mean and the median values for each nutrient. The type of transformation used when completing the t-tests to test differences in mean nutrient intakes between smokers and non-smokers are indicated in Table 13. Data for males and females were evaluated separately since nutrients such as calcium and iron are frequently nutrients at risk for females only. Therefore it was of interest to identify whether these trends were also seen among smoking vs. non-smoking women. The groups were not further divided by age due to the limited number of smokers in the sample. There was no difference in the mean age of smokers compared to non-smokers.

Table 13: Mean Nutrient Intake of Adult Smokers and Non-Smokers

	Mean Intake Males 18-65 yrs			Mean Intake Females 18-65yrs		
Energy/ Nutrient	**Smokers N= 127**	**Non-Smokers N= 445**	**P-value ***	**Smokers N= 181**	**Non-Smokers N= 790**	**P-value ***
Energy (kcal)	2611	2632	n.s. ***	1723	1821	n.s. ****
Carbohydrate (g)	313	337	0.045 **	215	245	0.0001 ***
Protein (g)	108	111	n.s. **	72.3	74.6	n.s. **
Fat (g)	94.0	89.6	n.s. **	60.9	60.4	n.s. ****
Saturated fat (g)	31.4	28.7	n.s. ***	21.1	19.5	n.s. ****
Cholesterol (mg)	372	320	n.s. ****	229	215	n.s. ****
Fiber (g)	13.6	18.5	0.0001 ****	11.5	14.6	0.0001 ****
Calcium (mg)	982	1023	n.s. **	739	789	0.028 **
Iron (mg)	17.6	19.1	0.0359 **	12.2	13.5	0.0005 **
Zinc (mg)	15.4	14.6	n.s. **	10.4	10.1	n.s. **
Folate (mcg)	261	321	0.0002 **	210	245	0.0001 **
Vitamin A (RE)	1298	1505	n.s. **	993	1228	0.0025 **
Vitamin C (mg)	125	166	0.0004 **	97.4	143	0.0001 ***

* All values significant at $p < 0.05$ except those marked n.s ** Log used *** Log base ten used **** Square root used

2) Significant Differences in Mean Nutrient Intake of Smokers vs. Non-Smokers

The mean absolute energy and nutrient intakes of smokers were lower than that of non-smokers except for mean total fat, saturated fat, cholesterol, and zinc intakes which were higher (Table 13). Mean nutrient intakes found to be significantly lower in smokers

were carbohydrate, fiber, iron, folate, and vitamin C for men and women 18-65 years, as well as calcium and vitamin A for women 18-65 years. All mean nutrient intakes which were significantly lower among smokers remained significantly lower ($p < 0.05$) when assessed on a per 1000 kcal basis, except calcium intake in females, where the difference became non-significant.

A t-test was performed to evaluate whether a significant difference existed in mean income and educational levels between smokers and non-smokers. Smokers were found to have a significantly lower level of education ($p=0.0001$), and lower income ($p=0.0045$) compared to non-smokers. The differences in nutrient and food group intake among smokers and non-smokers may be attributed not only to smoking but to lifestyle choices, socioeconomic status, and general nutrition knowledge (Dallongeville et al, 1998). The reasons for differences in nutrient intake are impossible to determine in the present study.

3) Percent Contribution of 51 and 123 Food Groups to the Mean Nutrient Intakes Found to be Significantly Different between Smokers and Non-Smokers

The evaluation of the percent contribution of 51 and 123 food groups was done only for nutrients found to be significantly different among smokers and non-smokers. The top eight food groups (from 51 and 123 food groups) contributing to carbohydrate, fiber, calcium, iron, folate, vitamin A, and vitamin C intakes are presented in Tables 14 and 15. The 51 and 123 food groups were not further collapsed to 17 groups (as in Santé Québec). The effect of smoking status on food group contribution to nutrient intake was not estimated in the Santé Québec survey and thus the results of this study cannot be compared to Santé Québec.

Similarities with previous studies existed in the mean nutrient intakes which were identified to be significantly different in smokers compared to non-smokers in the present study. A meta-analysis of 51 studies from 15 countries consistently identified smokers as having a significantly greater intake of energy, total fat, saturated fat, cholesterol, and alcohol. Smokers from this meta-analysis were also found to have a significantly lower intake of polyunsaturated fat, fiber, vitamin C, vitamin E, and beta-carotene (Dallongeville et al, 1998). Although not all of the nutrients found to be significantly different in previous

studies were significantly different in the present study, the direction of the differences was the same for most nutrients.

Carbohydrate sources in both smokers and non-smokers were primarily from breads, mainly refined yeast breads, when considering 51 food groups (16.1-17.4% of carbohydrate) (Tables 14 & 15). Non-smokers, from the NHANES II study, have been shown to consume a larger amount of high fiber grains than smokers (Subar et al, 1990). This finding was repeated in the present study where whole grain yeast breads contributed more to carbohydrate, fiber, iron and folate intake in non-smokers compared to smokers. The contribution of 123 food groups to carbohydrate intake showed that carbonated beverages contributed approximately two times as much carbohydrate in female and male smokers than in non-smokers (Table 15). The contribution of sugars/jams/syrups was also greater in both male and female smokers (6.5 vs. 3.8% of carbohydrate and 4.8 vs. 3.9% of carbohydrate). Fruits in contrast, particularly the non-orange non-citrus variety and citrus fruit juices, contributed more to the carbohydrate intake in non-smokers (Table 15). The results of the present study confirm that smokers typically consume less fruits and vegetables (Larkin et al, 1990; Subar et al, 1990).

Mean calcium intake in smokers compared to non-smokers was only found to be significantly different in females. The proportion of calcium intake was predominantly due to higher fat milk products in female smokers. As an example, the contribution of whole milk to calcium intake in smokers was 6.7% compared to 1.8% in non-smokers (Table 15; whole milk not shown for non-smokers). In non-smoking women, skim milk (8.9% vs 5.7%) and 1% milk (9.1% vs. 5.5%) contributed more to calcium intake than in smokers. Empty calorie foods such as carbonated beverages and coffee/tea also contributed more to the calcium intake in smokers (Table 15). Smokers have previously been shown to consume whole milk rather than lower fat milks (Subar et al,1990).

Breads were the main contributor of iron in smokers and non-smokers as shown using 51 food groups (Table 14). Other non-heme sources such as cereals were generally the second contributor and contributed more in non-smokers compared to smokers (12.8-14.6% of iron in non-smokers vs. 7.4-11.8% of iron in smokers) (Table 14). In contrast, certain heme sources of iron such as beef/veal and sausages contributed more to iron

intake in male and female smokers as did other sources such as coffee/tea (Tables 14 & 15). Meal replacements contributed more to iron intake in male smokers only (3.2 vs. 0.9%). Despite smokers generally having a poorer diet than non-smokers, the percent contribution of beef to iron intake was greater in smokers. Smokers may have greater potential for iron absorption due to the type of iron consumed since beef is considered to be an excellent source of bioavailable iron.

The primary folate source in female smokers and non-smokers was lettuce/cabbage/greens (12.5-13.3% of folate). Citrus fruit juice (7.6-11.2%) was the primary source in males when considering 123 food groups (Table15). Other important sources were refined and whole grain yeast breads. Alcoholic beverages, mostly beer, provided a greater amount to folate intake in male (5.3% smokers vs. 2.7% non-smokers) and female (1.9% smokers vs. 0.7% non-smokers) smokers compared to non-smokers (Tables 14 & 15). The contribution from coffee/tea was also greater in male (3.4 vs 2.8%) and female (5.4 vs. 4.5%) smokers compared to non-smokers. There were higher contributions from fruit and vegetable sources to folate intake in non-smoking men and women. Citrus fruit juices and other green vegetables were two types of fruit/vegetable sources which contributed more to folate intake in non-smokers (Table 15). More healthful sources of folate such as citrus fruit juices should replace carbonated beverage intake in smokers to promote optimal folate intake.

Vitamin A sources in female smokers and non-smokers were predominantly dark yellow/orange vegetables (40.6 and 46% respectively), mainly carrots (Tables 14 & 15). It is of interest to note the greater percent and absolute contribution of margarine/butter/lard and cheese to the vitamin A intake in smokers compared to non-smokers (5.5 vs. 3.7% for fats, 4.5 vs. 3.0% for cheese). Higher fat fluid milks contributed more to vitamin A intake in smokers, and 2% milk had a greater absolute and percent contribution than 1% fluid milk. The higher fat and saturated fat intake among smokers found in other studies may be a result of higher fat milk product consumption.

Table 14: Top 8 Food Group Contributors to Nutrient Intakes Which Differ Significantly Between Smokers and Non-Smokers (51 Food Groups)

	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Carboh.	Breads	17.4	Breads	16.7	Breads	16.1	Breads	16.9
	Carbonated beverages	10.7	Pasta/rice/grains	9.3	Carbonated beverages	7.7	Pasta/rice/grains	9.2
	Pasta/rice/grains	7.1	Cake/cookie/pie/granola	7.3	Sugar/syrup/gelat./cocoa	6.3	Non-citrus fruits	7.7
	Cake/cookie/pie/ granola	7.0	Non-citrus fruits	6.1	Pasta/rice/grains	5.7	Cake/cookie/pie/granola	7.5
	Sugar/syrup/gelatin/ cocoa	6.6	Cereals	6.0	Cake/cookie/pie/granola	5.6	Cereals	5.4
	Milk/chocolate milk	4.5	Carbonated beverages	5.8	Potato-boiled/mashed	5.4	Milk/chocolate milk	4.4
	Potato-boiled/mashed	3.9	Potato-boiled/mashed	4.4	Cereals	5.1	Potato-boiled/mashed	4.2
	Fruit drinks/juice drinks	3.4	Milk/chocolate milk	4.3	Non-citrus fruits	4.9	Citrus fruit juices	4.2
	Mean	**313 g**	**Mean**	**337 g**	**Mean**	**215 g**	**Mean**	**245 g**
Total fiber	Breads	22.6	Breads	17.7	Breads	14.2	Breads	16.2
	Potato-boiled/mashed	8.0	Cereals	11.6	Cereals	12.8	Non-citrus fruits	14.7
	Pasta/rice/grain	6.8	Non-citrus fruits	11.5	Non-citrus fruits	10.1	Cereals	11.4
	Non-citrus fruits	6.5	Potato-boiled/mashed	6.5	Potato-boiled/mashed	8.3	Pasta/rice/grains	6.2
	Cereals	6.0	Pasta/rice/grain	6.4	Other non-dark green veg.	8.1	Potato-boiled/mashed	5.8
	Tomato/tom.jce/ tom.sce	5.4	Other non-dark green veg.	4.3	Dark yellow/orange veg.	5.0	Other non-dark green veg.	5.3
	Other dark green veg.	4.5	Legumes/nuts/seeds	4.2	Pasta/rice/grains	4.7	Dark yellow/orange veg.	4.8
	Other non-dark green veg.	4.5	Dark yellow/orange veg.	4.2	Salty snacks	3.9	Tomato/tom.jce/tom.sce	3.7
	Mean	**13.6 g**	**Mean**	**18.5 g**	**Mean**	**11.5 g**	**Mean**	**14.6 g**

Table 14: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Calcium					Milk/chocolate milk	34.1	Milk/chocolate milk	31.9
					Cheese	14.5	Cheese	13.1
					Breads	8.4	Breads	9.4
					Carbonated beverages	4.1	Yogourts	4.6
					Hamburgers/pizza	3.5	Carbonated beverages	3.4
					Coffee/tea	2.1	Icecreams/puddings	2.9
					Lettuce/cabbage/greens	2.0	Cake/cookie/pie/granola	2.1
					Sour cream/creams	1.9	Hamburgers/pizza	1.9
					Mean	**739 mg**	**Mean**	**789 mg**
Iron	Breads	19.1	Breads	18.0	Breads	16.8	Breads	19.0
	Beef/veal	8.9	Cereals	14.6	Cereals	11.8	Cereals	12.8
	Cereals	7.4	Beef/veal	7.2	Beef/veal	9.2	Beef/veal	5.6
	Cakes/cookies/pies/ granol.	4.8	Pasta/rice/grain	5.7	Pasta/rice/grains	4.0	Pasta/rice/grains	5.6
	Pasta/rice/grain	4.5	Cakes/cookies/pies/ granol.	4.5	Cake/cookie/pie/granola	3.5	Cake/cookie/pie/granola	4.7
	Mixed pasta dishes	4.4	Poultry	2.9	Coffee/tea	3.5	Poultry	3.0
	Sausage/lunchmeat/ bacon	3.2	Legumes/nuts/seeds	2.8	Potato-boiled/mashed	3.0	Other non-dark green veg.	2.5
	Meal replacements	3.2	Mixed meat/poultry/fish dish	2.7	Poultry	2.8	Potato-boiled/mashed	2.5
	Mean	**17.6 mg**	**Mean**	**19.1 mg**	**Mean**	**12.2 mg**	Non-citrus fruits	2.5
							Mean	**13.5 mg**

Table 14: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	**Food Group**	**%**	**Food Group**	**%**	**Food Group**	**%**	**Food Group**	**%**
Folate	Breads	13.0	Citrus fruit juices	11.1	Lettuce/cabbage/greens	13.3	Lettuce/cabbage/greens	12.5
	Citrus fruit juices	7.6	Breads	10.9	Breads	9.7	Citrus fruit juices	11.6
	Legume/nuts/seeds	7.0	Lettuce/cabbage/greens	7.5	Citrus fruit juices	8.2	Breads	10.4
	Lettuce/cabbage/greens	6.1	Legumes/nuts/seeds	6.4	Other non-dark green veg.	7.0	Other non-dark green veg.	5.3
	Milk/chocolate milk	5.3	Milk/chocolate milk	4.5			Other dark green veg.	4.7
	Alcohol	5.3	Hamburgers/pizza	4.4	Hamburgers/pizza	6.1	Coffee/tea	4.5
	Hamburger/pizza	4.3	Other dark green veg.	4.3	Coffee/tea	5.4	Non-citrus fruits	4.5
	Tomato/tom. jce./tom.sce	4.2	Other non-dark green veg.	4.0	Milk/chocolate milk	4.9	Milk/chocolate milk	4.3
					Tomato/tom.jce/tom.sce.	3.5		
	Mean	**261 mcg**	**Mean**	**321 mcg**	**Mean**	**210 mcg**	**Mean**	**245 mcg**
Vitamin A					Dark yellow/orange veg.	40.6	Dark yellow/orange veg.	46.0
					Milk/chocolate milk	11.0	Milk/chocolate milk	9.4
					Lettuce/cabbage/greens	6.8	Lettuce/cabbage/greens	5.4
					Margarine/butter/lard	5.5	Margarine/butter/lard	3.7
					Other non-dark green veg.	4.8	Other soups/sauces	3.1
							Cheese	3.0
					Cheese	4.5	Tomato/tom.jce/tom.sce	2.8
					Tomato/tom.jce/tom.sce	3.1	Non-citrus fruits	2.8
					Non-citrus fruits	1.8		
					Hamburgers/pizza	1.8		
					Mean	**993 RE**	**Mean**	**1228 RE**

Table 14: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Vitamin C	Citrus fruit juices	23.8	Citrus fruit juices	26.9	Citrus fruit juices	22.8	Citrus fruit juices	25.8
	Fruit drinks/juice drinks	12.8	Citrus fruits	13.0	Citrus fruits	12.4	Citrus fruits	13.4
	Other dark green veg.	9.9	Other dark green veg.	8.3	Non-citrus fruits	10.4	Non-citrus fruits	11.7
	Tomato/tom. jce./tom.sce	9.0	Non-citrus fruits	8.2	Tomato/tom.jce/tom.sce.	7.1	Other dark green veg.	8.7
	Non-citrus fruit juices	7.7	Fruit drinks/juice drinks	7.4	Other dark green veg.	6.7	Fruit drinks/juice drinks	7.2
	Citrus fruits	6.8	Non-citrus fruit juice	7.1	Lettuce/cabbage/greens	6.0	Tomato/tom.jce/tom.sce	5.1
	Non-citrus fruits	5.2	Tomato/tom. jce./tom.	5.1	Potato-boiled/mashed	6.0	Dark yellow/orange veg.	4.8
	Potato-boiled/mashed	4.8	sauce		Non-citrus fruit juices	4.7	Non-citrus fruit juices	4.8
			Dark yellow/orange veg.	4.5				
	Mean	**125 mg**	**Mean**	**166 mg**	**Mean**	**97.4 mg**	**Mean**	**143 mg**

N.B.: Mean nutrient intakes which were not found to be significantly different between smokers and non-smokers have shaded areas.

Citrus fruit juices were the principal source of vitamin C intake in both male and female smokers and non-smokers. Among differences in sources of vitamin C were the higher (absolute and percent) contribution of fruit drinks/juice drinks in male smokers compared to non-smokers (12.8 vs. 7.4 % of vitamin C) and the inferior contribution of whole citrus and non-citrus fruits in both male and female smokers (6.8-12.4% vs. 13-13.4% of vitamin C for citrus fruits) (Tables 14 & 15).

Smokers are individuals at greater risk for nutrient deficiency, in part due to their increased needs for antioxidant nutrients such as vitamin C, and also due to their poorer mean nutrient intake and food choices. Studies have shown that serum vitamin C levels are lower in smokers and that turnover in the body is greater (Subar et al, 1990). For this reason, the recommendation for vitamin C intake is greater for smokers. Smokers need to be targeted for specific nutrition education related to their needs. Studies consistently show poorer mean micronutrient intakes and higher fat, cholesterol, and saturated fat intakes among smokers, further corroborated in the present study. Smokers need to be encouraged to increase fruit, particularly citrus fruit, and vegetable consumption in order to increase intakes of folate, vitamin C, vitamin A, and fiber. Citrus juices and fortified fruit drinks are two accepted sources of vitamin C among smokers. The use of lower fat milk products would help to reduce overall fat and saturated fat intakes. Education needs to be done in order to advocate the replacement of energy dense, or nutrient poor foods and beverages such as alcohol, sugars, carbonated beverages, and coffee/tea with more nutrient dense food choices. Finally, smokers should continue to include excellent sources of iron and zinc, such as beef and other red meats, to achieve adequate iron intakes.

Table 15: Top 8 Food Group Contributors to Nutrient Intakes Which Differ Significantly Between Smokers and Non-Smokers (123 Food Groups)

	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Carboh.	Carbonated beverages	10.7	Refined yeast breads	9.4	Refined yeast breads	10.3	Refined yeast breads	8.6
	Refined yeast breads	10.4	Carbonated beverages	5.8	Carbonated beverages	7.7	Non-orange non-citrus	5.4
	Sugars/jams/syrups	6.5	Whole grain yeast breads	5.0	Sugars/jams/syrups	4.8	fruits	
	Cakes/cookies	5.2	Non- orange non-citrus	4.8	Potatoes-boiled	4.4	Whole grain yeast breads	4.9
	Whole grain yeast	4.7	fruits		Non-orange non-citrus	4.0	Cakes/cookies	4.6
	breads		White semolina pasta	4.8	fruits		Citrus fruit juices	4.2
	White semolina pasta	4.1	Cakes/cookies	4.3	Cakes/cookies	3.7	White semolina pasta	4.1
	Fruit drinks/juice	3.4	Low fiber cold cereals	4.2	White semolina pasta	3.5	Carbonated beverages	3.9
	drinks		Citrus fruit juices	3.7	Whole grain yeast	3.1	Potatoes-boiled	3.5
	Potatoes-boiled	3.3			breads			
	Mean	**313 g**	**Mean**	**337 g**	**Mean**	**215 g**	**Mean**	**245 g**
Total fiber	Whole grain yeast	14.9	Whole grain yeast breads	11.7	Non-orange non-citrus	7.9	Whole grain yeast breads	10.8
	bread		Non-orange non-citrus	9.1	fruits		Non-orange non-citrus	10.3
	Refined yeast bread	6.8	fruits		Whole grain yeast	7.6	fruits	
	Potatoes-boiled	6.3	Low fiber cold cereals	6.2	breads		Potatoes-boiled	4.9
	White semolina pasta	5.1	Potatoes-boiled	5.5	High fiber cold cereals	6.8	High fiber cold cereals	4.9
	Non-orange non-	4.6	Refined yeast breads	5.0	Potatoes-boiled	6.6	Low fiber cold cereals	4.5
	citrus fruit		White semolina pasta	4.5	Refined yeast breads	5.0	Refined yeast breads	3.8
	Other green vegetable	4.5	Other green vegetables	3.5	Low fiber cold cereals	4.3	Citrus fruits	3.6
	Carrot	3.5	High fiber cold cereals	3.3	Other root vegetables	4.2	Salty snacks	3.6
	Mixed pasta dishe	3.3			Salty snacks	3.9		
	Mean	**13.6 g**	**Mean**	**18.5 g**	**Mean**	**11.5 g**	**Mean**	**14.6 g**

Table 15: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Calcium					2% Milk	15.7	2% Milk	10.9
					High fat natural cheese	10.7	High fat natural cheese	9.2
					Whole milk	6.7	1% Milk	9.1
					Skim milk	5.7	Skim milk	8.9
					Refined yeast breads	5.7	Refined yeast breads	4.3
					1% Milk	5.5	Water	2.8
					Pizza (non "vegetarian")	3.3	Refined quick breads	2.4
							Whole grain yeast breads	2.2
					High fat processed cheese	3.3		
					Mean	**739 mg**	**Mean**	**789 mg**
Iron	Refined yeast breads	11.1	Low fiber cold cereals	10.7	Refined yeast breads	11.0	Refined yeast breads	9.3
	Whole grain yeast breads	5.8	Refined yeast breads	9.5	Low fiber cold cereals	7.0	Low fiber cold cereals	7.9
			Whole grain yeast breads	6.0	Other beef cuts	6.2	Whole grain yeast breads	6.2
	Low fiber cold cereals	5.0	Other beef cuts	4.2	Whole grain yeast breads	3.8	White semolina pasta	3.7
			White semolina pasta	4.1			High fiber cold cereals	3.2
	Other beef cuts	4.4	Ground beef	2.9	Coffee/tea	3.5	Cakes/cookies	3.0
	Mixed pasta dishes	4.4	Cakes/cookies	2.7	White semolina pasta	3.1	Other beef cuts	3.0
	Ground beef	4.3	Chicken	2.4	Potatoes-boiled	2.8	Refined quick breads	2.8
	White semolina pasta	3.7			Ground beef	2.7		
	Cakes/cookies	3.6						
	Mean	**17.6 mg**	**Mean**	**19.1 mg**	**Mean**	**12.2 mg**	**Mean**	**13.5 mg**

Table 15: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Folate	Citrus fruit juices	7.6	Citrus fruit juices	11.2	Lettuce/greens/cabbage	13.3	Lettuce/greens/cabbage	12.5
	Refined yeast breads	6.9	Lettuce/greens/cabbage	7.5	Citrus fruit juices	8.2	Citrus fruit juices	11.6
	Lettuce/greens/cabb.	6.1	Refined yeast breads	5.1	Refined yeast breads	6.0	Other green vegetables	4.7
	Whole grain yeast breads	5.2	Whole grain yeast breads	5.0	Pizza (non "vegetarian")	5.9	Whole grain yeast breads	4.6
	Beer	5.1	Other green vegetables	4.3	Coffee/tea	5.4	Refined yeast breads	4.5
	Nuts/seeds	4.5	Legumes	4.1	Other root vegetables	4.1	Coffee/tea	4.5
	Other green vegetables	4.1	Pizza (non "vegetarian")	3.8	Citrus fruits	3.2	Citrus fruits	4.2
	Pizza (non "vegetarian")	3.6	Citrus fruits	3.7	Other green vegetables	2.9	Non-orange non-citrus fruits	2.9
	Mean	**261 mcg**	**Mean**	**321 mcg**	**Mean**	**210 mcg**	**Mean**	**245 mcg**
Vitamin A					Carrots	39.8	Carrots	42.3
					Lettuce/greens/cabbage	6.8	Lettuce/greens/cabbage	5.4
					2% Milk	5.5	Other orange vegetables	3.8
					Mixed vegetables	4.4	2% Milk	3.3
					Soft margarine	3.9	Non milk based soups	2.8
					High fat natural cheese	3.4	Skim milk	2.8
					Skim milk	2.1	1% Milk	2.8
					1% Milk	2.0	Sausages	2.7
					Mean	**993 RE**	**Mean**	**1228 RE**

Table 15: Cont'd	Males 18-65 years (N= 572)				Females 18-65 years (N= 971)			
	Smokers (N=127)		Non-Smokers (N= 445)		Smokers (N= 181)		Non-Smokers (N= 790)	
Nutrient	Food Group	%	Food Group	%	Food Group	%	Food Group	%
Vitamin C	Citrus fruit juices	23.8	Citrus fruit juices	26.9	Citrus fruit juices	22.8	Citrus fruit juices	25.8
	Fruit drinks/juice-drinks	12.8	Citrus fruits	13.0	Citrus fruits	12.4	Citrus fruits	13.4
			Other green vegetables	8.3	Other green vegetables	6.7	Other green vegetables	8.7
	Other green vegetables	9.9	Fruit drinks/juice-drinks	7.4	Lettuce/greens/cabbage	6.0	Fruit drinks/juice-drinks	7.2
	Non citrus fruit juices	7.7	Non citrus fruit juices	7.1	Non-orange non-citrus fruits	5.7	Non-orange non-citrus fruits	5.4
	Citrus fruits	6.8	Non-orange non-citrus fruits	4.7	Potatoes-boiled	5.2	Non citrus fruit juices	4.8
	Tomatoes	5.1			Non-citrus fruit juices	4.7	Other orange vegetables	3.9
	Potatoes-boiled	4.3	Potatoes-boiled	3.7	Tomatoes	4.3	Lettuce/greens/cabbage	3.9
	Lettuce/greens/cabb.	3.0	Other orange vegetables	3.6				
	Mean	**125 mg**	**Mean**	**166 mg**	**Mean**	**97.4 mg**	**Mean**	**143 mg**

N.B.: Mean nutrient intakes which were not found to be significantly different between smokers and non-smokers have shaded areas.

V. Food Group Contribution to Iron, Calcium and Folate Intakes in Adults Meeting the RNI and those not Meeting the RNI on a Given Day

Three nutrients of importance in the public health domain, particularly for women, are iron, calcium, and folate. These nutrients are not of concern for most men as mean intakes met and often surpassed requirements. Individuals not meeting the RNI for a given nutrient presumably have different food habits compared to those meeting the RNI. Differences in food sources of calcium, iron and folate were evaluated for individuals meeting the RNI for these nutrients and those not meeting the RNI. Although iron, calcium, and folate are typically nutrients of concern in women, the evaluation was done with men as well in order to determine whether similarities in food sources existed. The absolute and per 1000 kcal energy, fiber, and nutrient intakes were also compared for individuals meeting the RNI for iron, calcium, and folate and those not meeting the RNI on a given day. This was done to determine whether the greater intake of calcium, iron, and folate in individuals meeting the RNI was due to a greater overall energy intake, or a more nutrient dense diet. Only 51 food groups were used for this analysis as it was of greater interest to determine the contribution of larger food groups such as fluid milk, compared to smaller groups such as one type of fluid milk (1%, 2% m.f.).

1) Differences in Calcium Sources in Adult Women and Men Who Met or Exceeded the RNI for Calcium on a Given Day vs. Adults Not Meeting the RNI

Men and women 18-65 years who met the RNI for calcium on a given day obtained approximately twice as much calcium from fluid milk and cheese (52.3-54.8% of calcium) compared to those who consumed less than the RNI for calcium (27.0-29.9% of calcium) (Table 16). This calcium contribution was due primarily to milk (38.1-39.8% of calcium in ≥ RNI group) in both groups (18.7%-21.2% of calcium in < RNI group). In contrast, approximately twice the percentage of calcium came from breads and 2-2.5 times as much from carbonated beverages in adults who did not meet the RNI for calcium on a given day. Despite the seemingly greater contribution of these items in individuals with lower calcium intake, the absolute contribution (mg calcium) from these food groups was

similar in individuals below and those meeting the RNI. Among other contributors to calcium intake in individuals with low calcium intake were cakes/cookies/pies/granola bars (2.2-3.8%) and other non-dark green vegetables (2.2-2.9%). These two food groups contributed a lower percent of the calcium intake in individuals who met the RNI (Table 16). The importance of milk products, particularly fluid milk and cheese as a calcium source was clearly demonstrated by the results from this study. The lack of calcium in the diet of individuals not meeting the RNI for calcium was due to a lack of milk products in their diets. It is unrealistic for the general population to meet calcium requirements without milk products or supplementation in spite of the existence of other calcium sources such as canned salmon, sardines or broccoli.

The mean absolute intakes of energy, carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, iron, zinc, folate, vitamin A, and vitamin C were higher in individuals meeting the RNI for calcium compared to those not meeting the RNI (results not shown). The per 1000 kcal intake of nutrients showed no consistent trend, except for carbohydrates, where intake per 1000 kcal was greater in individuals below the RNI for calcium. Individuals not meeting the RNI for calcium on a given day had a slightly lower mean percent energy from fat (29.4-30.0% vs. 29.8-31.6% of energy) and saturated fat (8.9-9.0% vs. 10.4-10.9% of energy). The higher carbohydrate intake per 1000 kcal appears to have been due to the greater intake of various food items particularly carbonated beverages, and fruit drinks, as well as salty snacks, sugars, and alcohol in individuals with lower fluid milk intake (data not shown). This was assessed by comparing the absolute contribution of 51 food groups to mean carbohydrate intakes between individuals meeting the RNI for calcium and those not meeting the RNI. Despite the slightly higher intake of fat by individuals meeting the RNI, the differences in means were not great, so benefits of higher calcium intake may outweigh the risks of a slightly higher fat intake.

One method for increasing nutrient intake in the population is food fortification. In the United States fortified foods include calcium fortified beverages, folate fortified flour, and iron fortified breads and cereals. A food item or ingredient must be carefully selected for fortification to avoid over consumption in individuals who are presently meeting the

recommended levels of intake. The difficulty in finding an ideal food or beverage for fortification is compounded by the fact that men and women often have different levels of intake. Finding a food item to be fortified with calcium which is consumed primarily or exclusively by women who have low calcium intake is complex. Although different food groups offer different levels of nutrient contribution among subgroups in the population, the intake of these food groups is not exclusive to one subgroup of individuals. The new Dietary Reference Intake will recommend higher levels of calcium which are "defined as the average intake of a population not demonstrating the risks of osteoporosis" (Hendricks, 1998). At the same time, the recommended upper limit of calcium intake falls within a narrow range of the recommended calcium intake. Intakes exceeding the upper limit may result in "milk alkali" syndrome or decreased iron absorption due to excess calcium competing for uptake (Hendricks, 1998).

2) Differences in Iron Sources in Adult Women and Men Who Met or Exceeded the RNI for Iron on a Given Day vs. Adults Not Meeting the RNI

Non-heme iron sources such as breads and cereals remain the primary contributors to iron intake overall (Table 16). The primary heme source of iron was beef/veal, particularly for individuals meeting the RNI for iron. Males and females whose intake was below the RNI for iron tended to have a greater percent contribution to iron intake from breads, poultry, legumes/nuts/seeds (except women 18-49 yrs), and coffee/tea. Despite a greater percent contribution, the absolute contribution of these food items was lower in individuals not meeting the RNI's. Individuals who had adequate iron intake on a given day tended to obtain more (% and absolute) iron from cereals, and beef/veal and a greater absolute iron intake from mixed meat/fish/poultry dishes. Dark green leafy vegetables were not high contributors to iron intake in either individuals with low or high iron intakes. These findings support the importance that beef, fortified cereal, and fortified bread intakes have in meeting iron needs.

The number of men 18-65 years and women 50-65 years meeting the RNI for iron far exceeded the number not meeting the RNI on a given day, except for women 18-49 years, due to the higher RNI for women in this age group. The mean absolute energy,

carbohydrate, protein, total fat, saturated fat, cholesterol, fiber, calcium, zinc, folate, vitamin A and vitamin C intake of individuals meeting the RNI for iron on a given day was higher than those not meeting the RNI (results not shown). The only nutrients which were consistently higher per 1000 kcal of energy intake among individuals not meeting the RNI for iron were carbohydrates, calcium, and vitamin C. The greater intake of calcium in individuals with lower iron intake appeared to be due to a greater intake of sour creams, ice creams, milk based soups/sauces, sugars, fruit drinks, and coffee/tea (data not shown). The greater intake of carbohydrate was due to greater intakes of candies/chocolate, sugars, coffee/tea, fruit drinks, alcohol, as well as other food items (data not shown). The mean percent of energy from fat (29.5-30.4% vs. 30.2-30.5% of energy) and saturated fat (9.4-9.9% vs. 10.2-11.2% of energy) for individuals meeting the RNI for iron intake was slightly lower than in those not meeting the RNI. The exception to this was in men 18-65 years of age where those meeting the RNI for iron on a given day had a higher mean percent energy from fat and saturated fat. These facts demonstrate the possibility of including beef in ones diet without compromising the recommendations for total and saturated fat intake.

3) Differences in Folate Sources in Adult Women and Men Who Met or Exceeded the RNI for Folate on a Given Day vs. Adults Not Meeting the RNI

The primary source for individuals meeting the RNI for folate on a given day was citrus fruit juices (11.3-22.7% of folate) or lettuce/cabbage/greens (14.8-15.9% of folate). For those not meeting the RNI the primary source was breads (15.8-24.7% of folate) (Table 16). Breads offered a similar contribution in both groups who had higher and lower folate intakes when evaluating absolute intakes (mcg folate). Other contributors to folate intake in men and women with lower folate intake were milk/chocolate milk, where percent (not absolute) contributions were higher in all age-gender groups for those consuming less than the recommended amount of folate in a 24 hour period compared to those meeting the RNI. Coffee/tea appeared as an unexpected but predominant folate source (most likely due to frequency of brewed tea intake) for women 25-65 years who had a lower mean folate intake. Foods typically recommended as folate sources, such as

dark green leafy vegetables or lettuce/cabbages/greens, contributed more to folate intake in women. In men, the more common source of folate was citrus fruit juice.

This difference illustrates a gender difference not only in mean nutrient intake but in the source of nutrients. A recommendation for obtaining adequate folate intake may be to increase not only the consumption of leafy green vegetables but citrus fruit juices as well.

Table 16: Percent Contribution of Top 8 Food Group Contributors to Mean Calcium, Iron, and Folate Intake of Adults Aged 18-65 Whose Mean Intake on a Given Day Meets the RNI vs. Adults Whose Mean Intake Does Not Meet the RNI (51 Food Groups)

Nutrient	Males ≥ RNI Age N	%	Males < RNI Age N	%	Females ≥ RNI Age N	%	Female < RNI Age N	%
Calcium	18-65 yrs N= 301		18-65 yrs N= 271		18-49 yrs N=320		18-49 yrs N=345	
	Milk/chocolate milk	38.7	Milk/chocolate milk	19.4	Milk/chocolate milk	38.1	Milk/chocolate milk	18.7
	Cheese	16.0	Breads	15.7	Cheese	16.7	Breads	14.4
	Breads	7.7	Cheese	8.0	Breads	7.1	Cheese	8.3
	Hamburgers/pizza	3.1	Carbonated beverages	5.2	Yogourts	4.2	Carbonated beverages	6.2
	Icecreams/puddings	2.8	Cake/cookie/pie/granola bar	3.1	Icecreams/puddings	2.7	Hamburgers/pizza	3.7
	Carbonated beverages	2.5			Carbonated beverages	2.5	Icecreams/puddings	2.6
	Yogourts	1.9	Hamburgers/pizza	2.7	Hamburgers/pizza	2.0	Other non-dark green veg.	2.6
	Mixed pasta dishes	1.9	Coffee/tea	2.6	Mixed pasta dishes	1.7	Cake/cookie/pie/granola	2.2
	Mean Intake	**1436 mg**	Other non-dark green veg.	2.2	**Mean Intake**	**1178 mg**	Yogourt	2.2
			Mean Intake	**546 mg**			Lettuce/greens/cabbage	2.2
							Coffee/tea	2.2
							Mean Intake	**440 mg**
					50-65 yrs N= 116		50-65 yrs N=190	
					Milk/chocolate milk	39.8	Milk/chocolate milk	21.2
					Cheese	12.5	Breads	12.4
					Breads	7.4	Cheese	8.7
					Yogourts	6.4	Carbonated beverages	5.5
					Other soups/sauces	2.6	Cake/cookie/pie/granola bar	3.8
					Icecreams/puddings	2.5	Yogourts	3.5
					Carbonated beverages	2.1	Other non-dark green veg.	2.9
					Citrus fruits	2.0	Icecreams/puddings	2.8
					Mean Intake	**1148 mg**	**Mean Intake**	**500 mg**

Table 16 cont'd	Males ≥ RNI Age N	%	Males < RNI Age N	%	Females ≥ RNI Age N	%	Female < RNI Age N	
Iron	**18-65 yrs** **N= 525**		**18-65 yrs** **N= 47**		**18-49 yrs** **N= 285**		**18-49 yrs** **N= 380**	
	Breads	18.0	Breads	23.6	Cereals	17.9	Breads	23.7
	Cereals	13.4	Coffee/tea	5.3	Breads	15.4	Beef/veal	5.0
	Beef/veal	7.7	Legumes/nuts/seeds	4.1	Beef/veal	7.0	Pasta/rice/grains	4.9
	Pasta/rice/grains	5.6	Cake/cookie/pie/granola	4.1	Pasta/rice/grains	5.8	Cereals	4.7
	Cake/cookie/pie/granola	4.5	Mixed meat/poultry/fish dishes	3.9	Cake/cookie/pie/granola	4.0	Cake/cookie/pie/granola	4.3
	Poultry	2.7			Poultry	2.8	Poultry	3.3
	Legumes/nuts/seeds	2.7	Poultry	3.6	Lettuce/greens/cabbage	2.7	Coffee/tea	3.3
	Mixed meat/poultry/fish dishes	2.6	Sausage/lunchmeat/ bacon	3.6	Mixed meat/poultry/fish dishes	2.4	Hamburgers/pizza	2.9
							Potatoes-boiled/mashed	2.9
	Mean Intake	**19.8 mg**	Potatoes-boiled/mashed	3.5	**Mean Intake**	**18.9 mg**	**Mean Intake**	**9.16 mg**
			Mean Intake	**7.15 mg**				
					50-65 yrs		**50-65 yrs**	
					N= 261		**N= 45**	
					Breads	17.7	Breads	29.1
					Cereals	13.4	Coffee/tea	5.0
					Beef/veal	6.7	Poultry	4.3
					Cake/cookie/pie/granola	5.7	Other non-dark green veg.	4.1
					Pasta/rice/grain	5.2	Other soups/sauces	4.1
					Non-citrus fruits	3.2	Cake/cookie/pie/granola	4.1
					Poultry	3.0	Citrus fruit juice	3.5
					Potatoes-boiled/mashed	2.9	Tomatoes/tomato	3.3
					Mean Intake	**14.1 mg**	juice/tomato sauce	
							Mean Intake	**6.35 mg**

Table 16 cont'd	Males ≥ RNI Age N	%	Males < RNI Age N	%	Females ≥ RNI Age N	%	Female < RNI Age N	%
Folate	**18-24 yrs**		**18-24 yrs**		**18-24 yrs**		**18-24 yrs**	
	N= 21		**N= 11**		**N= 25**		**N= 17**	
	Citrus fruit juices	21.2	Breads	24.7	Citrus fruit juices	22.7	Breads	19.2
	Breads	8.8	Milk/chocolate milk	12.0	Breads	8.4	Citrus fruit juices	14.6
	Cereals	8.6	Mixed meat/poultry/fish	8.5	Hamburger/pizza	6.6	Milk/chocolate milk	9.3
	Other dark green veg.	6.6	dishes		Lettuce/greens/cabb.	6.6	Hamburgers/pizza	5.3
	Legumes/nuts/seeds	5.1	Pasta/rice/grains	7.2	Milk/chocolate milk	5.6	Other non-dark green veg.	5.1
	Milk/chocolate milk	4.9	Tomatoes/tomato	5.3	Cereals	5.4	Mixed pasta dishes	4.9
	Mixed breads dishes	4.5	juice/tomato sauce		Other non-dark green veg.	4.2	Eggs	4.5
	Lettuce/greens/cabbage	3.9	Other non-dark green veg.	3.9	Legumes/nuts/seeds	4.1	Mixed breads dishes	4.1
	Mean Intake	**449 mcg**	Beef/veal	3.7	**Mean Intake**	**296 mcg**	**Mean Intake**	**109 mcg**
			Salty snacks	3.5				
			Mixed pasta dishes	3.5				
			Eggs	3.5				
			Mean Intake	**152 mcg**				
			25-65 yrs		**25-49 yrs**		**25-49 yrs**	
	25-65 yrs		**N= 208**		**N= 341**		**N=282**	
	N= 332		Breads	18.1	Lettuce/greens/cabb.	15.9	Breads	15.8
	Citrus fruit juices	11.3	Milk/chocolate milk	5.9	Citrus fruit juices	12.5	Milk/chocolate milk	6.5
	Breads	9.5	Other non-dark green veg.	5.4	Breads	8.6	Coffee/tea	6.1
	Lettuce/greens/cabbage	8.7	Citrus fruit juices	4.9	Other non-dark green veg.	5.2	Other non-dark green veg.	5.3
	Legumes/nuts/seeds	7.7	Non-citrus fruits	3.9	Legumes/nuts/seeds	4.6	Lettuce/greens/cabbage	4.2
	Hamburgers/pizza	4.9	Alcohol	3.5	Other dark green veg.	4.6	Citrus fruit juices	4.1
	Other dark green	4.5	Cereals	3.2	Citrus fruits	4.6	Tomatoes/tomato	3.8
	vegetables		Hamburger/pizza	3.2	Milk/chocolate milk	3.8	juice/tomato sauce	
	Milk/chocolate milk	4.2	Coffee/tea	3.2	Non-citrus fruits	3.8	Cereals	3.8
	Citrus fruits	4.2	**Mean Intake**	**162 mcg**	Coffee/tea	3.8	**Mean Intake**	**130 mcg**
	Mean Intake	**395 mcg**			**Mean Intake**	**325 mcg**		

Table 16 cont'd	**Males ≥ RNI Age N**	**%**	**Males < RNI Age N**	**%**	**Females ≥ RNI Age N**	**%**	**Female < RNI Age N**	**%**
Folate					**50-65 yrs (195 mcg) N= 174**		**50-65 yrs (195 mcg) N= 132**	
					Lettuce/greens/cabbage	14.8	Breads	17.0
					Citrus fruit juices	12.6	Coffee/tea	7.7
					Breads	7.9	Lettuce/greens/cabbage	5.8
					Other non-dark green veg.	6.8	Milk/chocolate milk	5.7
							Citrus fruit juices	5.5
					Other dark green veg.	5.7	Other non-dark green veg.	5.2
					Non-citrus fruits	5.2		
					Citrus fruits	5.1	Non citrus fruits	4.7
					Coffee/tea	4.8	Cereals	3.4
					Mean Intake	**327 mcg**	Citrus fruits	3.4
							Mean Intake	**138 mcg**

CHAPTER 5: CONCLUSION

The Food Habits of Canadians survey 1997-98 provides much needed information regarding the nutrient and food intake of the Canadian population. The food groupings presented in this study provided a detailed view of foods contributing to the intake of adults 18-65 years of age. Previous Canadian studies have demonstrated food group contribution to nutrient intake with a limited number of food groups.

Potential problem nutrients have been identified in the 1997-98 survey particularly for women. The nutrients which are consumed at an inadequate level in some individuals are calcium, iron, folate and zinc. In order to optimize intake of these nutrients, health professionals must encourage foods that are recognized by the general population. With the use of food group contribution to nutrient intake, acceptable foods were identified.

Dietary patterns appear to be improving over time. There is a trend towards a lower percentage of energy from total and saturated fat and lower mean cholesterol intakes. These changes occur for a variety of reasons such as increased public awareness, and greater availability of lower fat food items. Despite improvements in the distribution of macronutrient intake, several micronutrients still pose a concern. Some foods contribute to the energy intake of the population while contributing little to the micronutrient intake, these foods may foster the problem of obesity in the Canadian population. There are limitations in the nutrient databases which prevent an exact determination of micronutrient intake. In spite of these limitations, evaluating the food group sources of nutrients provides a clear picture of "important" food sources of nutrients.

Examples of foods contributing to energy intake, while contributing minimally to micronutrient intake were carbonated beverages, pies/pastries, and salty snacks. Cakes/pies was also a contributor to energy intake, and at the same time contributed to iron intake. Other sources of iron may be more appropriate since cakes/pies tend to have a high caloric content.

Milk products, specifically fluid milk and cheese continue to play an important role in optimizing calcium intake. Other milk based products such as yogourts, puddings, and

ice-creams played a minimal role in calcium consumption. As seen with trends in food intake, the population appears to be choosing lower fat fluid milks and yogourts, however, the intake of higher fat cheeses remains popular.

The importance of breads, cereals and beef to the intake of iron is apparent. Beef was also the main contributor to zinc intake. Although the bioavailability of iron from foods cannot be evaluated in the present study, women tended to have more sources of non-heme iron compared to heme iron when they were compared to men. Consumption of iron which is less available to the body, coupled with mean intakes of iron that are borderline, results in a greater risk of inadequate iron intake for some women.

Breads, lettuce/cabbages/greens, and citrus fruit juice were main providers to folate intake. One method of encouraging folate intake would be to encourage the use of citrus juices, rather than "artificial" citrus drinks, only the former contain folate. The population tends to recognize the importance of vitamin C intake, a nutrient which is added to these beverages, but may not recognize the importance of other nutrients which real fruit juices provide.

Smokers have been consistently identified as having poorer dietary habits than non-smokers. This fact has been demonstrated in the present survey as well. The mean energy and nutrient intake of smokers was found to be lower than non-smokers. Significantly lower intakes of carbohydrates, fiber, calcium, iron, folate, vitamins A and C were found in smokers. The types of foods contributing to nutrient intake among smokers tended to be higher in energy, less nutrient dense, and higher in fat. The percent contribution of fruit and vegetables to nutrient intake tended to be lower in smokers as well. A greater contribution to folate intake from alcohol was also found among smokers. One positive aspect was the presence of beef consumption which provided a good source of iron in the diets of smokers. Smokers need to be encouraged to modify their dietary habits by increasing fruit and vegetable consumption, selecting lower fat milk products, and decreasing consumption of nutrient poor foods.

Differences were found among individuals meeting and those not meeting the RNI for calcium, iron, and folate. Evaluating the contribution of food groups to these nutrients

demonstrated the importance of milk products, particularly fluid milk and cheese, cereals, beef/veal, breads and citrus juices in obtaining adequate calcium, iron, and folate intake.

Despite improvements in dietary intake over time the need to continue education, particularly for women, and individuals at greater risk, remains essential in optimizing the health potential of the Canadian population.

Future Implications:

In order to assess the nutrient intake of the Canadian population, nutritional surveys need to be conducted at regular intervals to obtain up to date information. Regular evaluation would help to determine whether the intake of potentially problematic nutrients is improving, or whether further nutrition education or other interventions are required. Evaluating changes in food group contribution to nutrient intake over time, can help determine the changes in important sources of nutrients which are acceptable to the population. Government nutrition policies regarding education requirements and nutrient fortification can be developed with the aid of information from up to date nutrition surveys.

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APPENDIX A

Appendix A: Differences in Food Groupings between Nova Scotia and Santé Québec Provincial Surveys

Santé Québec Survey (16 Food Groups)	Nova Scotia Survey (13 Food Groups)
1) **Breads, cereals, pasta** -excludes crackers, biscuits, popcorn, pretzels, soups with noodles/rice	1) **Pasta, rice, cereals, breads** -includes crackers, biscuits, popcorn, pretzels, soups with noodles/rice
2) **Rusks, salty type snacks** -includes popcorn, pretzels, crackers, biscuits, and chips	2) This group does not exist as a separate group.
3) **Pastries** -same as Nova Scotia	3) **Cookies, cakes, pies, doughnuts** -same as Santé Québec
4) **Milk, yogourt** -excludes ice-cream, whipping cream, table cream, coffee cream, and sour cream	4) **Milk, creams, yogourts, ice-creams** -includes ice-cream, whipping cream, table cream, coffee cream, and sour cream
5) **Creams, ice-creams** -includes ice-cream, whipping cream, table cream, coffee cream, and sour cream	5) This group does not exist as a separate group.
6) **Cheeses** -same as Nova Scotia	6) **Cheeses** -same as Santé Québec
7) **Meat, poultry, fish** -excludes bacon	7) **Meat, poultry, fish** -includes bacon
8) **Eggs** -same as Nova Scotia	8) **Eggs** -same as Santé Québec
9) **Legumes, nuts** -same as Nova Scotia	9) **Legumes, nuts, seeds** -same as Santé Québec
10) **Vegetables** -includes french fries	10) **Vegetables** -excludes french fries
11) **Fruits, fruit juices** -same as Nova Scotia	11) **Fruits, fruit juices** -same as Santé Québec
12) **Fats** -includes bacon	12) **Fats** -excludes bacon
13) **Tea, coffee, fruit drinks** -same as Nova Scotia	13) **Tea, coffee, fruit drinks** -same as Santé Québec
14) **Alcohol** -same as Nova Scotia	14) **Alcohol** -same as Santé Québec
15) **Sugars, confections** -includes sugars, jams, syrups, candies, popsicles, sherbet, gelatin, chocolates	15) **Miscellaneous** -includes sugars, jams, syrups, candies, popsicles, sherbet, gelatin, chocolates, chips, french fries, aspartame, salty/fatty snack foods, sauces, supplements, bottled water, baby foods, spices, yeast, vinegar, salt
16) **Other** -includes aspartame, soups with noodles/rice, sauces, supplements, spices, yeast, bottled water	

Appendix A: Summary of Food Items from 1997 Canadian Nutrient File and Institute File Included in 123 Food Groups

123 Food Groups	Contents of Food Group
1) Beer	Beer
2) Alcoholic coolers	Alcoholic coolers
3) Liquor	Mixed alcoholic beverages, hard/coffee liquor
4) Wine	Red/white/rosé wine
5) Babyfood - cereals	Hot/cold babycereals
6) Other bread products	Stuffing, croutons, bread crumbs, shake & bake
7) Low fiber cold cereals	Cold cereals < 4g fiber/ 30g cereal
8) High fiber cold cereals	Cold cereals >= 4g fiber/ 30g cereal
9) Hot cereals	All hot cereals
10) Crackers	Refined & whole grain crackers, melba toast, filled crackers, rice cakes
11) Grains	Grains, flour, bran, wheat germ, cornstarch
12) Mixed bread dishes	Filled dumplings, french toast, mixed sandwiches, fritters, egg rolls, spanikopita
13) White semolina pasta	Refined spaghetti, macaroni, somen/ramen noodle won-ton wrappers
14) Other pasta	Spinach/protein fortified pasta, gnocchi, rice/mung bean/corn/egg/chow mein/ soba/whole wheat/cellophane noodles
15) Mixed pasta dishes	Pasta with meat/cheese/tomato sauce, lasagna, tortellini, pasta salad
16) Pizza	All-dressed, pepperoni, plain pizza, calzone
17) Refined quick breads	Scones, waffles, pancakes, popovers, biscuits, refined muffins, matzo, banana/pumpkin bread, taco shells, tortillas, plain dumplings, fry bread
18) Whole grain quick breads	Whole grain muffins, whole grain biscuits, whole grain pancakes
19) White rice	White rice, rice flour, rice bran
20) Other rice	Fried rice, sushi with vegetables, brown rice, wild rice, brown rice flour, vegetable/rice mixtures
21) Refined yeast breads	French/ italian/ pita/ raisin/ protein/ pumpernickel/ barley/ cheese/ egg breads, pizza dough, foccocia, croissants, bagels, english muffins, rolls
22) Whole grain yeast breads	Whole wheat, cracked wheat, oatmeal, oatbran, mixed grain, wheat germ breads as above
23) Carbonated beverages	Cola, non-cola beverages (sweetened & unsweetened), tonic water, instant tea
24) Cocoa	Cocoa powder, carob powder, chocolate drink powders or powders mixed with water only, flavoured instant coffees
25) Coffee/tea	Brewed coffee, brewed black/herbal teas, postum, grain based coffee substitute
26) Fruit drinks/juice drinks	Fruit cocktails, fruit drinks, juice-drinks
27) Water	Municipal water, club soda, mineral & spring water
28) Cakes/cookies	Cakes, cookies, squares, brownies, torte
29) Candies	Hard candy, jellybeans, gumdrops, taffy, toffee, candied fruit, fruit leather, caramel coated popcorn, yogourt covered raisins, peanut brittle

30) Chocolate	Chocolates, frostings, chocolate syrups, caramels, butterscotch
31) Gelatins	Gelatin mixes (dry & prepared), frozen ices, frozen juice bars, frozen ice pops, sherbet
32) Granola	Cereal bars, granola bars
33) Pies/pastries	Pies, pie crusts, pie fillings, pastries, meringue, turnovers, doughnuts, danishes, bannock, burritos with fruit, nachos with sugar
34) Sugars/jams/syrups	White/brown/icing sugar, jams/marmalade (includes "diet"), syrups, honey, molasses, pectin, dry pudding mixes, marshmallow cream, rennin tablets unsweetened, fruit butters
35) Butter	Butter, butter oil
36) Lard	Lard, fish oil, suet, tallow, animal fat, shortening
37) Hard margarines	Hard stick margarines
38) Soft margarines	Soft tub margarines (includes "calorie reduced")
39) Mayonnaise	Mayonnaise, mayonnaise type dressing (includes "light" and "diet")
40) Oils	All oils (except fish, seal oil)
41) Salad dressings	All salad dressings (includes "calorie reduced")
42) Toppings	Dessert toppings, non-dairy coffee whitener
43) Berries	All berries, currants
44) Canned fruits	All canned fruits (in juice/light syrup/heavy syrup), applesauce, cranberry-orange relish
45) Citrus fruits	All citrus fruits, fruit salads including citrus fruit, lemon/orange peel
46) Dried fruits	All dried fruits except fruit leather
47) Citrus fruit juices	All citrus juices (diluted & undiluted)
48) Non-citrus fruit juices	All non-citrus fruit juices (diluted & undiluted)
49) Melons	All melons
50) Dark yellow/orange fruits	Apricots, carambola, jackfruits, loquats, mango, papaya, peaches, persimmons, pineapple
51) Non-orange non-citrus fruits	All other fruits
52) Ground beef	All ground beef
53) Hamburgers/cheeseburgers	All hamburgers/cheeseburgers (includes bun & toppings)
54) Mixed beef dishes	Shepherd's pie, meatloaf, meatballs, beef dinners, beef stews, beef casseroles, stuffed cabbage rolls, beef pie, mince pie, burrito with beef
55) Other beef cuts	All other cuts of beef (non-battered/non-flour dipped
56) Chicken	All cuts of chicken,cornish hens, canned chicken
57) Mixed chicken dishes	Chicken dinner, chicken taco, chicken burrito, battered/flour dipped chicken, chicken salad, chicken stew, chicken pie, chicken chow mein, chicken burger, chicken sandwich
58) Eggs- boiled	Raw/frozen/boiled eggs
59) Fried eggs	Fried eggs
60) Mixed egg dishes	Quiche, egg salad, omelet, scrambled egg, egg sandwich, sugared/salted eggs
61) Egg substitute	Egg substitute
62) Fish	Non-battered/non-fried fish, canned fish, dolphin, whale, fish tongues/cheeks

63) Mixed fish dishes	Breaded or fried fish/seafood, sushi with fish, salmon/seafood salad, lobster paste, fish sandwich
64) Lamb	All cuts of lamb & moussaka
65) Legumes	All legumes (non-sprouted), tofu, soy protein isolate, soy meal, soy flour, soy protein concentrate, miso, natto, tempeh
66)Mixed legume dishes	Vegetarian patties, vegetarian stews/chili, vegetarian slices, burritos with beans, hummus, falafel, black bean sauce, baked beans (with & without meat), fried tofu
67) Lunchmeats	Lunchmeats, sandwich spreads
68) Nuts/seeds	All nuts & seeds, coconut meat/milk/cream, trail mixes, yogourt covered nuts
69) Nut butters	Peanut & other nut butters
70) Organ meats	Organ meats from all animals, excludes ears/feet/tails/jowl
71) Other meats	Duck, goose, guinea, pheasant, quail, squab, emu, antelope, bear, beaver, boar, caribou, deer, elk, goat, horse, moose, muskrat, rabbit, squirrel, opossum, raccoon, frog's legs, seal, walrus, snail
72) Pork	All cuts of pork (cured & non-cured), back bacon
73) Bacon	Side bacon, simulated bacon, pork belly, pork fat, salt pork
74) Mixed pork dishes	Tourtiere, biscuit with ham, pork casserole
75) Sausages	All frankfurters, wieners, sausages
76) Seafood	All non-battered/non-fried seafood and shellfish, surimi
77) Turkey	All non-breaded/non-fried cuts of turkey, canned turkey
78) Mixed turkey dishes	Turkey dinner, turkey pie, turkey salad, turkey sandwich, turkey with gravy
79) Veal	All cuts of veal
80) Low fat natural cheese	Natural cheese <= 20% m.f.
81) High fat natural cheese	Natural cheese > 20% m.f.
82) Low fat processed cheese	Processed cheese <= 20% m.f.
83) High fat processed cheese	Processed cheese > 20% m.f.
84) Chocolate milk	Chocolate milk, hot chocolate made with milk, milkshakes
85) Lower fat cottage cheese	Cottage cheese < 2% m.f.
86) Higher fat cottage cheese	Cottage cheese >= 2% m.f.
87) Lower fat creams	Creams <= 15% m.f.
88) Higher fat creams	Creams > 15% m.f.
89) Icecreams/frozen yogourts	Icecreams, icecream bars, icecream cakes, fudgesicle, frozen yogourts, frozen ice milk, pudding pops, sundaes
90) Skim milk	Skim milk, 0.2% evaporated milk
91) 1% Milk	1% milk, buttermilk
92) 2% Milk	2% milk , 2% evaporated milk
93) Whole milk	Whole milk, evaporated/condensed whole milk
94) Calcium enriched milk	Calcium enriched milk
95) Non-frozen milk based desserts	Puddings made with milk, flan, custards, mousse, bread pudding, rennin with milk
96) Other milk	Rice/goat/sheep/soy/human milk

97) Milk based sauces	Alfredo/cheese/bernaise/stroganoff/hollandaise/sour cream/curry sauces, white sauces made with milk, tzaziki, cheese fondue
98) Lower fat sour cream	Sour cream <= 7% m.f., lower fat cream cheese
99) Higher fat sour cream	Sour cream > 7% m.f.. higher fat cream cheese
100) Milk based soups	Cream soups made with milk, lobster bisque, fish chowder, clam chowder
101) Yogourt <1% m.f.	Yogourt < 1% m.f.
102) Yogourt 1-2% m.f.	Yogourt 1-2% m.f.
103) Yogourt >2% m.f.	Yogourt > 2% m.f.
104) Gravies	Non milk based sauces, gravies
105) Herbs	Herbs, spices, salt, yeast, vinegar, vanilla extract, cream of tartar, baking powder, baking soda
106) Pickles	Pickled vegetables
107) Non-milk based soups	All other soups not made with milk
108) Meal replacements	Meal supplements, meal replacements, energy/protein bars, ovaltine
109) Salty snacks	Potato chips, pretzels, popcorn, beef jerky, pork skins, meat based sticks
110) Other botanical fruits/flowers/sprouts/fungi/pods	Alfalfa sprouts, balsam pear pod, cauliflower, eggplant, gourd, mushrooms, edible flowers, fennel, yellow beans, cucumber, zucchini, sprouted legumes
111) Other green vegetables	Artichokes, asparagus, broccoli, brussel sprouts, chives, okra, peas, seaweed, green beans, tomatillos, green peppers, jalapeno peppers, fiddleheads
112) Lettuce/greens/cabbage	All types of lettuce, greens, cabbages
113) Mixed vegetables	Mixed vegetables, tabouleh, eggplant parmesan, coleslaw, sauerkraut, succotash, breaded onion rings, corn on the cob with butter, vegetable salad
114) Potatoes- boiled	Boiled/raw potatoes, potato flour
115) Fried potatoes	French fries, hashbrowns
116) Mashed potatoes	Mashed potatoes made from real potatoes or granules
117) Mixed potato dishes	Poutine, scalloped potatoes, o'brien/au gratin potatoes, baked potatoes with toppings
118) Other root vegetables	All other root vegetables: bamboo shoot, beets, burdock root, cassava, celeriac, chicory root, ginger root, kohlrabi, lotus root, yam, onions, poi, pokeberry shoots, radishes, salsify, taro, turnips, waterchestnuts, leek, shallots, hearts of palm, celery, garlic, parsnips, rutabagas, horseradish
119) Tomatoes	Tomatoes, tomato paste, tomato puree
120) Tomato juice	All tomato, vegetable, clam juices
121) Tomato sauce	All tomato sauces, salsa
122) Carrots	Carrots, carrot juice
123) Other dark yellow/orange vegetables	Corn, pumpkin, crookneck/scallop/acorn/butternut/spaghetti/ hubbard squash, sweetpotatoes, yellow peppers, red peppers

Appendix A: Summary of Food Groups Included (from initial 123 groups) in each of 51 Collapsed Food Groups

51 Collapsed Food Groups	Food Groups Included from Initial 123 Groups
Breads	17, 18, 21, 22
Pasta/rice/grains	11, 13, 14, 19, 20
Cereals	5, 7, 8, 9
Mixed bread dishes	12
Mixed pasta dishes	15
Crackers	6, 10
Cakes/cookies/pies/granola bars	28, 32, 33
Milk/chocolate milk	84, 90, 91, 92, 93, 94, 96
Yogourts	101, 102, 103
Ice creams/puddings	89, 95
Sour creams/creams/cream cheese	87, 88, 98, 99
Cheese	80, 81, 82, 83
Cottage cheese	85, 86
Beef/veal	52, 55, 79
Pork	72
Lamb and other meats	64, 71
Poultry	56, 77
Fish/seafood	62, 76
Organ meats	70
Sausages/lunchmeats/bacon	67, 73, 75
Mixed meat/poultry/fish dishes	54, 57, 63, 74, 78
Hamburgers/pizza	16, 53
Eggs	58, 59, 61
Egg mixtures	60
Legumes/nuts/seeds	65, 68, 69
Mixed legume dishes	66
Lettuce/cabbage/greens	112
Other dark green vegetables	111
Dark yellow/orange vegetables	122, 123
Other non-dark green vegetables	110, 113, 118
Potatoes-boiled/mashed	114, 116
Potatoes-fired/mixed dish	115, 117
Tomatoes/tomato juice/tomato sauce	119, 120, 121
Citrus fruits	45
Non-citrus fruits	43, 44, 46, 49, 50, 51
Citrus fruit juice	47
Non-citrus fruit juice	48
Margarine/butter/lard	35, 36, 37, 38, 42
Oils	40
Salad dressings/mayonnaise	39, 41
Coffee/tea	25
Fruit drinks/juice drinks	26
Carbonated beverages/water	23, 27
Alcohol	1, 2, 3, 4
Sugars/syrups/gelatins/cocoa mixes	24, 31, 34
Candies/chocolates	29, 30
Meal replacements	108
Salty snacks	109

Appendix A: Summary of Food Groups Included (from initial 123 groups) in each of 51 Collapsed Food Groups (cont'd)	
51 Collapsed Food Groups	**Food Groups Included from Initial 123 Groups**
Milk based soups/sauces	97, 100
Other soups/sauces	104, 107
Herbs/pickles	105, 106

Appendix A: Summary of Food Groups Included (from initial 123 groups) in each of 17 Collapsed Food Groups

17 Collapsed Food Groups	Food Groups Included from Initial 123 Groups
Breads	5-9,11,13,14,19,20-22
Crackers	10, 109
Cakes/pies	17, 18, 28, 32, 33
Milk/yogourt	84, 90-94, 96, 101-103
Ice-creams/cream	87-89, 95, 98, 99
Cheese	80-83, 85-86
Meat/fish/poultry	52, 55, 56, 62, 63, 64, 67, 70-72, 75- 77, 79
Eggs	58, 59, 61
Legumes/nuts	65, 66, 68, 69
Vegetables	110-123
Fruits/fruit juices	43-51
Fats	35-42, 73
Coffee/tea/fruit drinks	23-26
Alcohol	1-4
Candies/chocolate	29-31, 34
Sauces/soups	27, 97, 100, 104-108
Mixed dishes	12, 15, 16, 53, 54, 57, 60, 74, 78,

APPENDIX B

Figure 1: Percent Contribution of 17 Food Groups to the Mean Energy Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 2109 kcal)

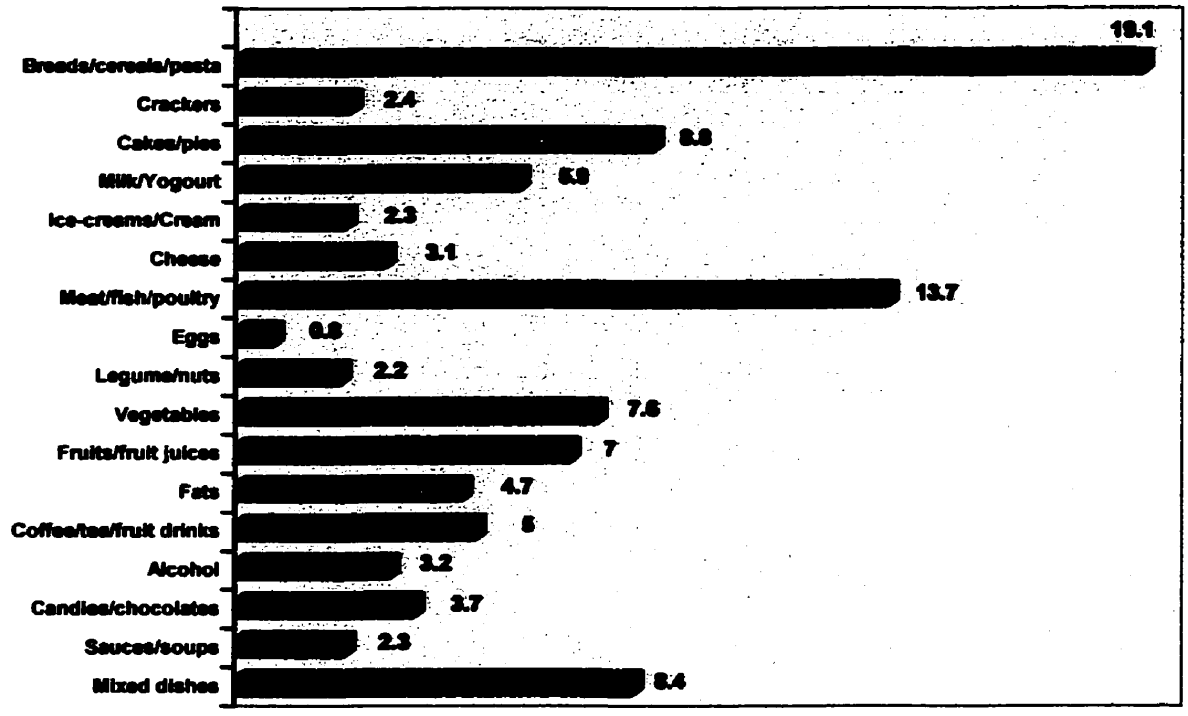


Figure 2: Percent Contribution of 17 Food Groups to the Mean Carbohydrate Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 274 g)

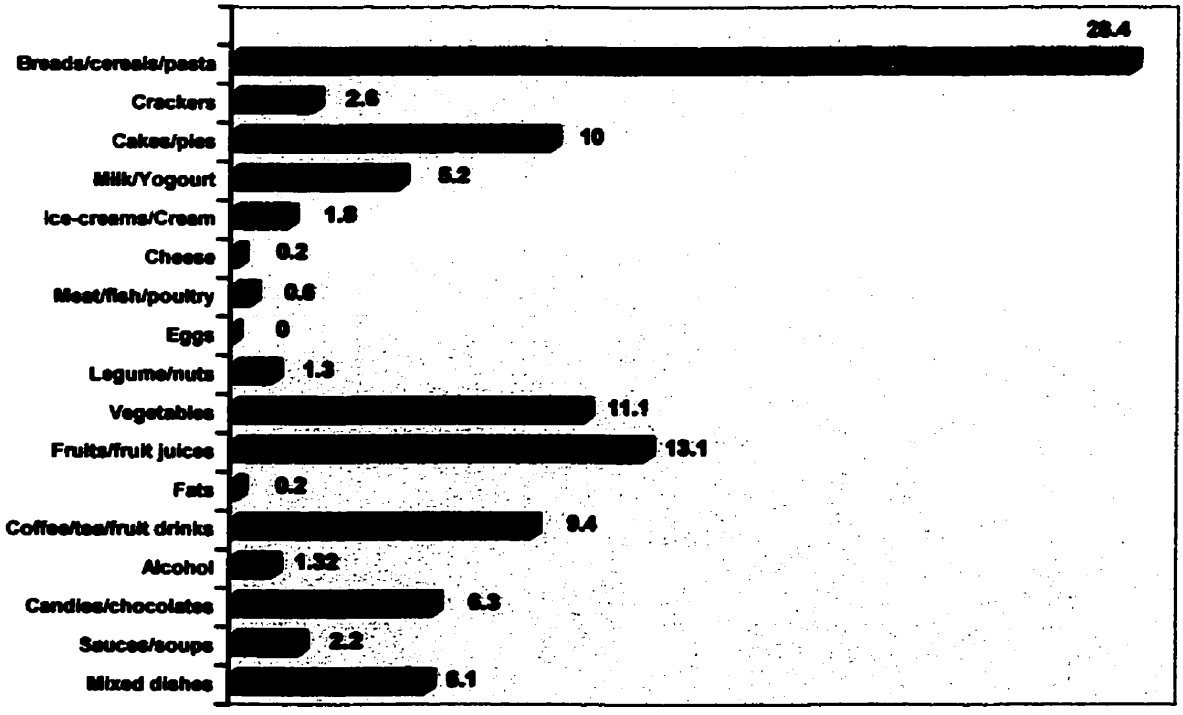


Figure 3: Percent Contribution of 17 Food Groups to the Mean Protein Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 87.6 g)

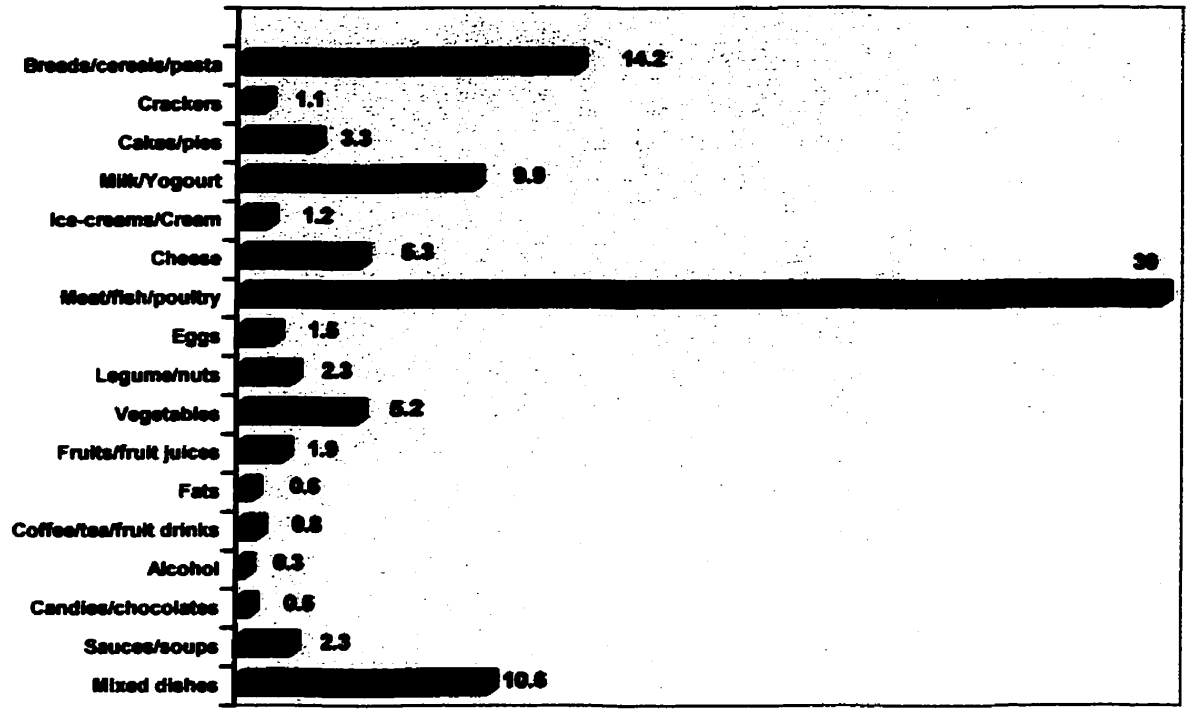


Figure 4: Percent Contribution of 17 Food Groups to the Mean Total Fat Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 71.6 g)

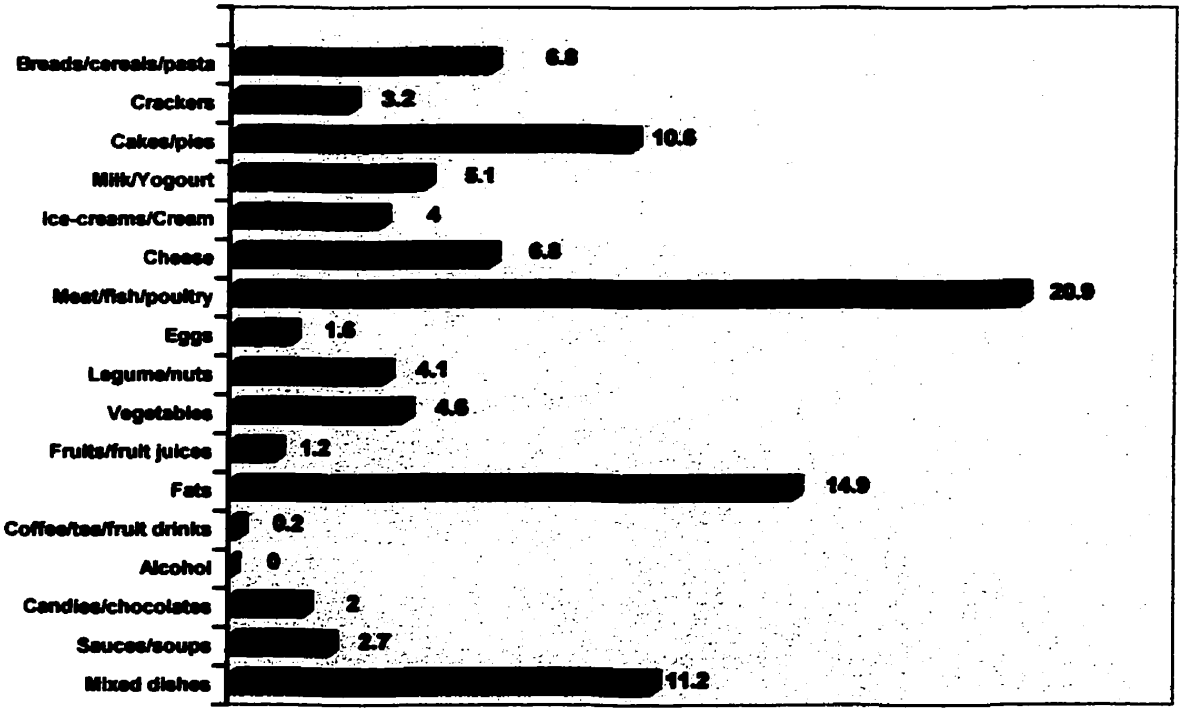


Figure 5: Percent Contribution of 17 Food Groups to the Mean Saturated Fat Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 23.3 g)

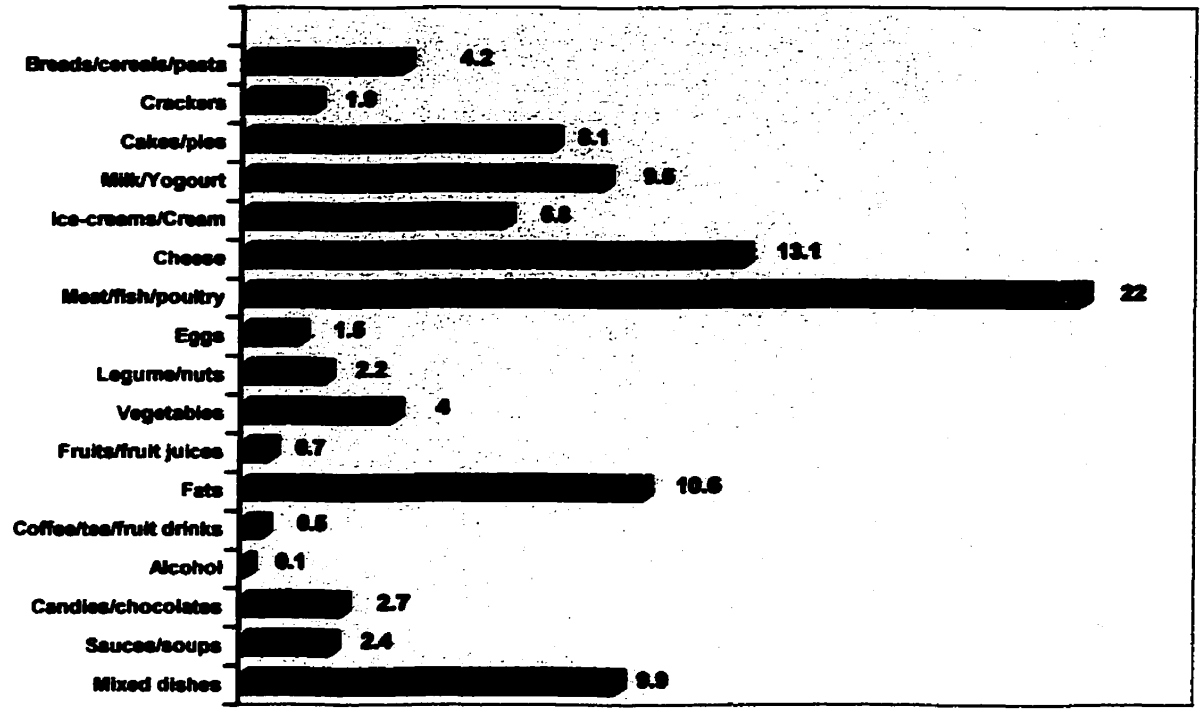


Figure 6: Percent Contribution of 17 Food Groups to the Mean Cholesterol Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 260 mg)

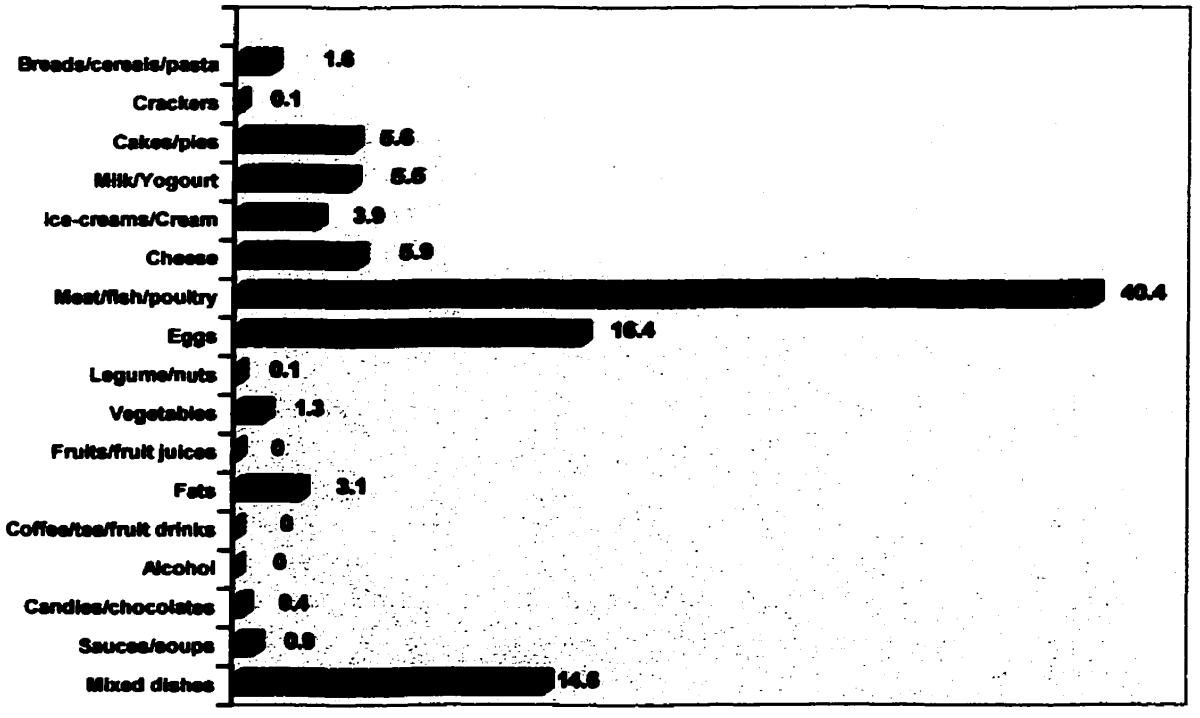


Figure 7: Percent Contribution of 17 Food Groups to the Mean Fiber Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 15.3 g)

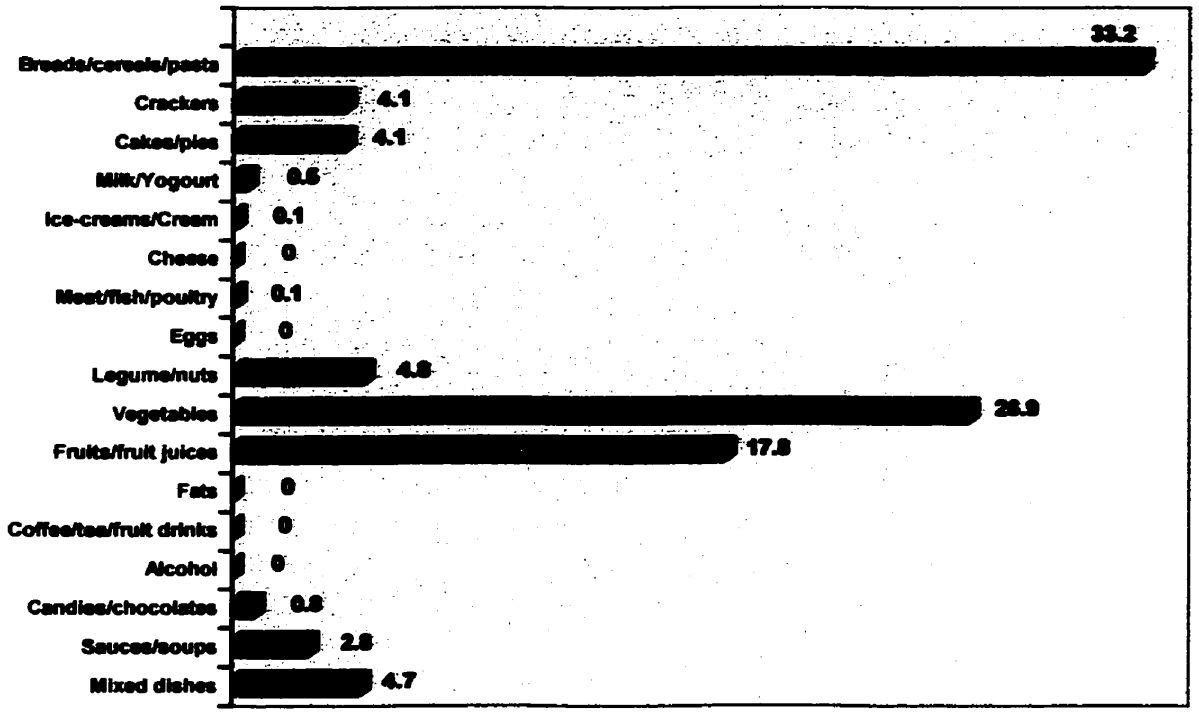


Figure 8: Percent Contribution of 17 Food Groups to the Mean Calcium Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 866 mg)

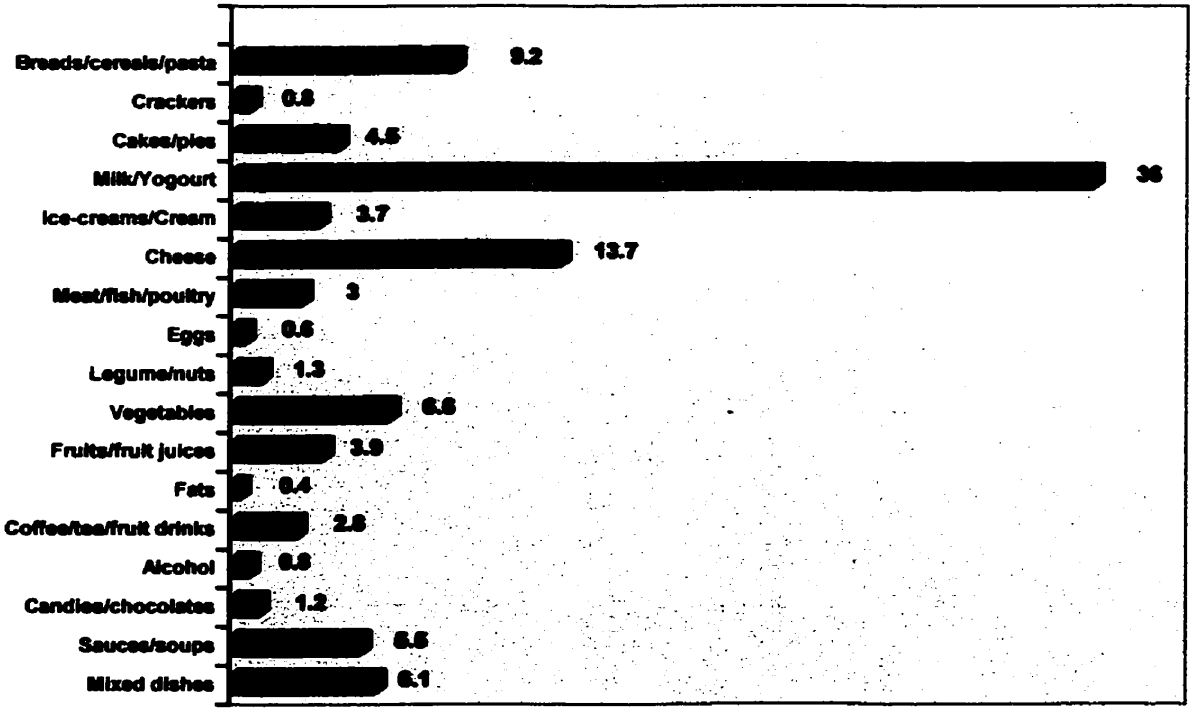


Figure 9: Percent Contribution of 17 Food Groups to the Mean Folate Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 264 mcg)

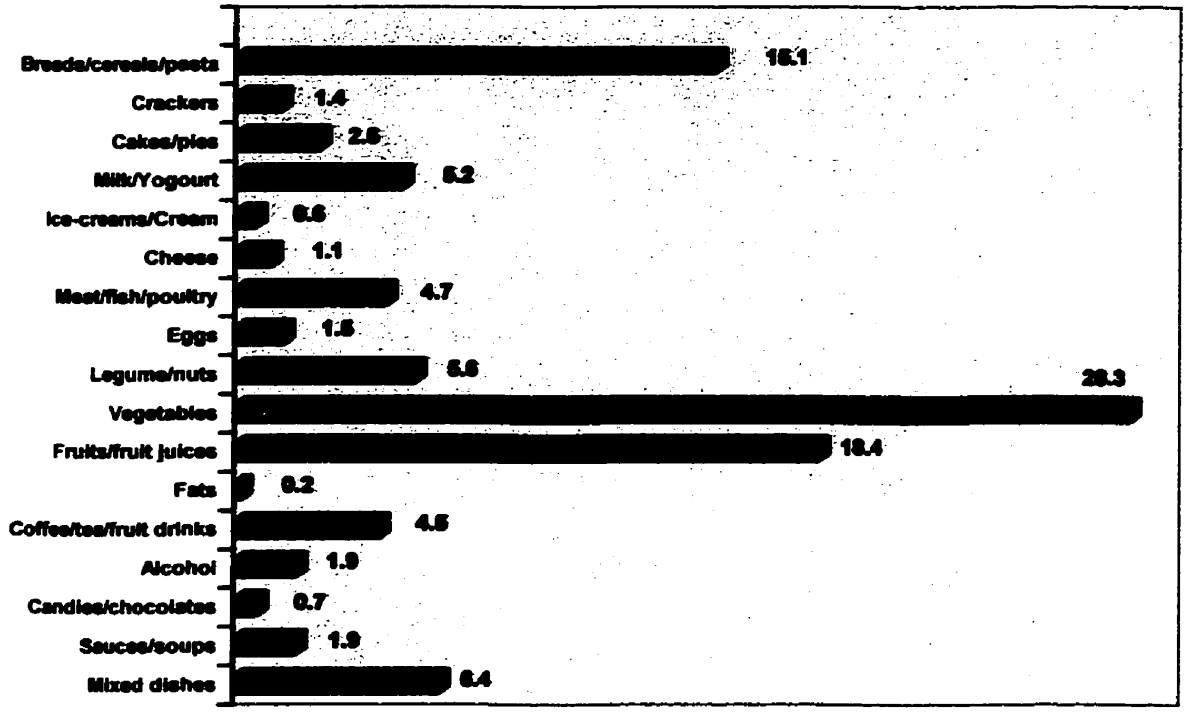


Figure 10: Percent Contribution of 17 Food Groups to the Mean Iron Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 15.3 mg)

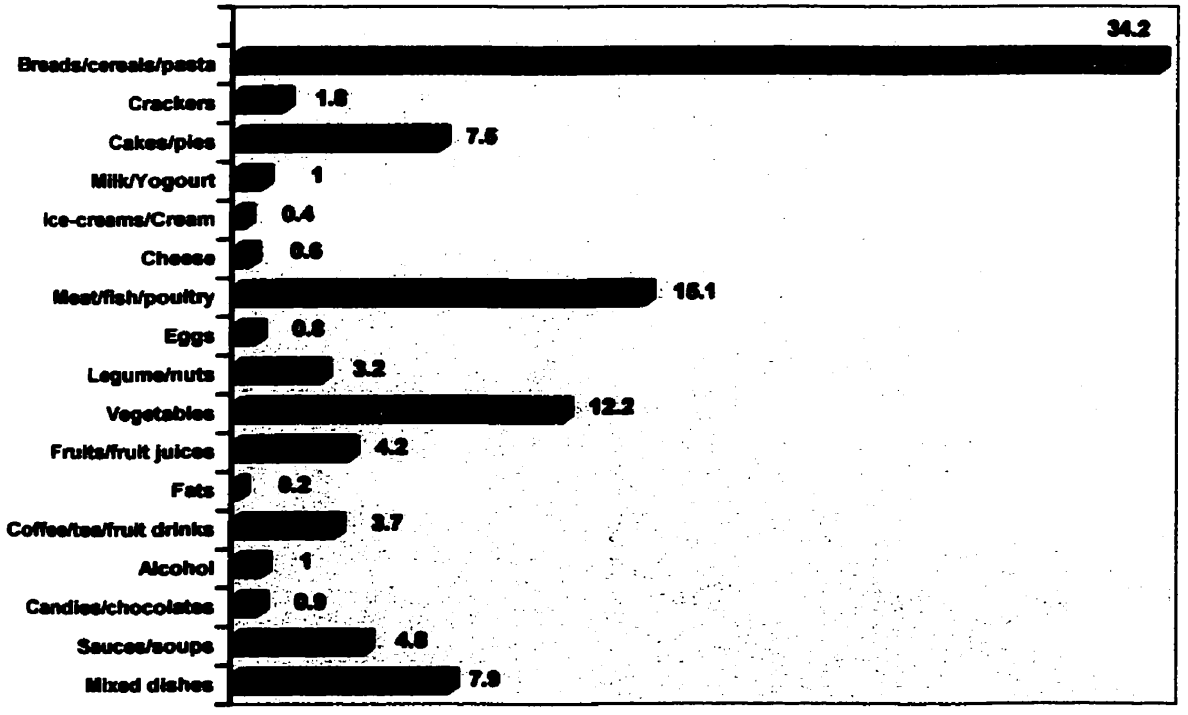


Figure 11: Percent Contribution of 17 Food Groups to the Mean Zinc Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 11.9 mg)

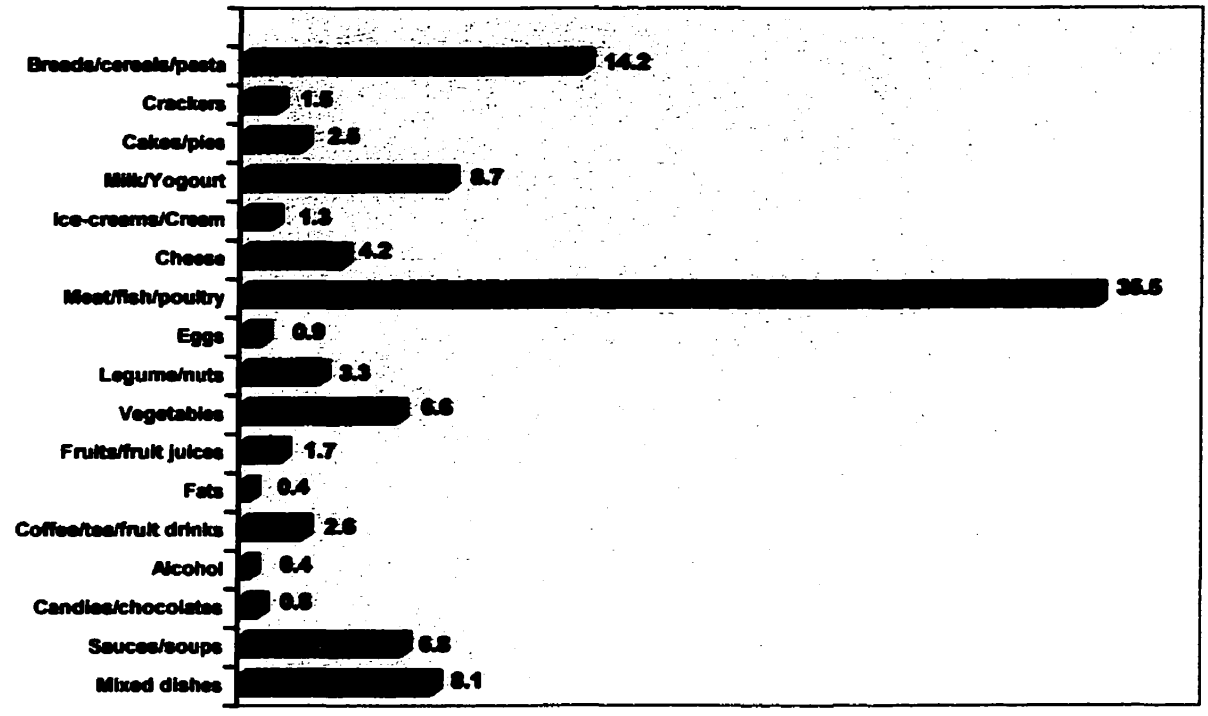


Figure 12: Percent Contribution of 17 Food Groups to the Mean Vitamin A Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 1286 RE)

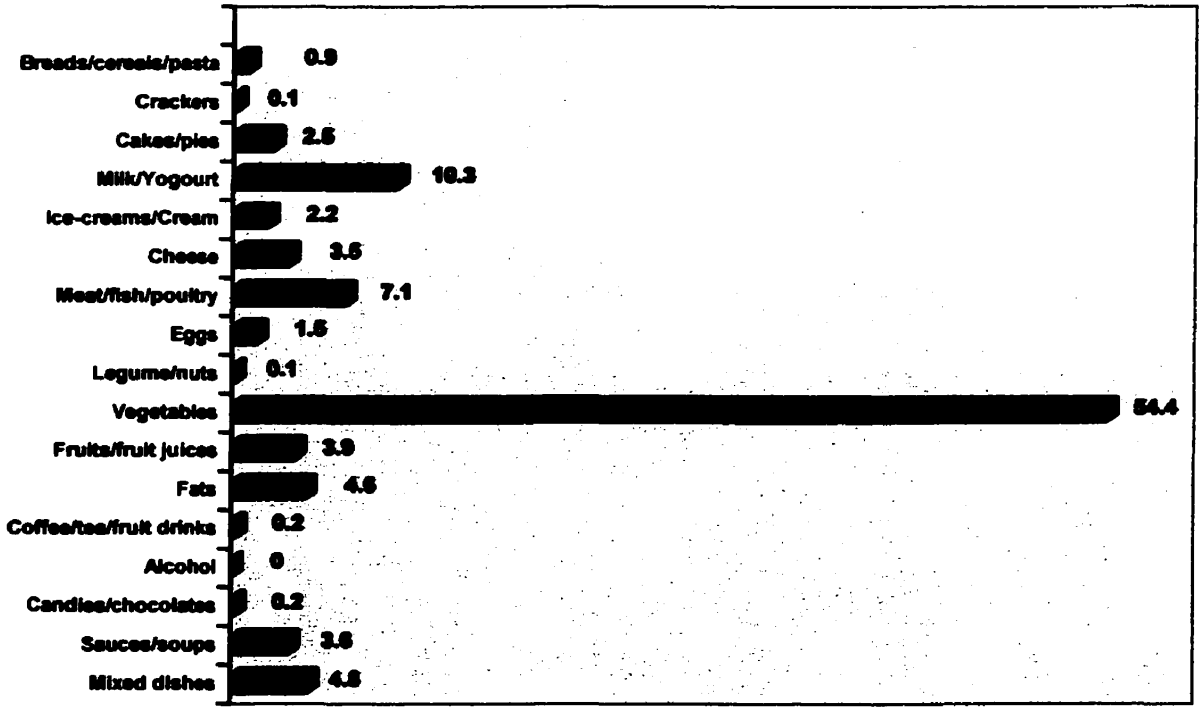
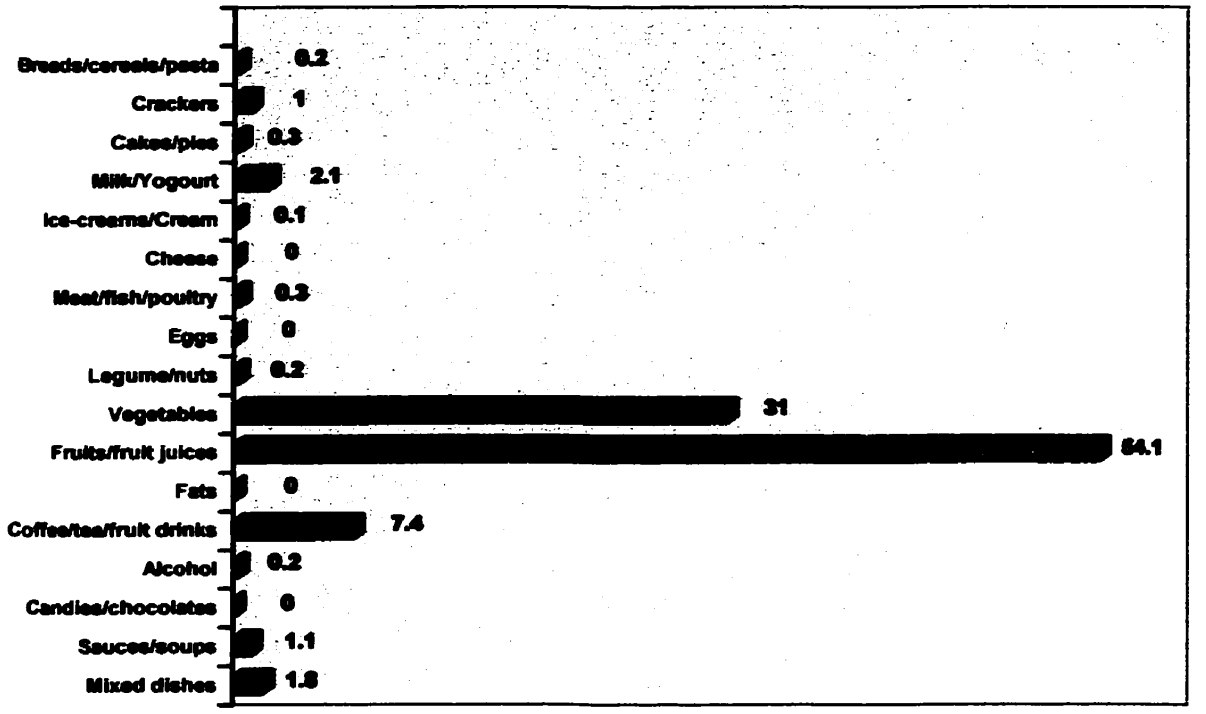


Figure 13: Percent Contribution of 17 Food Groups to the Mean Vitamin C Intake of Canadian Males & Females Aged 18-65 yrs (N= 1543, Mean= 143 mg)



APPENDIX C

Figure 14: Percent Contribution of 51 Food Groups to the Mean Energy Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 2628 kcal)

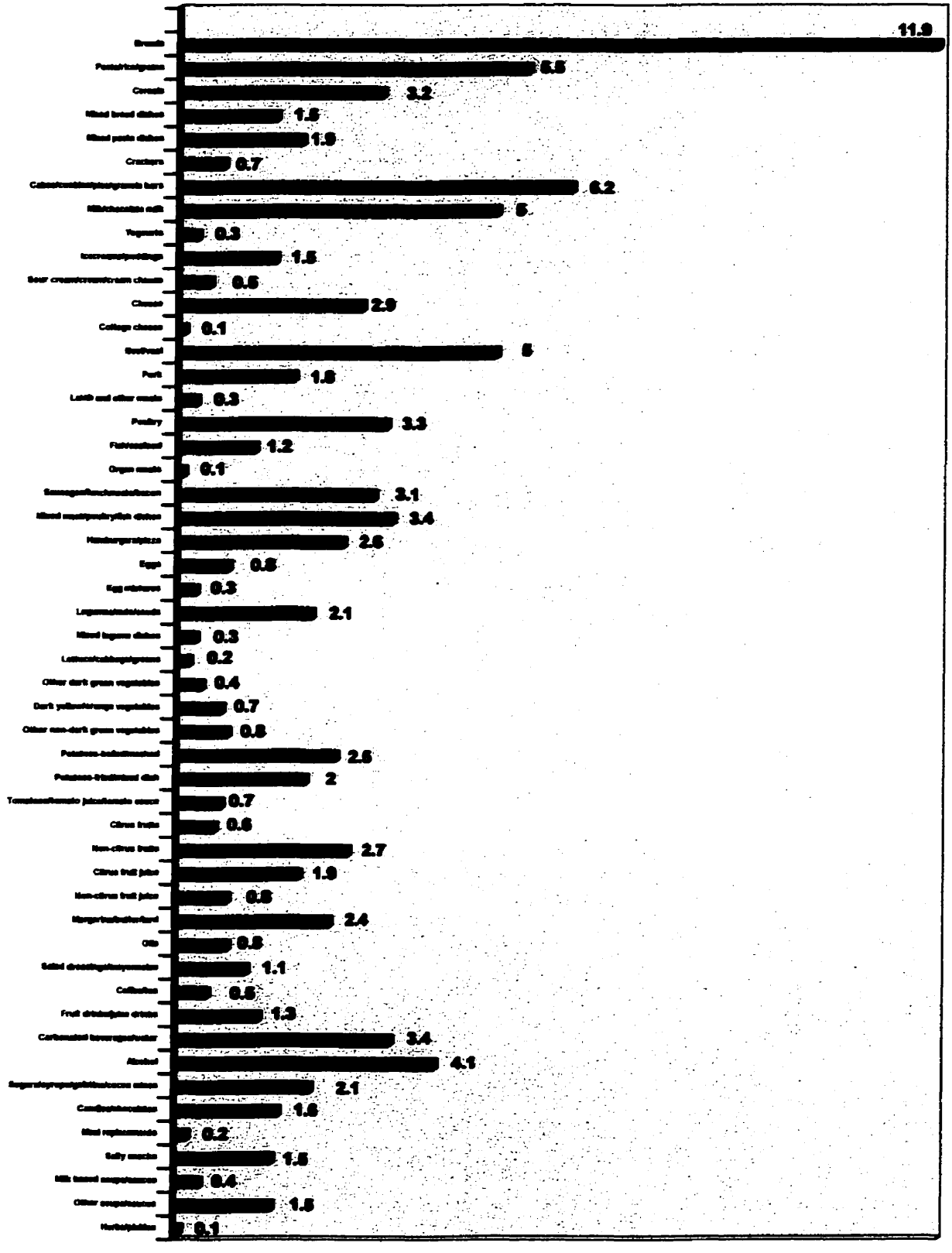


Figure 15: Percent Contribution of 51 Food Groups to the Mean Carbohydrate Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 332 g)

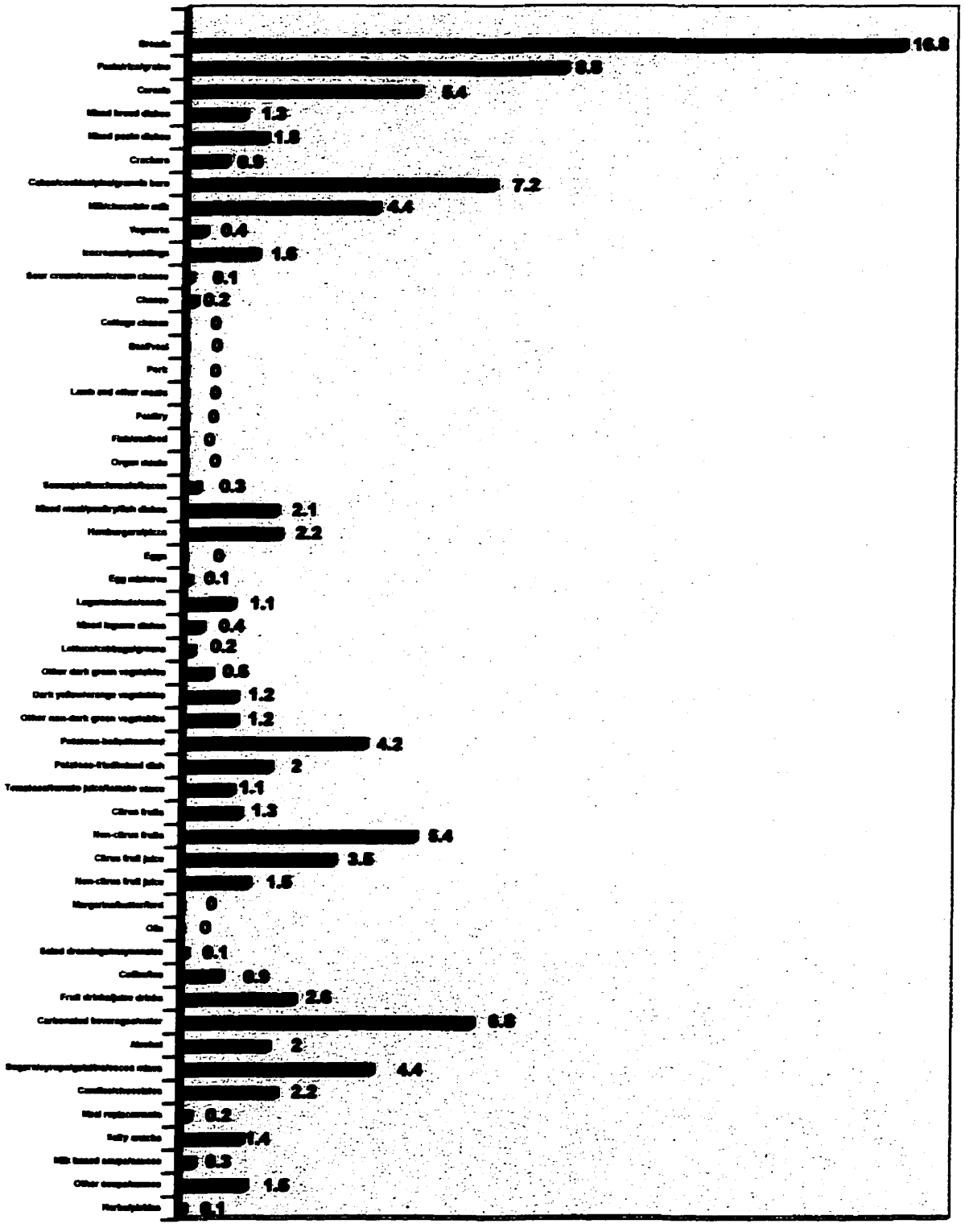


Figure 16: Percent Contribution of 51 Food Groups to the Mean Protein Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 110 g)

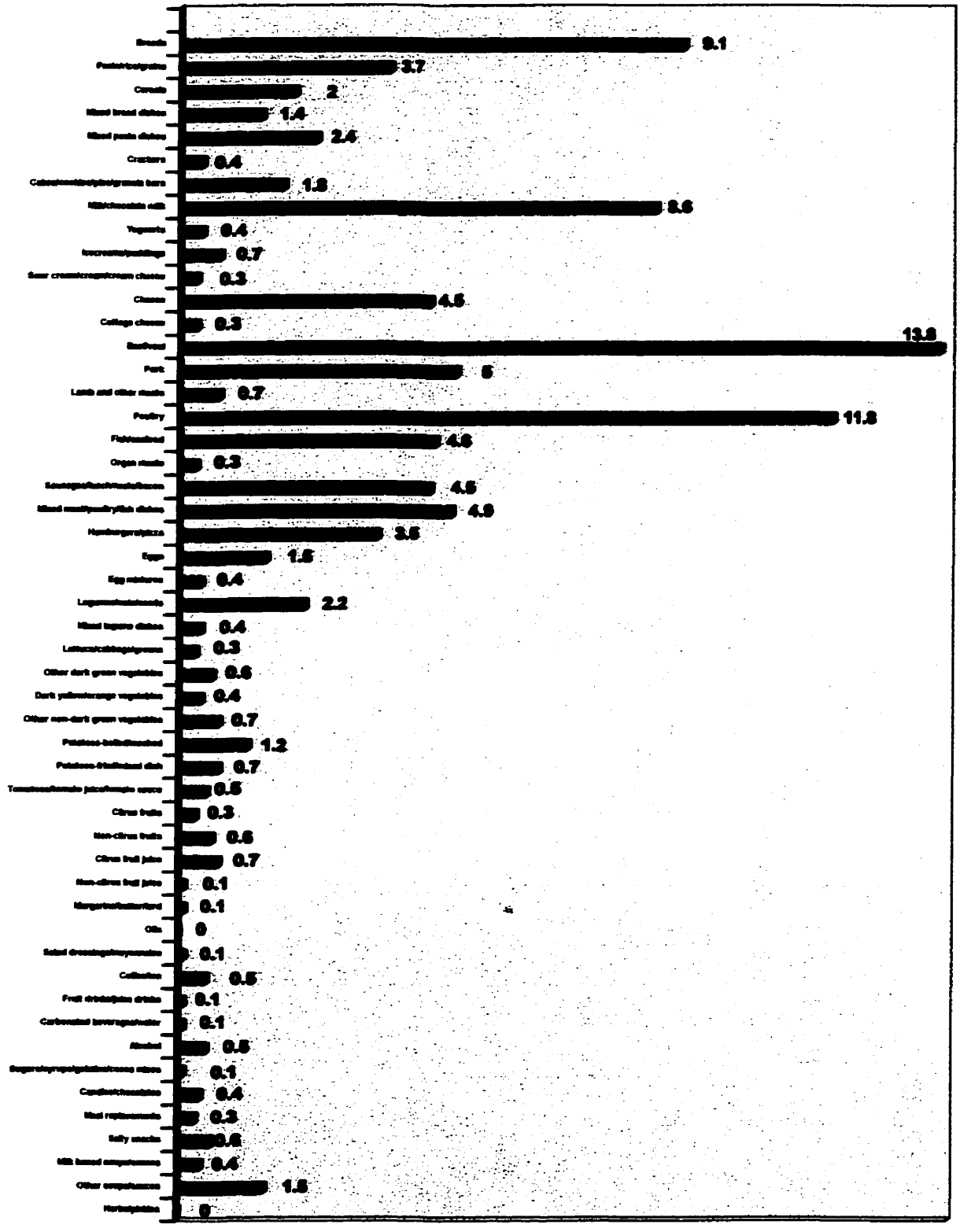


Figure 17: Percent Contribution of 51 Food Groups to the Mean Total Fat Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 90.6 g)

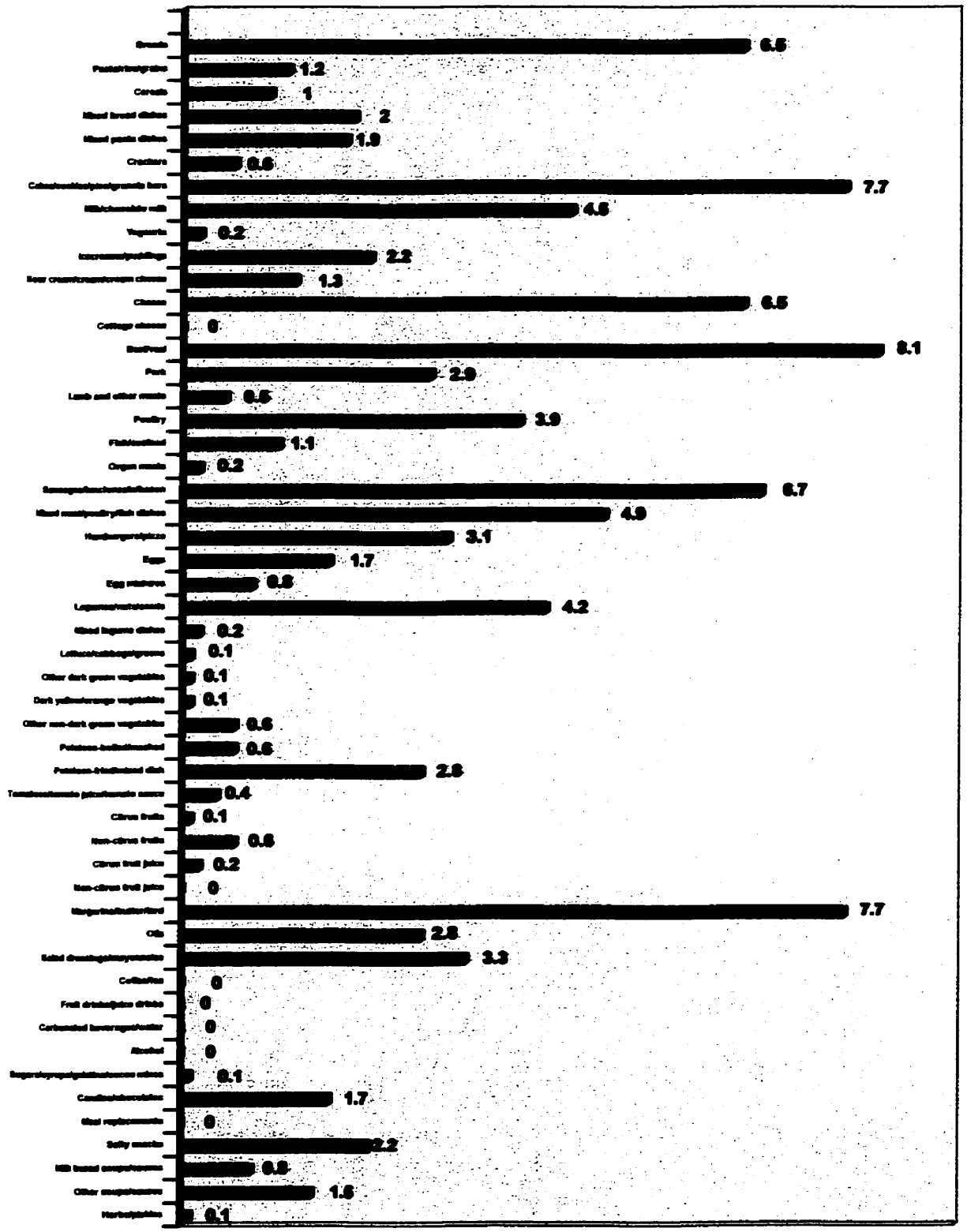


Figure 18: Percent Contribution of 51 Food Groups to the Mean Saturated Fat Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 29.3 g)

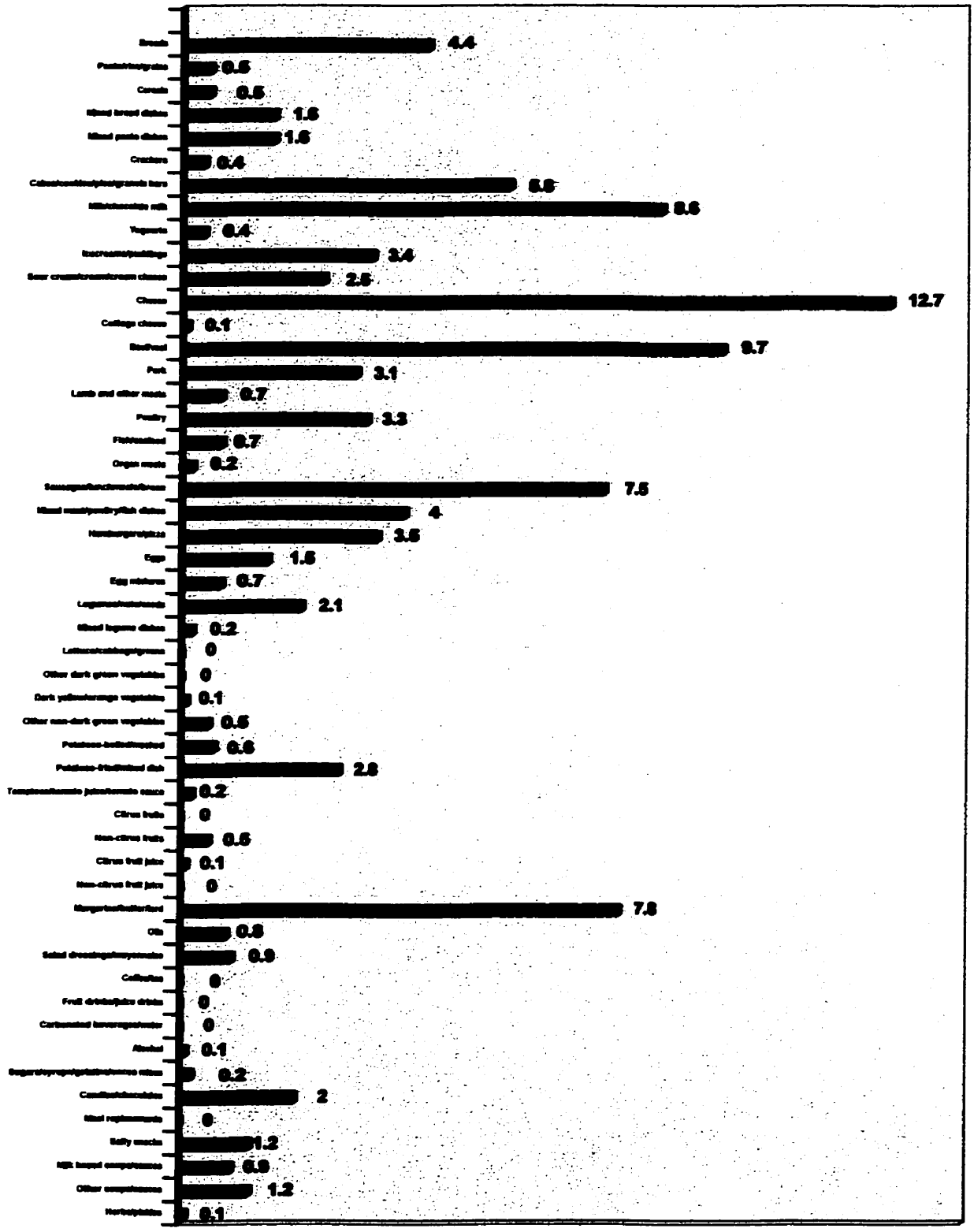


Figure 19: Percent Contribution of 51 Food Groups to the Mean Cholesterol Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 332 mg)

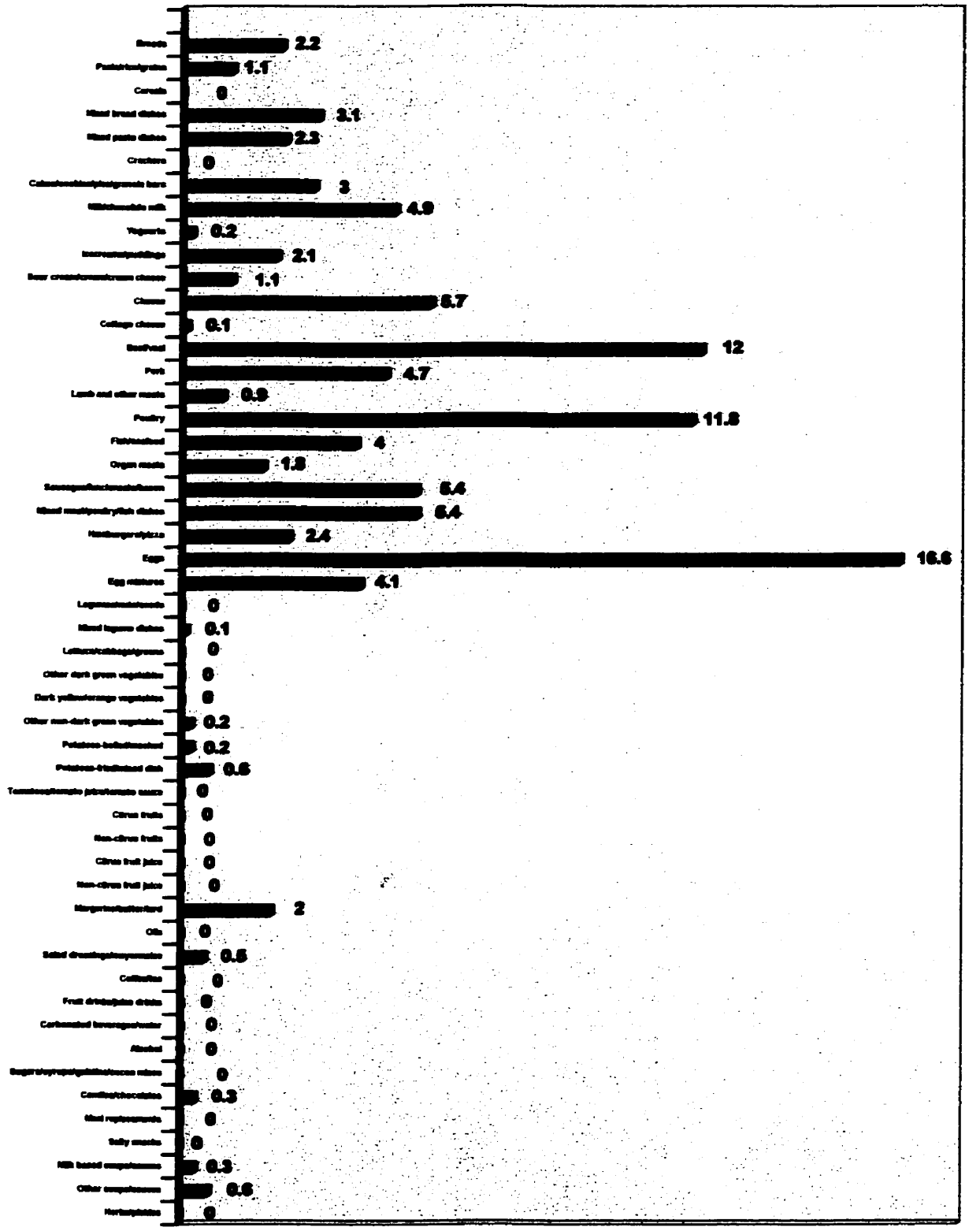


Figure 20: Percent Contribution of 51 Food Groups to the Mean Fiber Intake of Canadian Males Aged 18-65 years
(N= 572, Mean= 17.4 g)

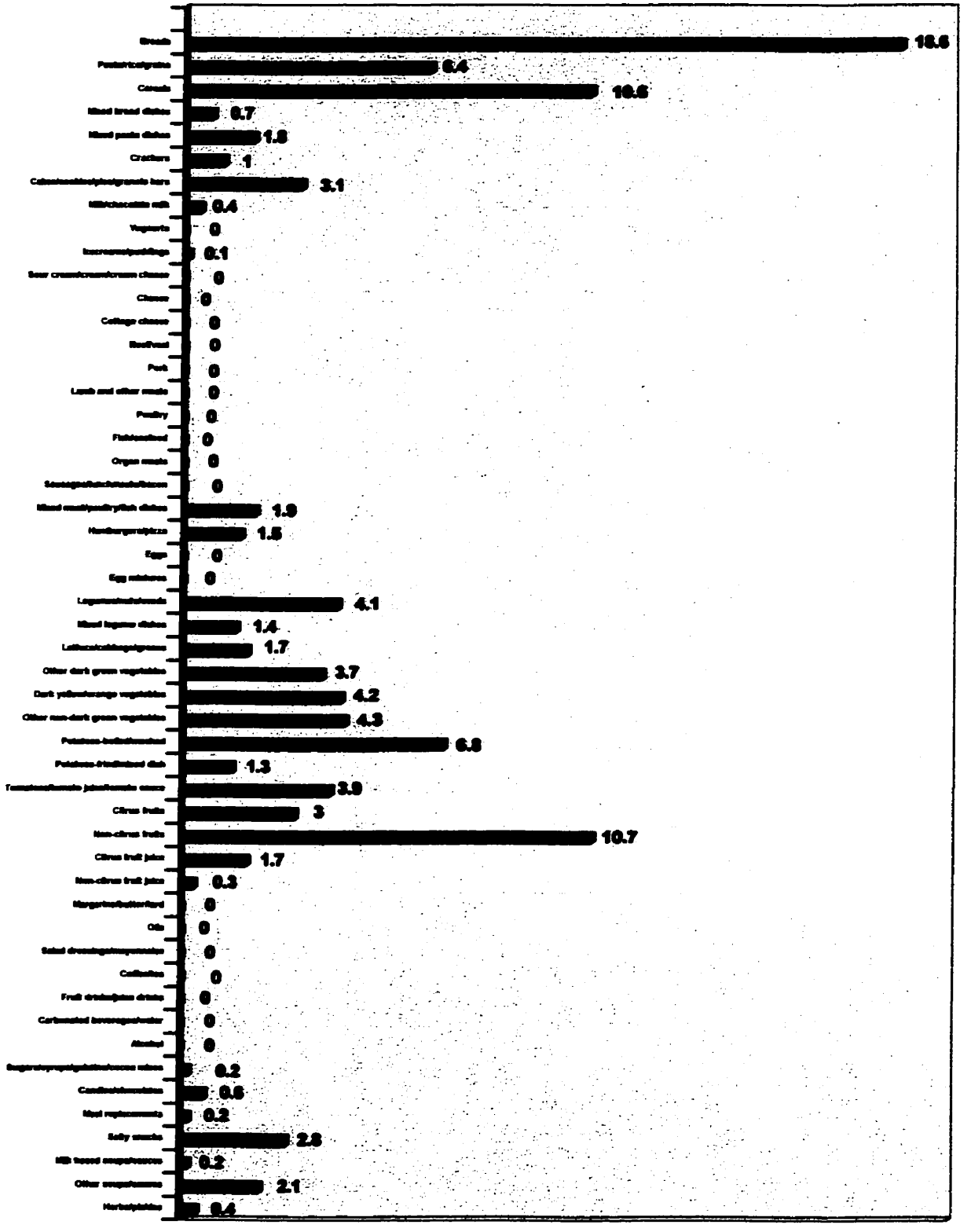


Figure 21: Percent Contribution of 51 Food Groups to the Mean Calcium Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 1014 mg)

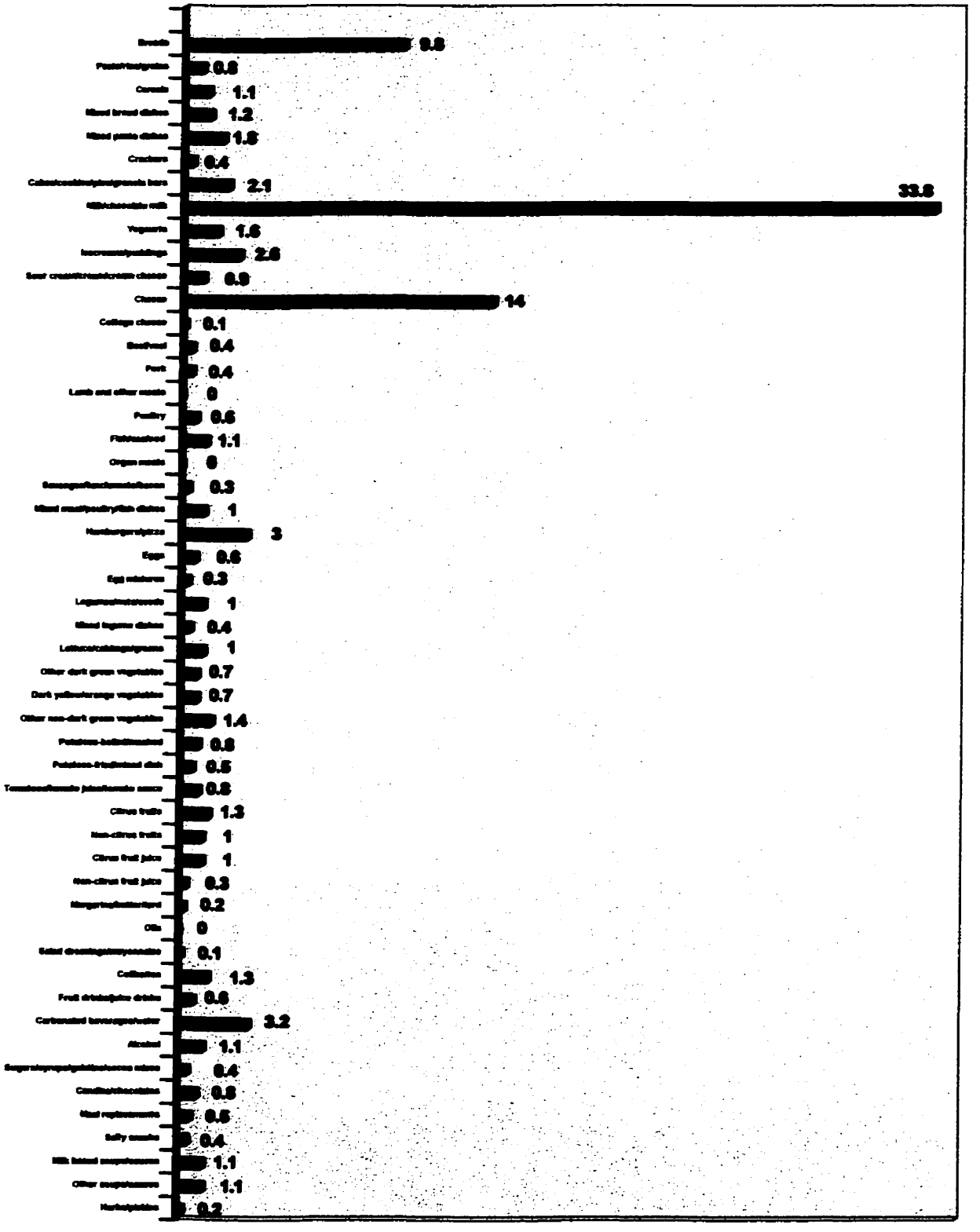


Figure 22: Percent Contribution of 51 Food Groups to the Mean Folate Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 307 mcg)

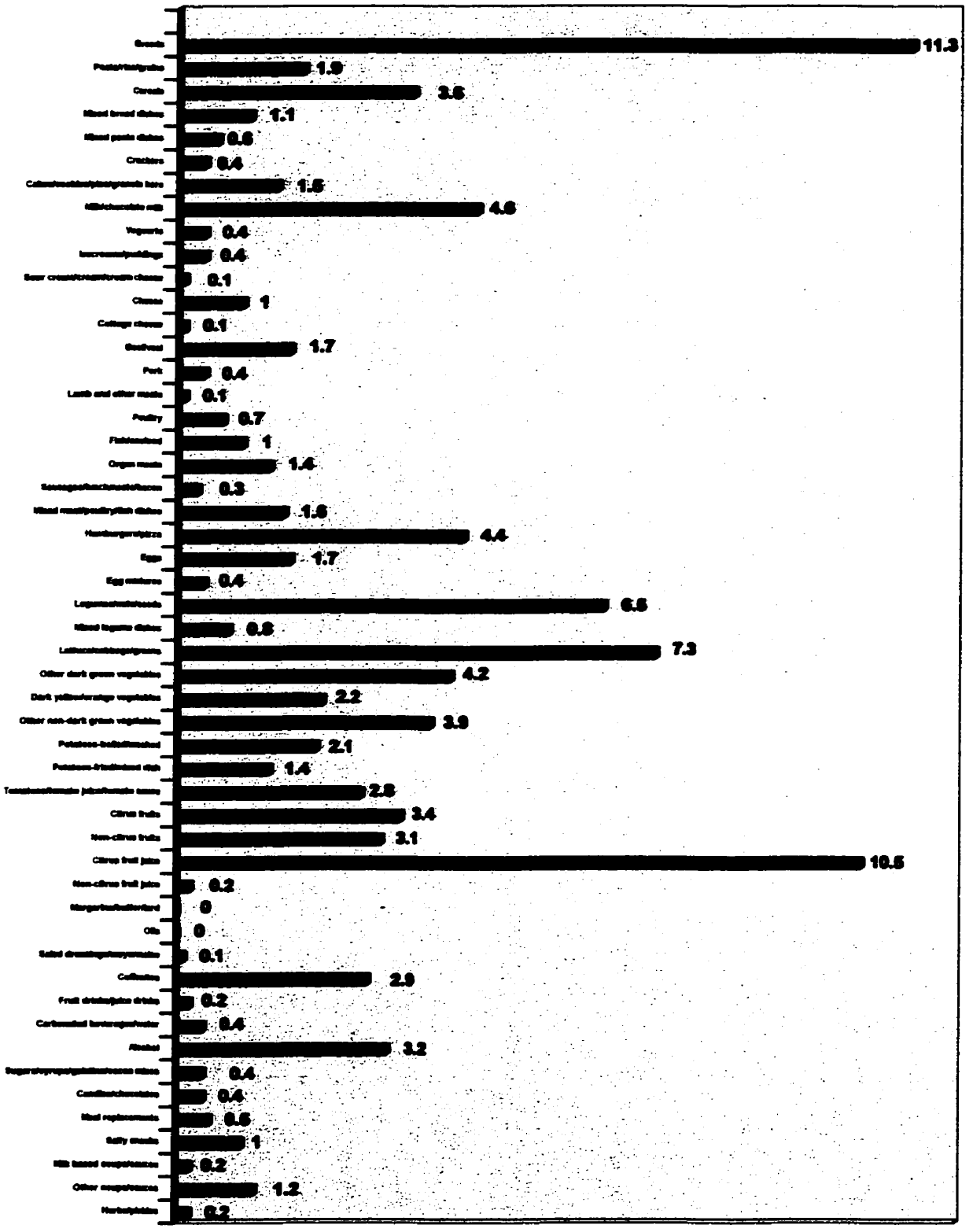


Figure 23: Percent Contribution of 51 Food Groups to the Mean Iron Intake of Canadian Males Aged 18-65 years
(N= 572, Mean= 18.7 mg)

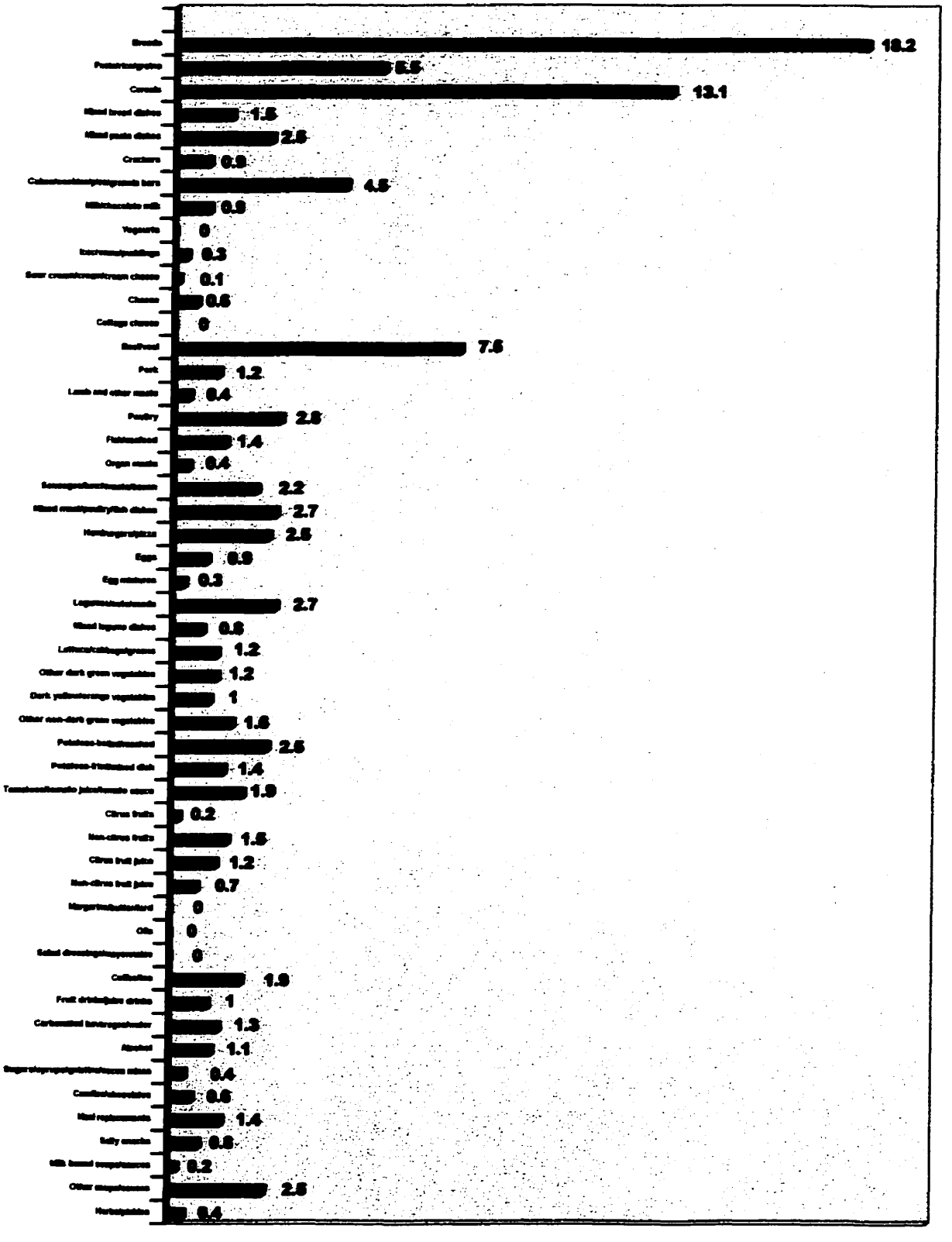


Figure 24: Percent Contribution of 51 Food Groups to the Mean Zinc Intake of Canadian Males Aged 18-65 years
(N= 572, Mean=14.8 mg)

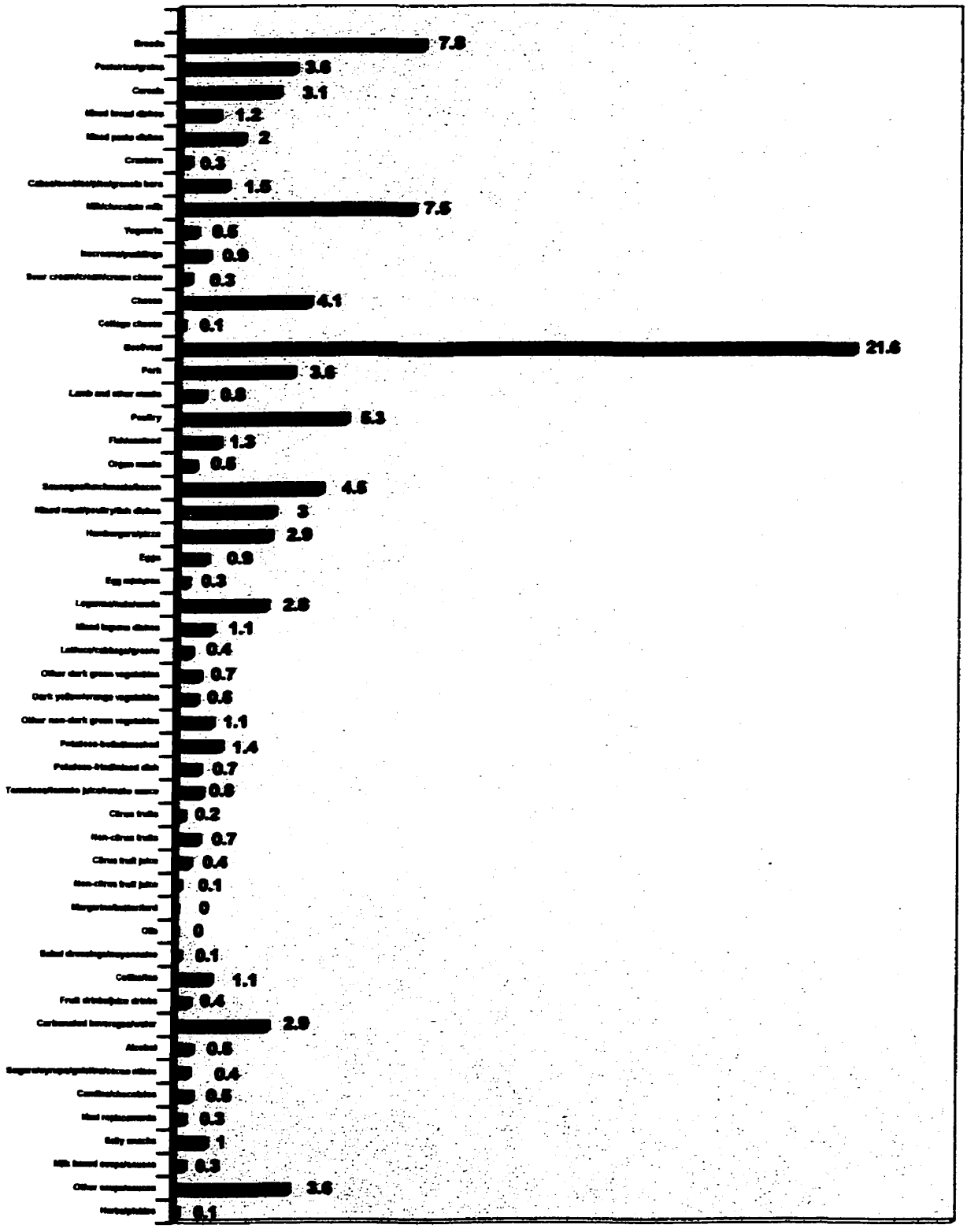


Figure 25: Percent Contribution of 51 Food Groups to the Mean Vitamin A Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 1459 RE)

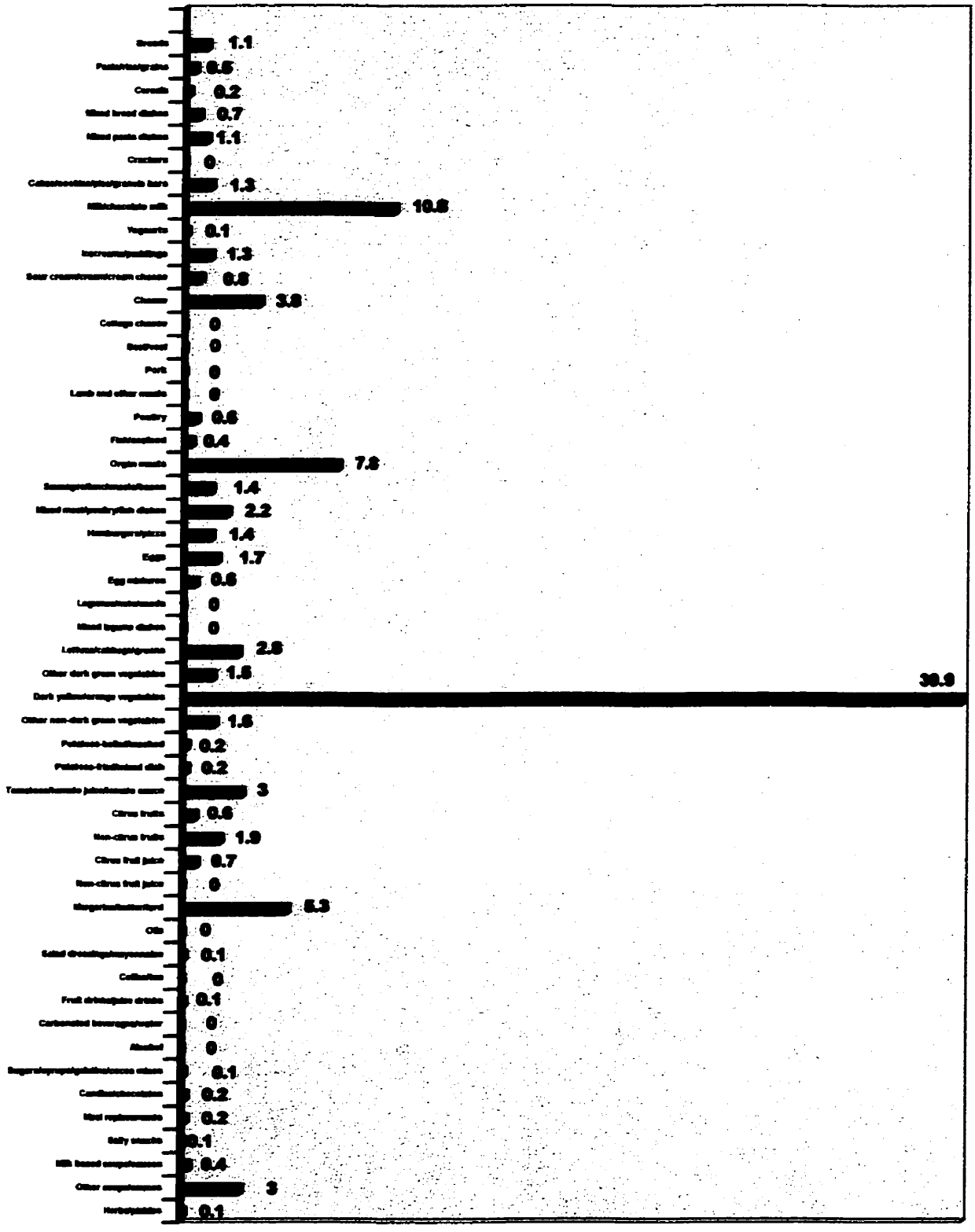


Figure 26: Percent Contribution of 51 Food Groups to the Mean Vitamin C Intake of Canadian Males Aged 18-65 years (N= 572, Mean= 157 mg)

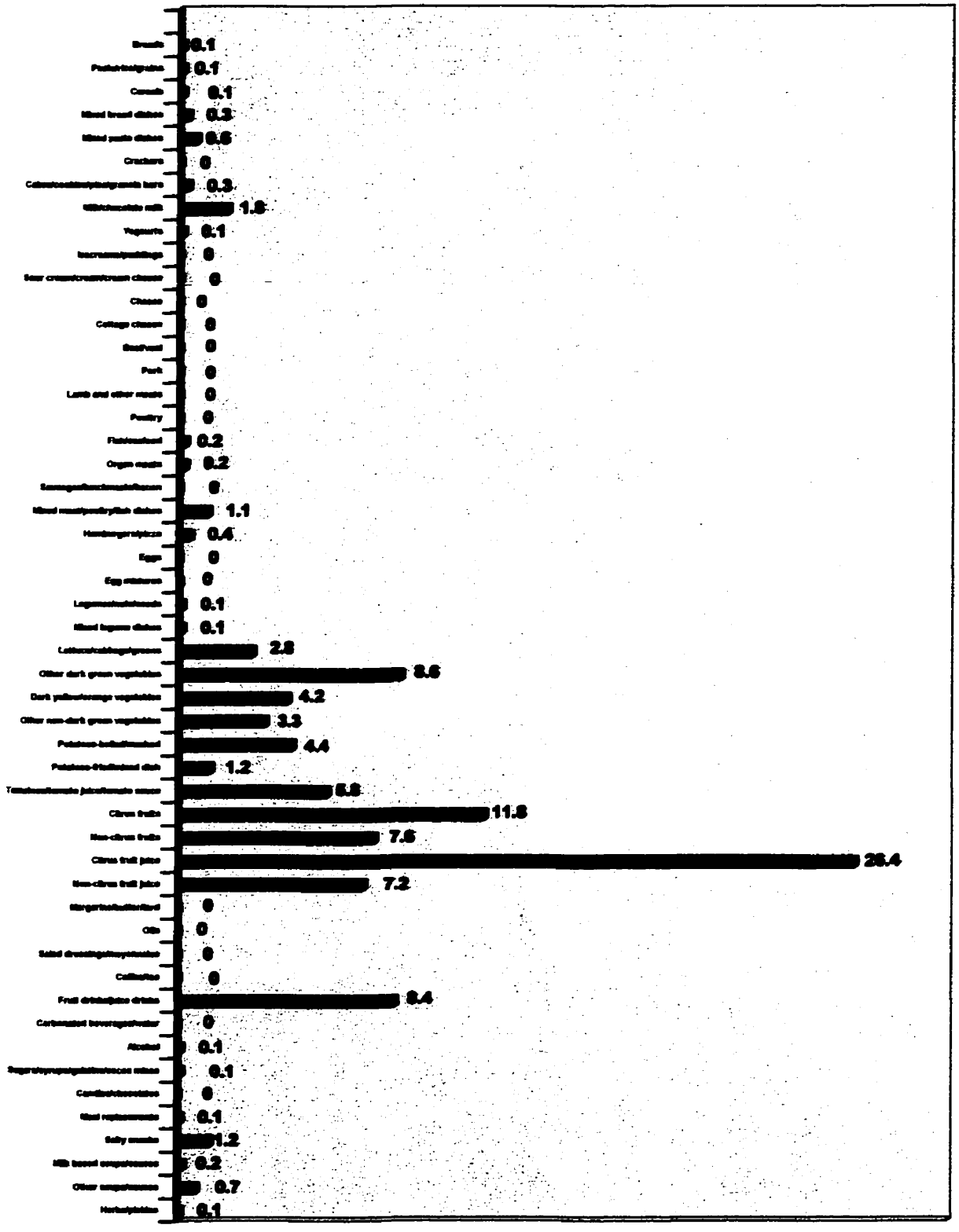


Figure 27: Percent Contribution of 51 Food Groups to the Mean Energy Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 1803 kcal)

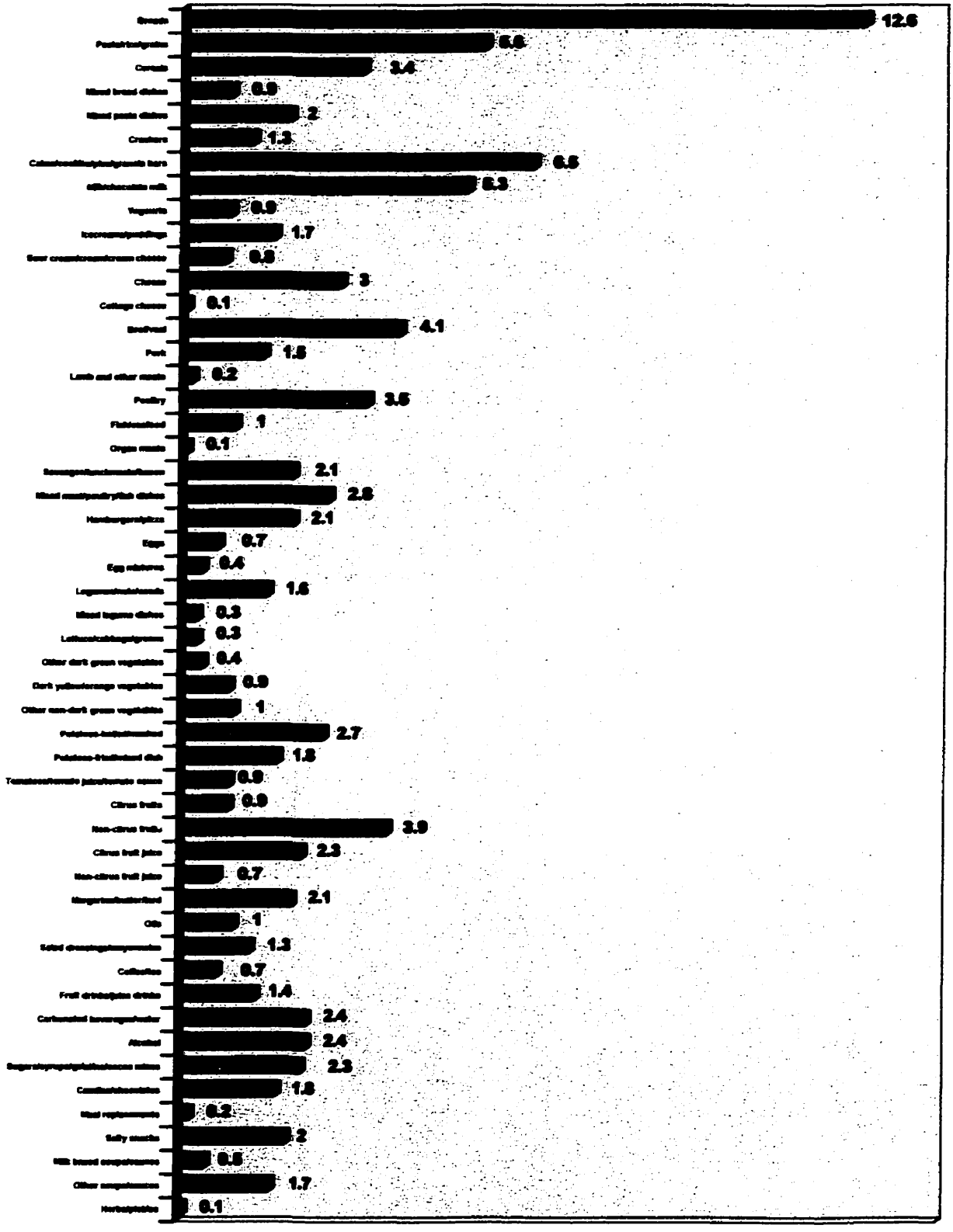


Figure 28: Percent Contribution of 51 Food Groups to the Mean Carbohydrate Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 240 g)

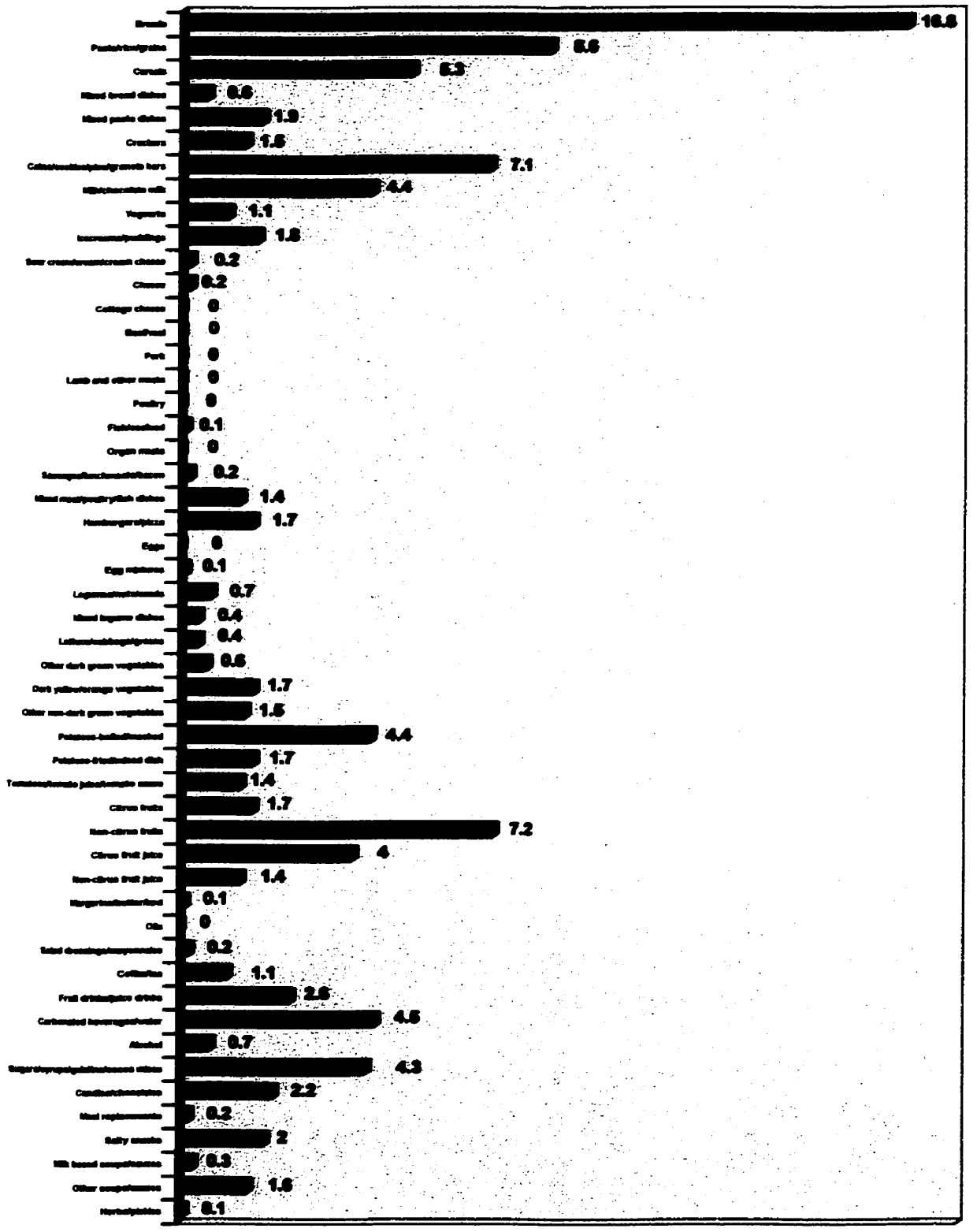


Figure 29: Percent Contribution of 51 Food Groups to the Mean Protein Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 74.2 g)

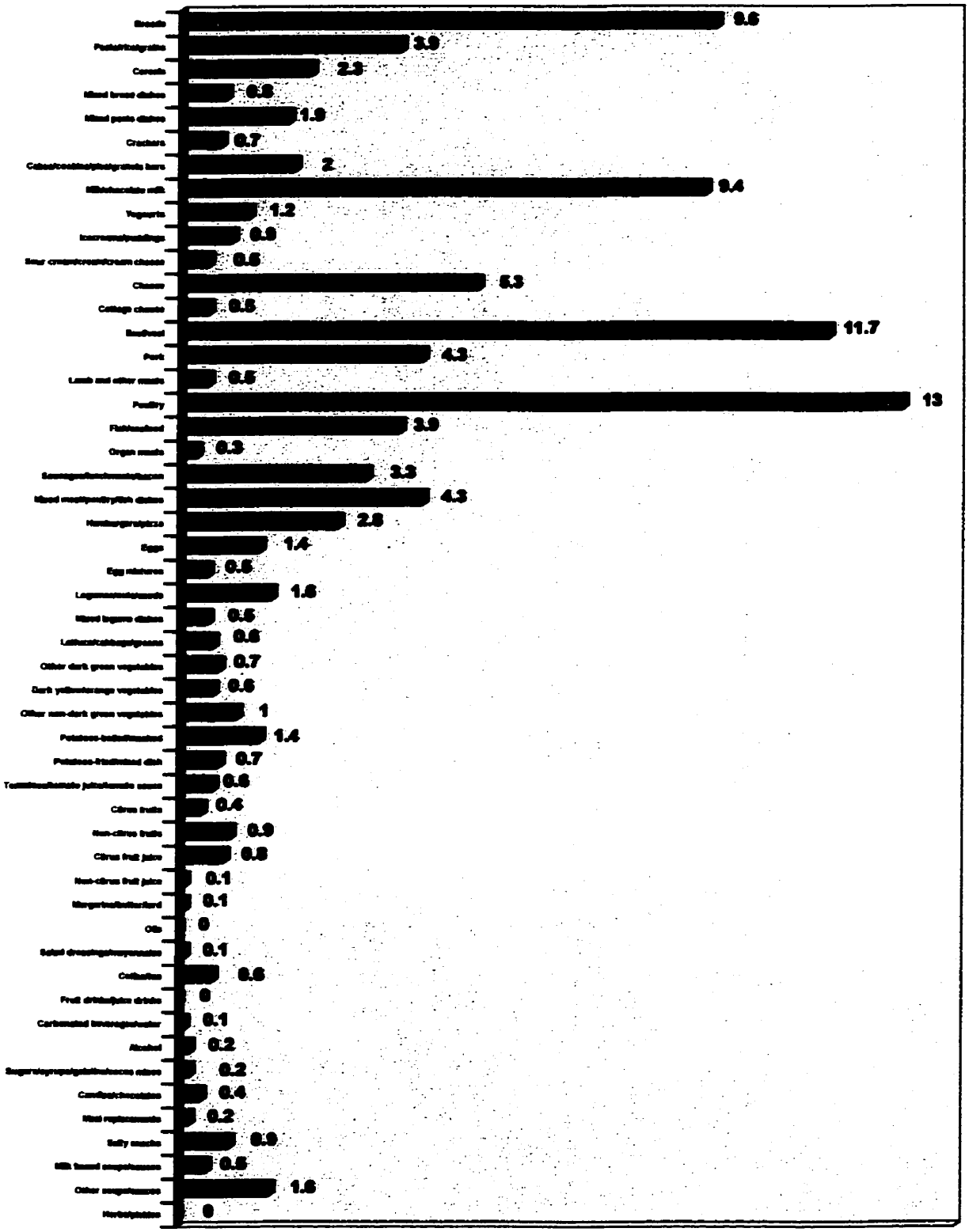


Figure 30: Percent Contribution of 51 Food Groups to the Mean Total Fat Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 60.5 g)

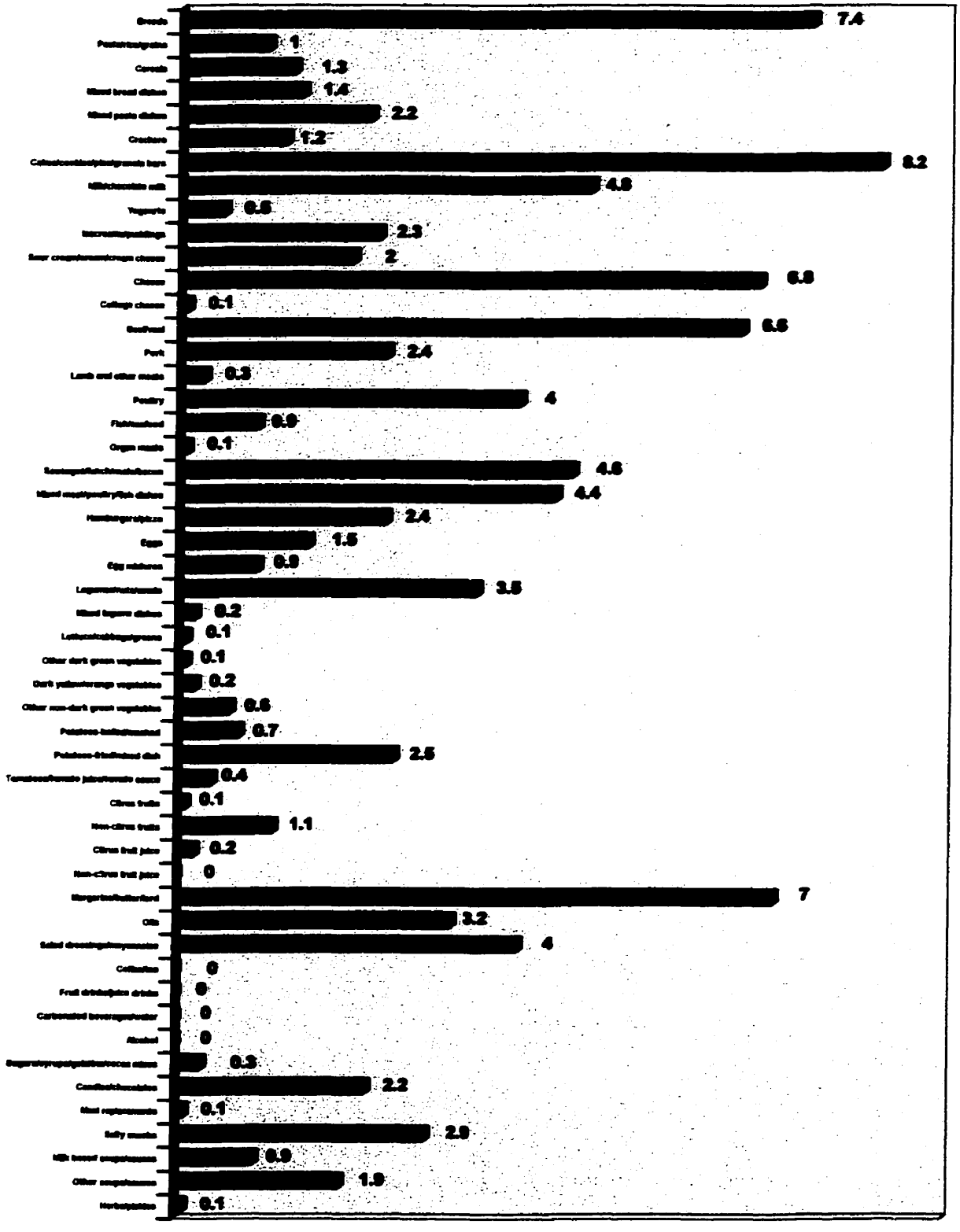


Figure 31: Percent Contribution of 51 Food Groups to the Mean Saturated Fat Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 19.8 g)

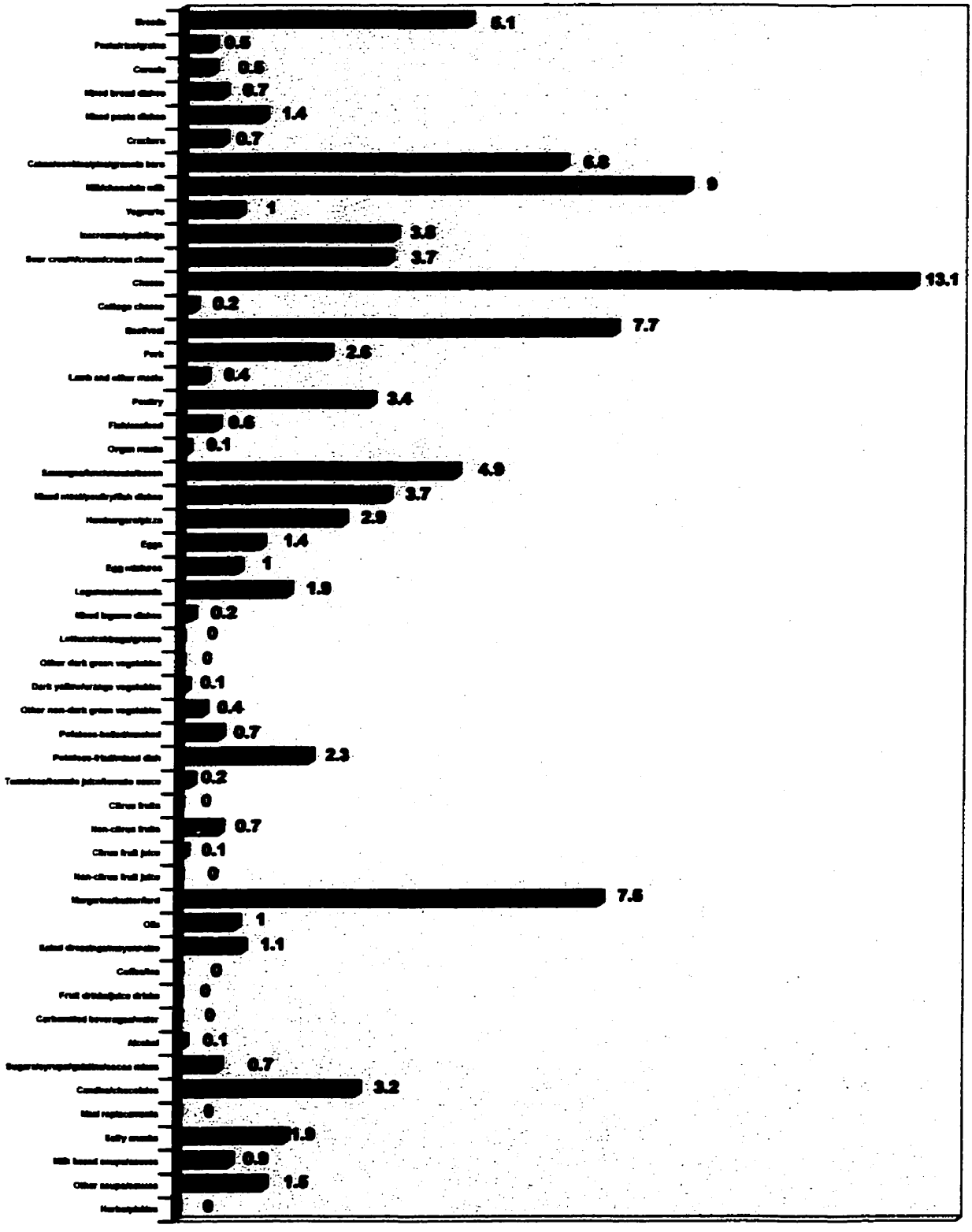


Figure 32: Percent Contribution of 51 Food Groups to the Mean Cholesterol Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 217 mg)

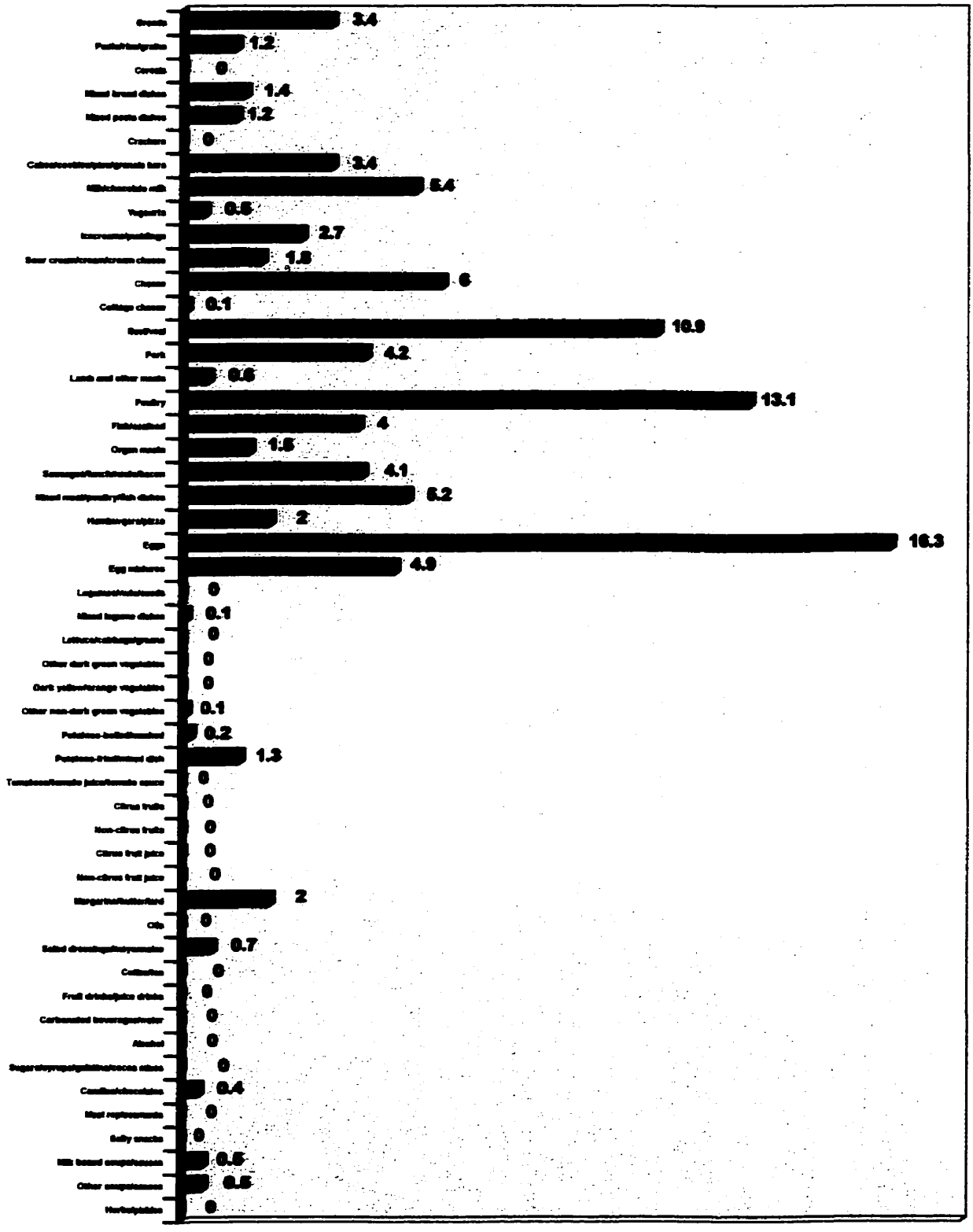


Figure 33: Percent Contribution of 51 Food Groups to the Mean Fiber Intake of Canadian Females Aged 18-65 years
(N= 971, Mean= 14.1 g)

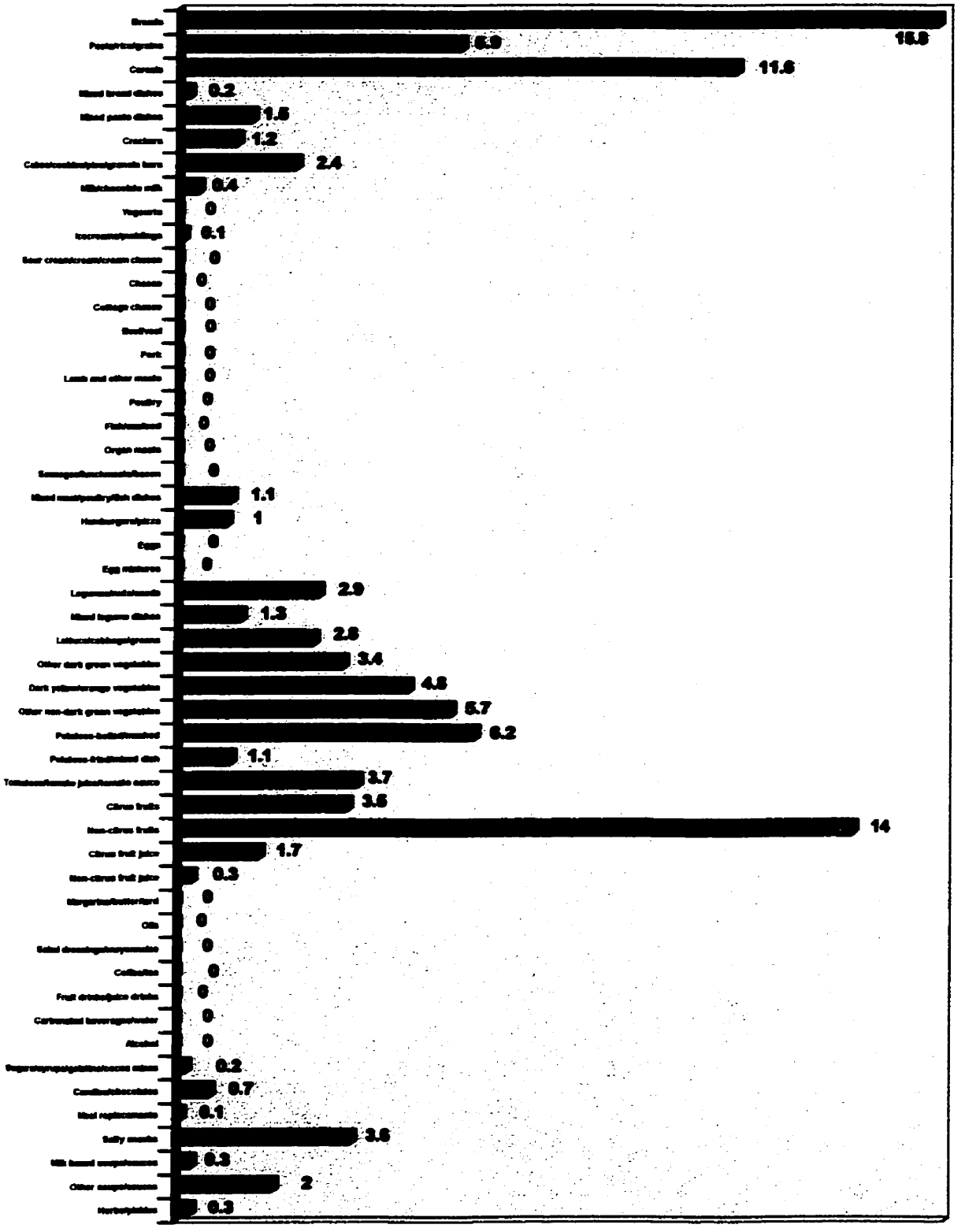


Figure 34: Percent Contribution of 51 Food Groups to the Mean Calcium Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 779 mg)

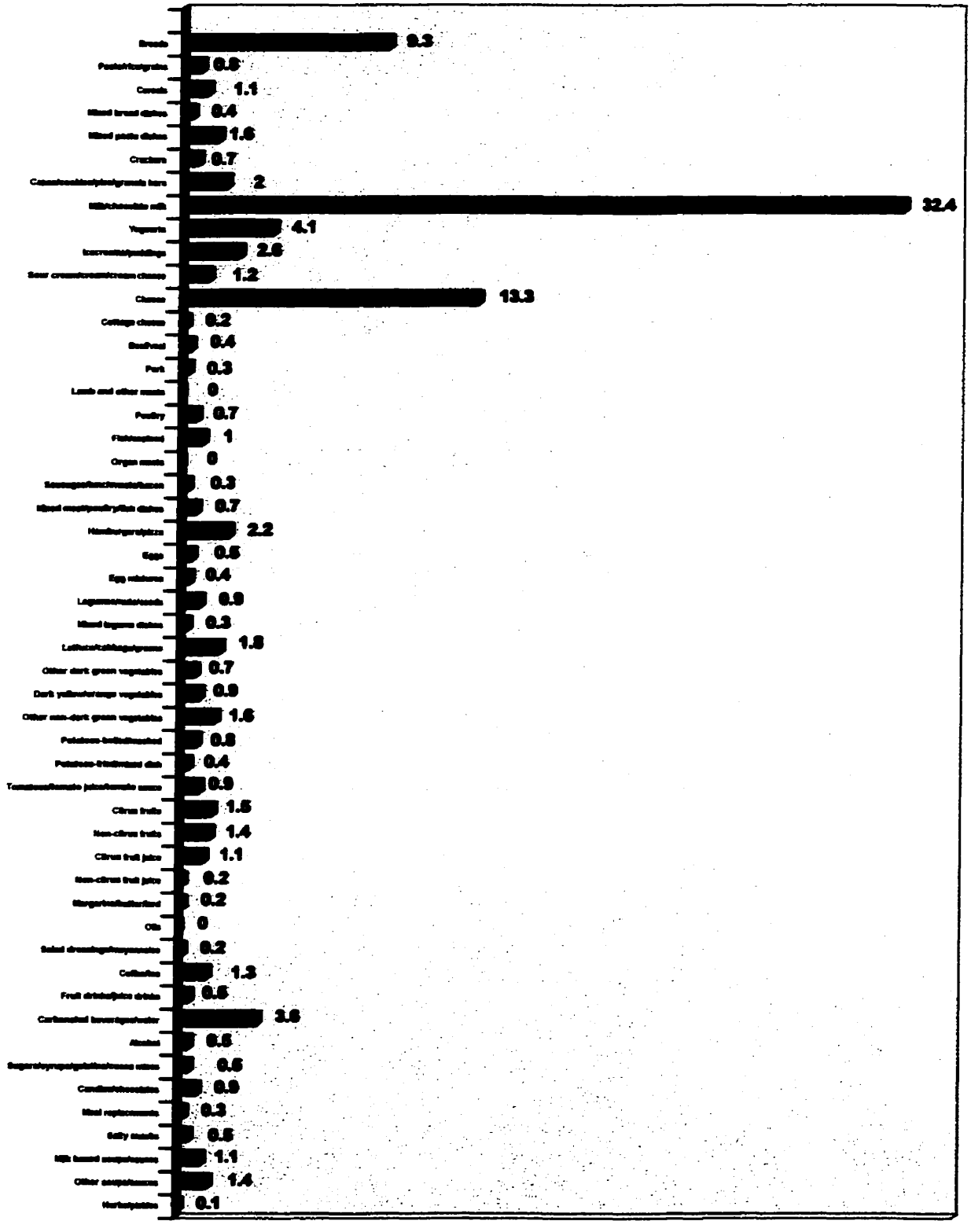


Figure 35: Percent Contribution of 51 Food Groups to the Mean Folate Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 239 mcg)

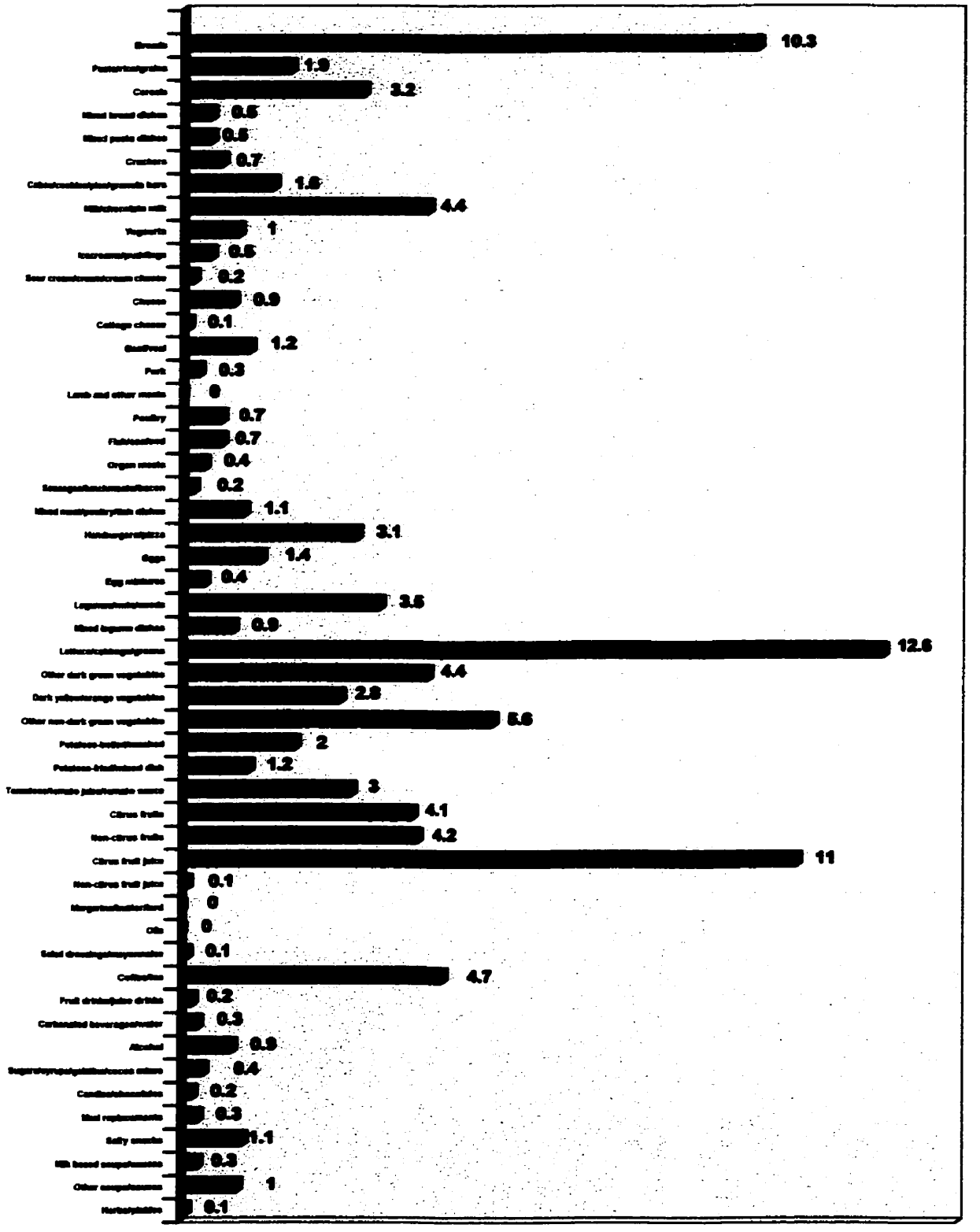


Figure 36: Percent Contribution of 51 Food Groups to the Mean Iron Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 13.2 mg)

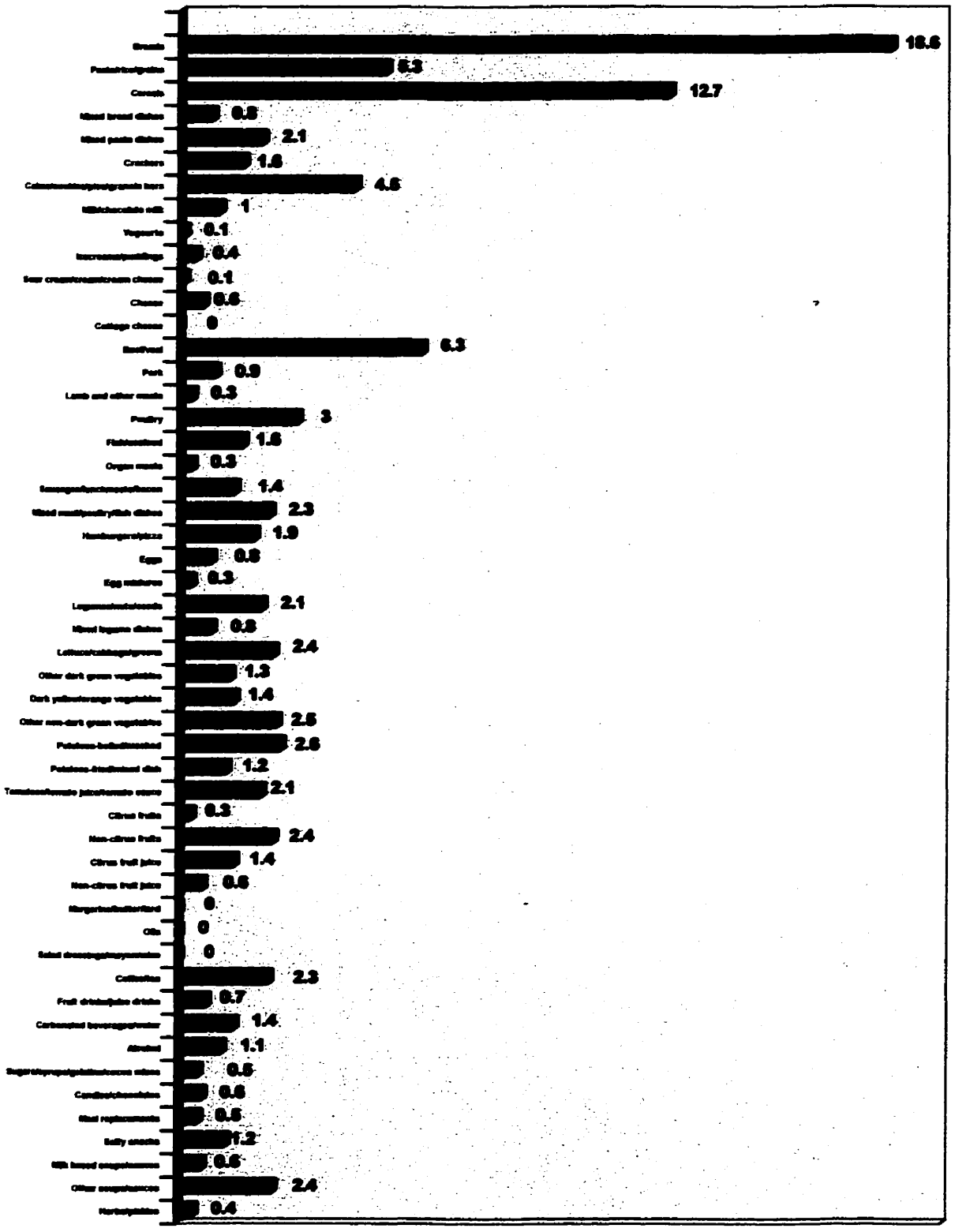


Figure 37: Percent Contribution of 51 Food Groups to the Mean Zinc Intake of Canadian Females Aged 18-65 years
(N= 971, Mean= 10.2mg)

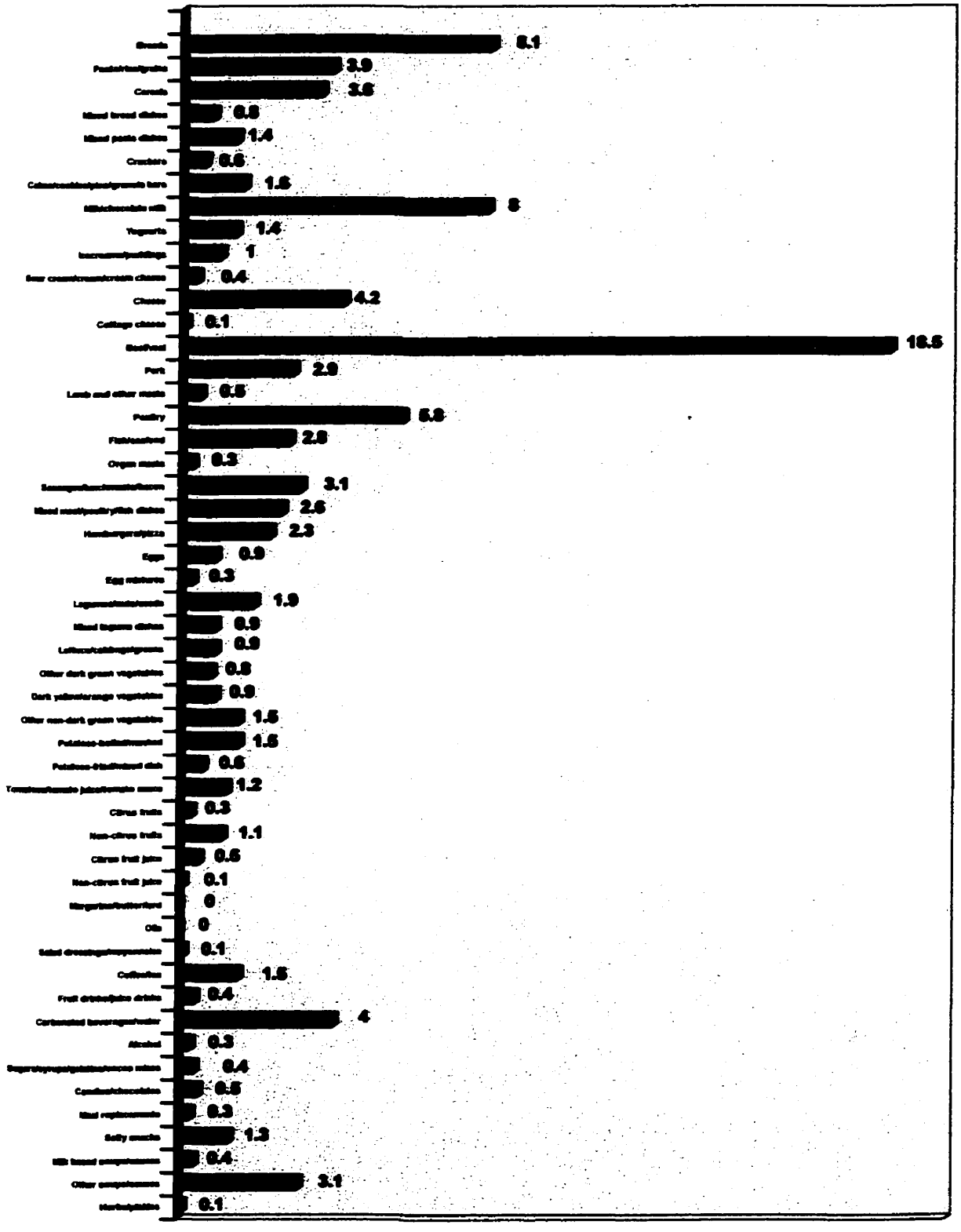


Figure 38: Percent Contribution of 51 Food Groups to the Mean Vitamin A Intake of Canadian Females Aged 18-65 years (N= 971, Mean= 1184 RE)

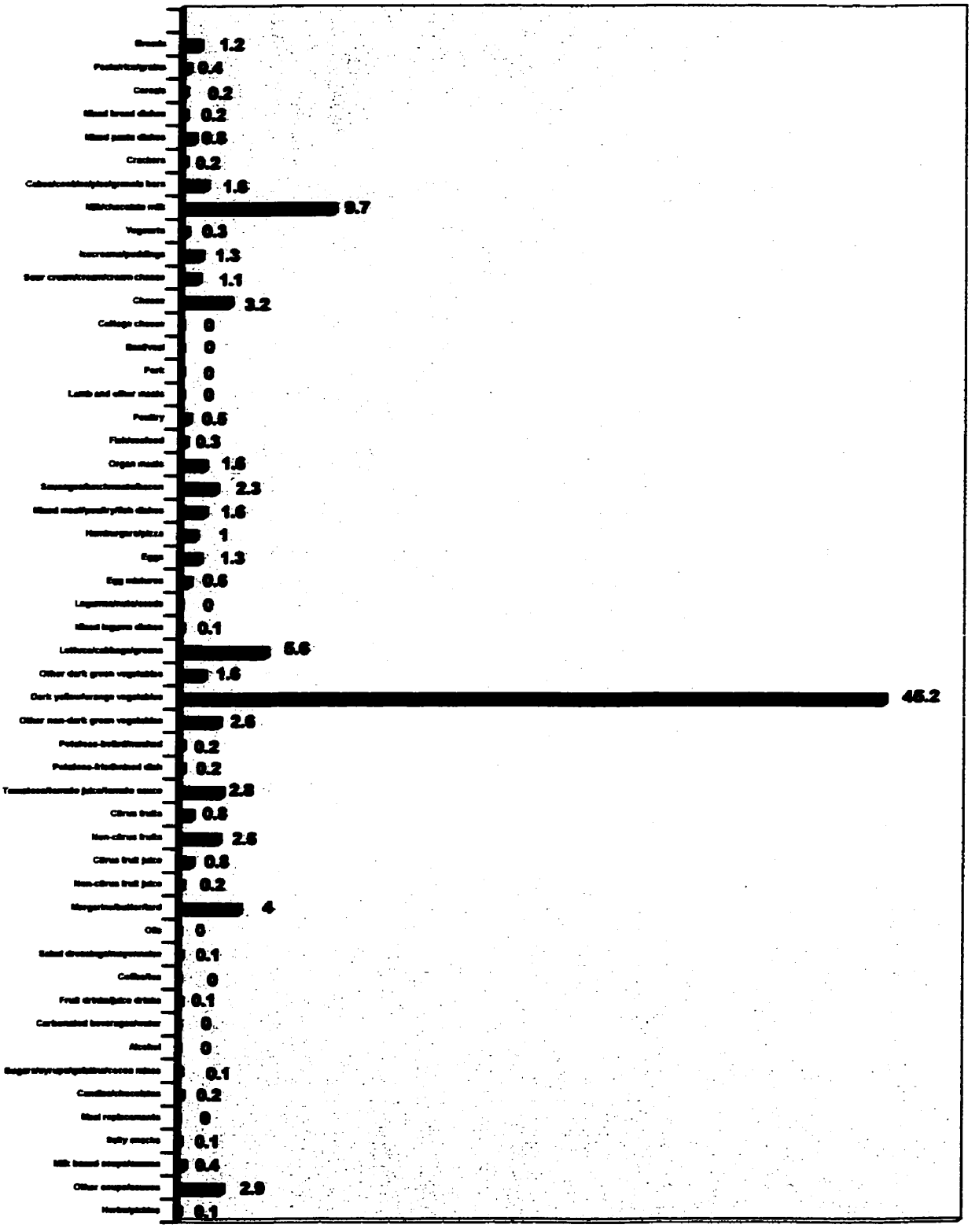
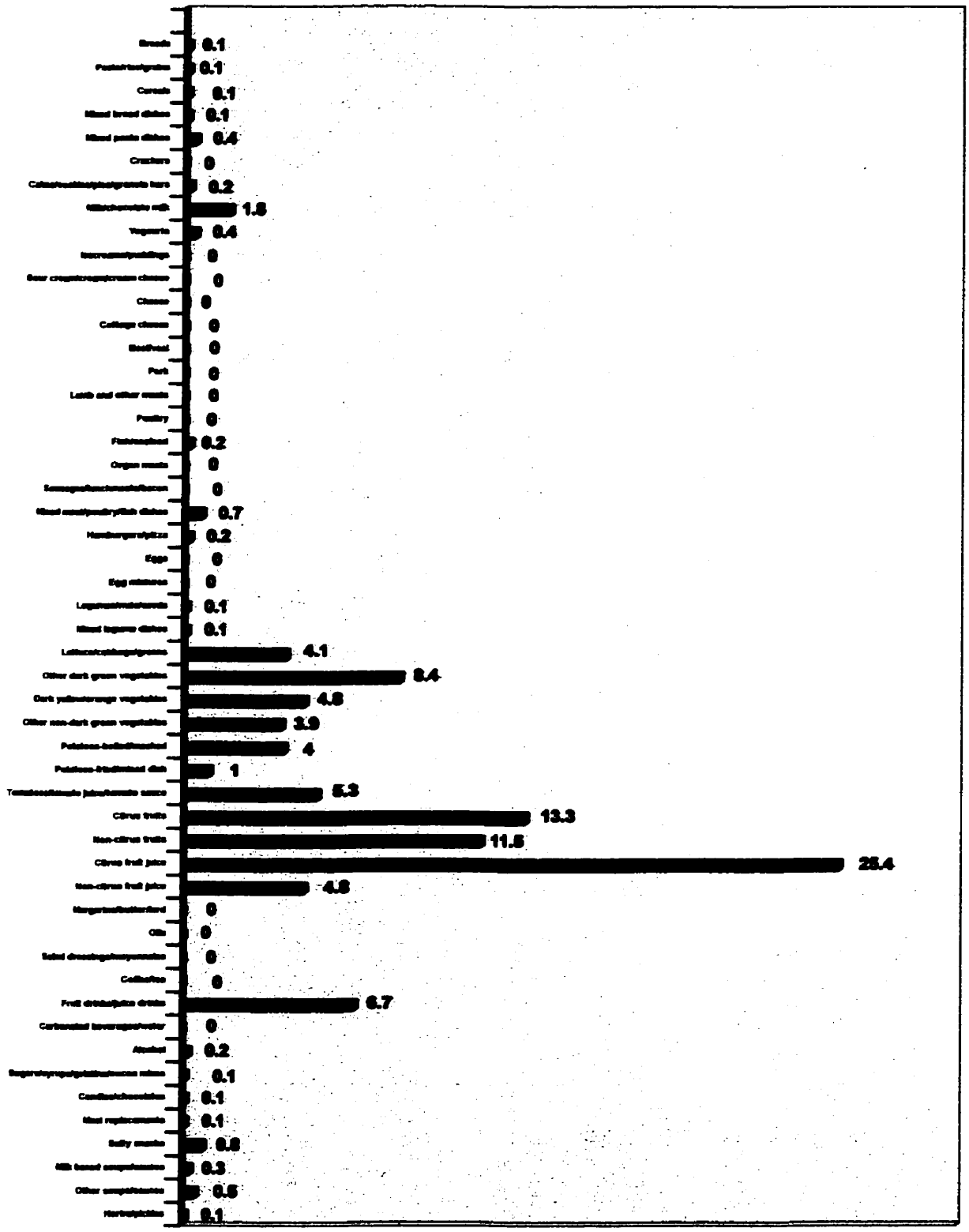


Figure 39: Percent Contribution of 51 Food Groups to the Mean Vitamin C Intake of Canadian Females Aged 18-65 years (N=971, Mean= 135 mg)



APPENDIX D

Table 10: Mean and Percent Contribution of Top Food Group Contributors to 50% of Mean Energy and Nutrient Intake in Males Aged 18-65 years (123 Food Groups)

Energy & Nutrients	Males 18-34 yrs N= 125	Mean (%)	Males 35-49 yrs N= 266	Mean (%)	Males 50-65 yrs N= 181	Mean (%)
Energy (kilocal.)	Refined yeast breads	189 (6.16)	Refined yeast breads	177 (6.67)	Refined yeast breads	160 (6.99)
	Carbonated beverages	154 (5.02)	Cakes/cookies	113 (4.26)	Whole grain yeast breads	106 (4.63)
	White semolina pasta	111 (3.62)	Chicken	90.1 (3.40)	Cakes/cookies	72.8 (3.18)
	High fat natural cheese	104 (3.39)	Carbonated beverages	88.1 (3.32)	Chicken	66.7 (2.91)
	Mixed pasta dishes	99.3 (3.24)	Whole grain yeast breads	82.5 (3.11)	Pies/pastries	60.8 (2.66)
	Cakes/cookies	89.6 (2.92)	Other beef cuts	80.5 (3.03)	Beer	60.8 (2.66)
	Beer	88.2 (2.88)	Pies/pastries	74.4 (2.80)	White semolina pasta	60.8 (2.66)
	Low fiber cold cereals	82.2 (2.68)	White semolina pasta	70.2 (2.65)	Potatoes-boiled	59.9 (2.62)
	Ground beef	81.8 (2.67)	Non-orange non citrus fruits	65.0 (2.45)	Soft margarine	59.5 (2.60)
	Mixed bread dishes	77.0 (2.51)	Ground beef	63.1 (2.38)	Sugar/jam/syrups	57.6 (2.52)
	Chicken	77.0 (2.51)	Beer	62.3 (2.35)	Other beef cuts	54.2 (2.37)
	2% Milk	75.2 (2.45)	Low fiber cold cereals	61.3 (2.31)	Non-orange non-citrus	53.6 (2.34)
	Mixed chicken dishes	72.8 (2.37)	Pork	52.7 (1.99)	fruits	
	Fried potatoes	71.9 (2.35)	Sugars/jams/syrups	51.8 (1.95)	2% Milk	52.7 (2.30)
	Hamburger/cheeseburgers	71.8 (2.34)	Mixed chicken dishes	50.4 (1.90)	Refined quick breads	52.1 (2.28)
	Pizza (non "vegetarian")	68.7 (2.24)	Potatoes-boiled	50.0 (1.88)	Pork	52.0 (2.27)
	Fruit drinks/juice-drinks	68.5 (2.23)	Citrus fruit juice	49.7 (1.87)	Carbonated beverages	45.2 (1.97)
	Total	1582 (51.6)	Salty snacks	49.7 (1.87)	Sausages	40.7 (1.78)
	Mean Intake	3066 kcal	**Total**	1332 (50.2)	Ground beef	40.2 (1.76)
			Mean Intake	2653 kcal	**Total**	1156(50.5)
					Mean Intake	2289 kcal
Carboh. (g)	Carbonated beverages	39.2 (10.0)	Refined yeast breads	32.2 (9.53)	Refined yeast breads	29.3 (10.4)
	Refined yeast breads	34.5 (8.82)	Carbonated beverages	22.3 (6.60)	Whole grain yeast breads	20.0 (7.07)
	White semolina pasta	22.3 (5.70)	Cakes/cookies	17.4 (5.15)	Sugars/jams/syrups	15.1 (5.34)
	Fruit drink/juice-drinks	17.4 (4.45)	Non-orange non citrus fruits	16.0 (4.73)	Potatoes-boiled	13.9 (4.91)
	Low fiber cold cereals	16.8 (4.30)	Whole grain yeast breads	15.5 (4.59)	Non-orange non-citrus	13.8 (4.88)
	Citrus fruit juice	15.0 (3.84)	White semolina pasta	14.1 (4.17)	fruits	
	Cakes/cookies	14.3 (3.66)	Sugar/jam/syrups	13.6 (4.02)	White semolina pasta	12.2 (4.31)
	Whole grain yeast breads	12.8 (3.27)	Low fiber cold cereals	12.8 (3.79)	Carbonated beverages	11.5 (4.06)
	Mixed pasta dishes	11.0 (2.81)	Citrus fruit juices	11.7 (3.46)	Cake/cookies	11.5 (4.06)
	White rice	10.7 (2.74)	Potatoes-boiled	11.6 (3.43)	Citrus fruit juices	8.90 (3.14)

Carboh. (g) cont'd	Non-orange non citrus fruits	10.6 (2.71)	White rice	10.6 (3.14)	Low fiber cold cereals	8.44 (2.98)
	Total	205 (52.4)	**Total**	178 (52.6)	Pies/pastries	8.26 (2.92)
	Mean Intake	391 g	**Mean Intake**	338 g	**Total**	153 (54.0)
					Mean Intake	283 g
Protein (g)	Chicken	12.2 (9.38)	Chicken	12.6 (11.4)	Chicken	9.79 (10.2)
	Other beef cuts	8.62 (6.63)	Other beef cuts	9.93 (8.95)	Other beef cuts	7.02 (7.31)
	Ground beef	8.38 (6.45)	Ground beef	6.63 (5.97)	Pork	6.16 (6.42)
	High fat natural cheese	6.67 (5.13)	Pork	6.00 (5.41)	Fish-non battered	5.90 (6.15)
	Mixed pasta dishes	6.55 (5.04)	Refined yeast breads	5.61 (5.05)	Refined yeast breads	4.98 (5.19)
	Refined yeast breads	6.06 (4.66)	Fish-non battered	3.44 (3.10)	Ground beef	4.11 (4.28)
	Fish-non battered	5.26 (4.05)	2% Milk	3.33 (3.00)	Whole grain yeast breads	4.08 (4.25)
	2% Milk	5.04 (3.88)	Mixed chicken dishes	3.22 (2.90)	2% Milk	3.54 (3.69)
	Pizza (non "vegetarian")	4.06 (3.12)	High fat natural cheese	3.21 (2.89)	Lunchmeats	3.01 (3.14)
	Mixed chicken dishes	3.92 (3.02)	Whole grain yeast breads	3.15 (2.84)	Mixed beef dishes	2.25 (2.34)
	Total	66.7 (51.4)	**Total**	57.1 (51.5)	**Total**	50.8 (53.0)
	Mean Intake	130 g	**Mean Intake**	111 g	**Mean Intake**	96.0 g
Total Fat (g)	High fat natural cheese	8.40 (8.16)	Cakes/cookies	4.61 (5.05)	Soft margarine	6.69 (8.26)
	Ground beef	5.11 (4.96)	Other beef cuts	4.23 (4.64)	Sausages	3.38 (4.17)
	Mixed chicken dishes	4.17 (4.05)	Chicken	3.99 (4.38)	Nuts/seeds	2.97 (3.67)
	Sausages	3.96 (3.84)	High fat natural cheese	3.89 (4.27)	Pies/pastries	2.90 (3.58)
	Hamburgers/cheeseburgers	3.82 (3.71)	Ground beef	3.86 (4.23)	Pork	2.84 (3.51)
	Fried potatoes	3.66 (3.55)	Pies/pastries	3.63 (3.98)	Oils	2.79 (3.44)
	Mixed bread dishes	3.39 (3.29)	Soft margarine	3.37 (3.70)	Cake/cookies	2.77 (3.42)
	Other beef cuts	3.38 (3.28)	Pork	3.00 (3.29)	Chicken	2.76 (3.41)
	Cakes/cookies	3.37 (3.27)	Mixed chicken dishes	2.96 (3.25)	High fat natural cheese	2.74 (3.38)
	Mixed pasta dishes	3.15 (3.06)	Oils	2.72 (2.98)	Other beef cuts	2.69 (3.32)
	Nuts/seeds	3.00 (2.91)	Refined yeast breads	2.63 (2.88)	Butter	2.67 (3.30)
	2% Milk	2.90 (2.82)	Sausages	2.56 (2.81)	Lunchmeats	2.67 (3.30)
	Chicken	2.75 (2.67)	Salty snacks	2.52 (2.76)	Ground beef	2.51 (3.10)
	Refined yeast breads	2.68 (2.60)	Butter	2.45 (2.69)	Refined yeast breads	2.33 (2.88)
	Salty snacks	2.61 (2.53)	Fried potatoes	2.08 (2.28)	Refined quick breads	2.23 (2.75)
	Total	56.4 (54.7)	**Total**	48.5 (53.2)	**Total**	44.9 (55.5)
	Mean Intake	103 g	**Mean Intake**	91.2 g	**Mean Intake**	81.0 g
Saturated Fat(g)	High fat natural cheese	5.30 (14.5)	High fat natural cheese	2.47 (8.61)	High fat natural cheese	1.74 (6.90)
	Ground beef	2.01 (5.51)	Other beef cuts	1.62 (5.64)	Butter	1.66 (6.59)

Saturated Fat (g) cont'd	2% Milk	1.81 (4.96)	Butter	1.52 (5.30)	Sausages	1.32 (5.24)
	Hamburgers/cheeseburgers	1.58 (4.33)	Ground beef	1.50 (5.23)	2% Milk	1.26 (5.00)
	Sausages	1.47 (4.03)	Cakes/cookies	1.23 (4.29)	Other beef cuts	1.01 (4.01)
	Butter	1.40 (3.84)	2% Milk	1.19 (4.15)	Pork	1.01 (4.01)
	Mixed chicken dishes	1.30 (3.56)	Chicken	1.11 (3.87)	Ice creams/frozen yogourts	1.00 (3.97)
	Fried potatoes	1.30 (3.56)	Pork	1.08 (3.76)	Ground beef	0.99 (3.93)
	Other beef cuts	1.29 (3.53)	Ice creams/frozen yogourts	0.97 (3.38)	Soft margarine	0.95 (3.77)
	Mixed bread dishes	1.03 (2.82)	Sausages	0.94 (3.28)	Lunchmeats	0.92 (3.65)
	Total	18.5 (50.7)	**Total**	13.6 (47.4)	**Total**	11.9 (47.2)
	Mean Intake	36.5 g	**Mean Intake**	28.7 g	**Mean Intake**	25.2 g
Cholesterol (mg)	Chicken	34.4 (9.17)	Chicken	39.3 (12.1)	Eggs-boiled	47.4 (15.3)
	Fried eggs	27.8 (7.41)	Eggs-boiled	29.1 (8.93)	Chicken	30.1 (9.74)
	High fat natural cheese	27.3 (7.28)	Other beef cuts	23.9 (7.33)	Fried eggs	22.9 (7.41)
	Mixed egg dishes	27.0 (7.20)	Ground beef	19.1 (5.86)	Other beef cuts	17.1 (5.53)
	Ground beef	24.3 (6.48)	Fried eggs	17.9 (5.49)	Pork	16.9 (5.47)
	Eggs-boiled	22.0 (5.87)	Pork	17.9 (5.49)	Fish-non battered	15.0 (4.85)
	Other beef cuts	20.3 (5.41)	High fat natural cheese	12.7 (3.90)	Ground beef	12.0 (3.88)
	Mixed bread dishes	19.0 (5.07)	Mixed egg dishes	11.5 (3.53)	Organ meats	11.7 (3.79)
	Total	202 (53.9)	**Total**	171 (52.6)	**Total**	173 (56.0)
	Mean Intake	375 mg	**Mean Intake**	326 mg	**Mean Intake**	309 mg
Total Dietary Fiber (g)	Whole grain yeast breads	1.54 (8.90)	Whole grain yeast breads	2.06 (11.4)	Whole grain yeast breads	2.66 (16.0)
	Low fiber cold cereals	1.44 (8.32)	Non-orange non-citrus fruits	1.68 (9.33)	Non-orange non-citrus fruits	1.35 (8.13)
	White semolina pasta	1.23 (7.11)	Refined yeast breads	1.02 (5.67)		
	Non-orange non-citrus fruits	1.14 (6.59)	Low fiber cold cereals	0.98 (5.44)	Potatoes-boiled	1.15 (6.93)
	Refined yeast breads	0.79 (4.57)	Potatoes-boiled	0.95 (5.28)	Refined yeast breads	0.87 (5.24)
	Potatoes-boiled	0.76 (4.39)	White semolina pasta	0.73 (4.06)	Hot cereals	0.75 (4.52)
	Other green vegetables	0.70 (4.05)	Salty snacks	0.72 (4.00)	High fiber cold cereals	0.69 (4.16)
	Mixed pasta dishes	0.65 (3.76)	Other green vegetables	0.63 (3.50)	Low fiber cold cereals	0.61 (3.67)
	Mixed legume dishes	0.59 (3.41)	High fiber cold cereals	0.60 (3.33)	White semolina pasta	0.61 (3.67)
	Total	8.84 (51.1)	**Total**	9.37 (52.1)	Other green vegetables	0.60 (3.61)
	Mean Intake	17.3 g	**Mean Intake**	18.0 g	**Total**	9.29 (56.0)
					Mean Intake	16.6 g
Calcium (mg)	High fat natural cheese	190 (14.5)	2% Milk	122 (12.5)	2% Milk	129 (14.8)
	2% Milk	184 (14.1)	High fat natural cheese	93.3 (9.57)	Skim milk	75.5 (8.69)
	1% Milk	114 (8.72)	1% Milk	93.2 (9.56)	High fat natural cheese	60.1 (6.92)

Calcium (mg) cont'd	Skim milk	94.9 (7.26)	Skim milk	68.5 (7.03)	1% Milk	59.9 (6.89)
	Refined yeast breads	55.3 (4.23)	Refined yeast breads	49.4 (5.07)	Refined yeast breads	54.7 (6.29)
	Pizza (non "vegetarian")	42.4 (3.24)	Whole milk	28.7 (2.94)	Whole grain yeast breads	30.6 (3.52)
	High fat processed cheese	35.9 (2.75)	High fat processed cheese	24.3 (2.49)	Ice creams/frozen yogourts	24.0 (2.76)
	Total	717 (54.9)	**Total**	479 (49.1)	**Total**	434 (49.9)
	Mean Intake	1307 mg	**Mean Intake**	975 mg	**Mean Intake**	869 mg
Folate (mcg)	Citrus fruit juice	43.7 (13.0)	Citrus fruit juice	33.2 (10.9)	Lettuce/greens/cabbage	26.4 (9.01)
	Pizza (non "vegetarian")	18.6 (5.55)	Lettuce/greens/cabbage	23.6 (7.76)	Citrus fruit juice	23.1 (7.88)
	Refined yeast breads	17.4 (5.19)	Refined yeast breads	16.1 (5.30)	Whole grain yeast breads	19.1 (6.52)
	Lettuce/greens/cabbage	13.7 (4.09)	Other green vegetables	14.5 (4.77)	Refined yeast breads	16.7 (5.70)
	Other green vegetables	12.9 (3.85)	Whole grain yeast breads	14.4 (4.74)	Coffee/tea	13.4 (4.57)
	Legumes	12.8 (3.82)	Legumes	10.5 (3.45)	Citrus fruits	11.9 (4.06)
	Beer	12.3 (3.67)	Citrus fruits	10.4 (3.42)	Legumes	11.2 (3.82)
	Whole grain yeast breads	12.0 (3.58)	Pizza (non "vegetarian")	9.48 (3.12)	Other green vegetables	11.0 (3.75)
	Low fiber cold cereals	11.2 (3.34)	Non-orange non-citrus fruits	8.96 (2.95)	Organ meats	10.3 (3.52)
	Nuts/seeds	11.0 (3.28)	Coffee/tea	8.91 (2.93)	Pizza (non "vegetarian")	9.76 (3.33)
	Citrus fruits	7.78 (2.32)	Beer	8.73 (2.87)	Beer	8.46 (2.89)
	Total	173 (51.6)	**Total**	159 (52.3)	**Total**	161 (54.9)
	Mean Intake	335 mcg	**Mean Intake**	304 mcg	**Mean Intake**	293 mcg
Iron (mg)	Low fiber cold cereals	2.27 (10.4)	Low fiber cold cereals	1.86 (10.0)	Refined yeast breads	1.75 (10.4)
	Refined yeast breads	2.11 (9.68)	Refined yeast breads	1.78 (9.57)	Whole grain yeast breads	1.38 (8.17)
	White semolina pasta	1.13 (5.18)	Whole grain yeast breads	1.06 (5.70)	Low fiber cold cereals	1.37 (8.11)
	Mixed pasta dishes	1.08 (4.95)	Other beef cuts	0.88 (4.73)	Other beef cuts	0.65 (3.85)
	Whole grain yeast breads	0.88 (4.04)	White semolina pasta	0.70 (3.76)	White semolina pasta	0.60 (3.55)
	Ground beef	0.81 (3.72)	Cakes/cookies	0.66 (3.55)	Potatoes-boiled	0.52 (3.08)
	Other beef cuts	0.81 (3.72)	Ground beef	0.64 (3.44)	Hot cereals	0.48 (2.84)
	Hamburgers/cheeseburgers	0.63 (2.89)	Chicken	0.50 (2.69)	High fiber cold cereals	0.47 (2.78)
	Meal replacements	0.59 (2.71)	Potatoes-boiled	0.42 (2.26)	Coffee/tea	0.41 (2.43)
	Mixed bread dishes	0.53 (2.43)	Non milk based soups	0.37 (1.99)	Ground beef	0.41 (2.43)
	Cakes/cookies	0.52 (2.39)	Coffee/tea	0.36 (1.94)	Refined quick breads	0.41 (2.43)
	Total	11.4 (52.3)	Mixed pasta dishes	0.36 (1.94)	Cakes/cookies	0.39 (2.31)
	Mean Intake	21.8 mg	**Total**	9.59 (51.6)	**Total**	8.84 (52.3)
			Mean Intake	18.6 mg	**Mean Intake**	16.9 mg
Zinc (mg)	Ground beef	1.85 (10.9)	Other beef cuts	2.09 (13.7)	Other beef cuts	1.45 (11.6)
	Other beef cuts	1.67 (9.82)	Ground beef	1.46 (9.54)	Ground beef	0.90 (7.20)

Zinc (mg) cont'd	Mixed pasta dishes	0.83 (4.88)	Chicken	0.79 (5.16)	Whole grain yeast breads	0.72 (5.76)
	High fat natural cheese	0.82 (4.82)	Pork	0.59 (3.86)	Pork	0.63 (5.04)
	Hamburgers/cheeseburgers	0.62 (3.65)	Whole grain yeast breads	0.56 (3.66)	Chicken	0.55 (4.40)
	2% Milk	0.59 (3.47)	Gravies/non milk sauces	0.55 (3.59)	Lunchmeats	0.44 (3.52)
	Chicken	0.54 (3.18)	Refined yeast breads	0.43 (2.81)	Refined yeast breads	0.42 (3.36)
	Refined yeast breads	0.50 (2.94)	High fat natural cheeses	0.40 (2.61)	2% Milk	0.41 (3.28)
	Low fiber cold cereals	0.47 (2.76)	2% Milk	0.39 (2.55)	Non milk based soups	0.30 (2.40)
	Whole grain yeast breads	0.46 (2.71)	Lunchmeats	0.34 (2.22)	Sausages	0.29 (2.32)
	White semolina pasta	0.42 (2.47)	Low fiber cold cereals	0.32 (2.09)	Nuts/seeds	0.29 (2.32)
	Total	8.77 (51.6)	**Total**	7.92 (51.8)	**Total**	6.40 (51.2)
	Mean Intake	17.0 mg	**Mean Intake**	15.3 mg	**Mean Intake**	12.5 mg
Vit A (RE)	Carrots	628 (42.1)	Carrots	633 (43.2)	Carrots	431 (30.2)
	2% Milk	86.2 (5.78)	Organ meats	97.7 (6.67)	Organ meats	215 (15.0)
	High fat natural cheeses	79.5 (5.33)	2% Milk	56.8 (3.88)	Soft margarine	86.3 (6.04)
	1% Milk	54.5 (3.66)	1% Milk	44.7 (3.05)	Sausages	63.3 (4.43)
	Skim milk	46.8 (3.14)	Soft margarine	43.7 (2.98)	2% Milk	60.4 (4.23)
	Mixed vegetables	32.2 (2.16)	Lettuce/greens/cabbage	41.7 (2.85)	Lettuce/greens/cabbage	50.2 (3.51)
	Total	927 (62.2)	**Total**	918 (62.7)	**Total**	906 (63.4)
	Mean Intake	1491 RE	**Mean Intake**	1464 RE	**Mean Intake**	1429 RE
Vit C (mg)	Citrus fruit juice	53.0 (26.6)	Citrus fruit juice	41.8 (27.7)	Citrus fruit juice	32.6 (23.6)
	Fruit drinks/juice-drinks	27.9 (14.0)	Citrus fruits	18.8 (12.5)	Citrus fruits	21.4 (15.5)
	Non citrus fruit juice	27.2 (13.7)	Other green vegetables	10.9 (7.22)	Other green vegetables	14.7 (10.7)
	Other green vegetables	17.1 (8.6)	Fruit drinks/juice-drinks	9.77 (6.47)	Fruit drinks/juice-drinks	7.93 (5.75)
	Citrus fruits	13.9 (6.98)	Non-citrus fruit juice	7.98 (5.28)	Potatoes-boiled	7.29 (5.28)
	Other dark yellow/orange vegetables	5.46 (2.74)	Non-orange non-citrus fruits	7.66 (5.07)	Non-orange non-citrus fruits	6.01 (4.36)
	Total	145 (72.9)	**Total**	96.9 (64.2)	**Total**	89.9 (65.1)
	Mean Intake	199 mg	**Mean Intake**	151 mg	**Mean Intake**	135 mg

Table 11: Mean and Percent Contribution of Top Food Group Contributors to 50% of Mean Energy and Nutrient Intake in Females Aged 18-65 yrs						
Energy and Nutrients	**Females 18-34 yrs N=206**	**Mean (%)**	**Females 35-49 yrs N=459**	**Mean (%)**	**Females 50-65 yrs N=306**	**Mean (%)**
Energy (kilocal.)	Refined yeast breads	136 (7.02)	Refined yeast breads	113 (6.21)	Refined yeast breads	109 (6.46)
	Carbonated beverages	70.5 (3.64)	Cakes/cookies	68.7 (3.78)	Cakes/cookies	84.7 (5.02)
	Salty snacks	59.0 (3.04)	Whole grain yeast breads	58.9 (3.24)	Whole grain yeast breads	69.1 (4.10)
	Chicken	56.3 (2.91)	Chicken	56.4 (3.10)	Non-orange non-citrus fruits	59.4 (3.52)
	Cakes/cookies	53.4 (2.76)	Refined quick breads	51.9 (2.85)	Chicken	51.8 (3.07)
	White semolina pasta	50.4 (2.60)	Non-orange non-citrus fruits	51.6 (2.84)	Pies/pastries	49.9 (2.96)
	Low fiber cold cereals	49.3 (2.54)	High fat natural cheese	47.2 (2.59)	Potatoes-boiled	45.7 (2.71)
	Citrus fruit juice	48.9 (2.52)	White semolina pasta	47.2 (2.59)	White semolina pasta	45.5 (2.70)
	Mixed pasta dishes	43.9 (2.27)	Other beef cuts	41.4 (2.28)	Citrus fruit juice	41.6 (2.47)
	Mixed chicken dishes	42.5 (2.19)	White rice	40.2 (2.21)	2% Milk	40.4 (2.39)
	Fried potatoes	42.3 (2.18)	Carbonated beverages	39.8 (2.19)	Refined quick breads	36.0 (2.13)
	Whole grain yeast breads	40.8 (2.11)	Low fiber cold cereals	39.7 (2.18)	Other beef cuts	34.4 (2.04)
	Fruit drinks/juice-drinks	39.5 (2.04)	Salty snacks	37.5 (2.06)	Sugars/jams/syrups	33.4 (1.98)
	Refined quick breads	39.0 (2.01)	Citrus fruit juice	36.4 (2.00)	Ground beef	32.1 (1.90)
	2% Milk	38.6 (1.99)	Mixed pasta dishes	35.3 (1.94)	Mixed pasta dishes	30.0 (1.78)
	High fat natural cheese	37.2 (1.92)	Pies/pastries	35.3 (1.94)	High fat natural cheese	28.5 (1.69)
	Chocolate	36.8 (1.90)	Potatoes-boiled	34.9 (1.92)	Carbonated beverages	28.4 (1.68)
	Non-orange non citrus fruits	36.6 (1.89)	2% Milk	34.7 (1.91)	Ice creams/frozen yogourts	26.4 (1.56)
	Pies/pastries	36.3 (1.87)	Ground beef	33.2 (1.83)	Pork	25.5 (1.51)
	Ground beef	35.1 (1.81)	Pork	28.3 (1.56)	Low fiber cold cereals	23.8 (1.41)
	Total	992 (51.2)	**Total**	932 (51.2)	**Total**	896 (53.1)
	Mean Intake	1938 kcal	**Mean Intake**	1819 kcal	**Mean Intake**	1687 kcal
Carbohydrate (g)	Refined yeast breads	24.5 (9.25)	Refined yeast breads	20.9 (8.82)	Refined yeast breads	19.8 (8.72)
	Carbonated beverages	17.9 (6.75)	Non-orange non-citrus fruits	12.9 (5.44)	Non-orange non-citrus fruits	14.2 (6.26)
	Citrus fruit juices	11.5 (4.34)	Whole grain yeast breads	11.2 (4.73)	Cakes/cookies	13.1 (5.77)
	Low fiber cold cereals	10.1 (3.81)	Cakes/cookies	10.4 (4.39)	Whole grain yeast breads	13.0 (5.73)
	White semolina pasta	10.1 (3.81)	Carbonated beverages	10.1 (4.26)	Potatoes-boiled	10.6 (4.67)
	Fruit drinks/juice drinks	9.94 (3.75)	White semolina pasta	9.48 (4.00)	Citrus fruit juice	9.81 (4.32)
	Non-orange non-citrus fruits	8.81 (3.32)	White rice	8.79 (3.71)	White semolina pasta	9.11 (4.01)
	Salty snacks	8.02 (3.03)	Citrus fruit juice	8.57 (3.62)	Sugars/jams/syrups	8.76 (3.86)
	Sugars/jams/syrups	7.91 (2.98)	Low fiber cold cereals	8.11 (3.42)	Carbonated beverages	7.23 (3.19)
	Cakes/cookies	7.87 (2.97)	Potatoes-boiled	8.08 (3.41)	Pies/pastries	6.65 (2.93)

Carbohydrate (g) cont'd	Whole grain yeast breads	7.83 (2.95)	Refined quick breads	7.72 (3.26)	Refined quick breads	5.07 (2.23)
	White rice	7.49 (2.83)	Sugars/jams/syrups	7.32 (3.09)	Citrus fruits	4.89 (2.15)
	Total	132 (49.8)	**Total**	124 (52.3)	**Total**	122 (53.7)
	Mean Intake	265 g	**Mean Intake**	237 g	**Mean Intake**	277 g
Protein (g)	Chicken	8.73 (11.5)	Chicken	8.66 (11.4)	Chicken	7.54 (10.6)
	Refined yeast breads	4.28 (5.66)	Other beef cuts	5.12 (6.76)	Other beef cuts	4.84 (6.83)
	Other beef cuts	3.96 (5.24)	Refined yeast breads	3.63 (4.80)	Refined yeast breads	3.43 (4.84)
	Ground beef	3.83 (5.07)	Ground beef	3.40 (4.49)	Ground beef	3.28 (4.63)
	Pork	3.38 (4.47)	Pork	3.23 (4.27)	Pork	3.02 (4.26)
	Mixed chicken dishes	2.63 (3.48)	High fat natural cheese	3.11 (4.11)	2% Milk	2.71 (3.82)
	2% Milk	2.59 (3.42)	Fish-non battered	3.00 (3.96)	Whole grain yeast breads	2.66 (3.75)
	1% Milk	2.40 (3.17)	2% Milk	2.33 (3.08)	Fish-nonbattered	2.51 (3.54)
	High fat natural cheese	2.38 (3.15)	Whole grain yeast breads	2.26 (2.99)	Turkey	1.95 (2.75)
	Skim milk	1.95 (2.58)	Skim milk	1.74 (2.30)	High fat natural cheese	1.79 (2.52)
	Pizza (non "vegetarian")	1.92 (2.54)	Mixed chicken dishes	1.73 (2.29)	Skim milk	1.74 (2.45)
	Total	38.1 (50.4)	**Total**	38.2 (50.5)	**Total**	35.5 (50.1)
	Mean Intake	75.6 g	**Mean Intake**	75.7 g	**Mean Intake**	70.9 g
Total fat (g)	High fat natural cheese	3.01 (4.69)	High fat natural cheese	3.76 (6.05)	Cakes/cookies	3.29 (5.93)
	Salty snacks	2.65 (4.13)	Cakes/cookies	2.83 (4.55)	Pies/pastries	2.40 (4.32)
	Mixed chicken dishes	2.52 (3.93)	Oils	2.56 (4.12)	Soft margarine	2.31 (4.16)
	Cakes/cookies	2.29 (3.57)	Soft margarines	2.44 (3.92)	High fat natural cheese	2.29 (4.13)
	Soft margarine	2.27 (3.54)	Other beef cuts	2.16 (3.47)	Chicken	2.17 (3.91)
	Refined yeast breads	2.18 (3.40)	Chicken	2.16 (3.47)	Ground beef	2.01 (3.62)
	Chicken	2.10 (3.27)	Ground beef	2.07 (3.33)	Butter	1.70 (3.06)
	Ground beef	2.10 (3.27)	Salty snacks	1.83 (2.94)	Refined yeast breads	1.68 (3.03)
	Chocolate	1.97 (3.07)	Refined quick breads	1.80 (2.89)	Oils	1.58 (2.85)
	Fried potatoes	1.93 (3.01)	Salad dressing	1.78 (2.86)	2% Milk	1.56 (2.81)
	Hamburgers/cheeseburgers	1.80 (2.80)	Pies/pastries	1.74 (2.80)	Other beef cuts	1.53 (2.76)
	Butter	1.79 (2.79)	Pork	1.61 (2.59)	Refined quick breads	1.41 (2.54)
	Mixed pasta dishes	1.64 (2.55)	Refined yeast breads	1.50 (2.41)	Pork	1.40 (2.52)
	Pies/pastries	1.62 (2.52)	Mixed chicken dishes	1.47 (2.36)	Ice creams/frozen yogourts	1.33 (2.40)
	Refined quick breads	1.50 (2.34)	Butter	1.46 (2.35)	Nuts/seeds	1.19 (2.14)
	2% Milk	1.49 (2.32)	Mixed pasta dishes	1.39 (2.23)	Lunchmeats	1.16 (2.09)
	Total	32.9 (51.2)	**Total**	30.4 (48.9)	**Total**	29.0 (52.3)
	Mean Intake	64.2 g	**Mean Intake**	62.2 g	**Mean Intake**	55.5 g

Saturated fat (g)	High fat natural cheese	1.92 (8.97)	High fat natural cheese	2.40 (11.8)	High fat natural cheese	1.46 (8.11)
	Butter	1.11 (5.19)	Butter	0.91 (4.48)	Butter	1.05 (5.83)
	Chocolate	1.03 (4.81)	Cakes/cookies	0.83 (4.09)	Cakes/cookies	0.98 (5.44)
	2% Milk	0.93 (4.35)	2% Milk	0.83 (4.09)	2% Milk	0.97 (5.39)
	Ground beef	0.77 (3.60)	Other beef cuts	0.83 (4.09)	Ground beef	0.79 (4.39)
	Hamburgers/cheeseburgers	0.72 (3.36)	Ground beef	0.82 (4.04)	Ice creams/frozen yogourts	0.76 (4.22)
	Cakes/cookies	0.67 (3.13)	Chicken	0.60 (2.96)	Chicken	0.59 (3.28)
	Ice creams/frozen yogourts	0.65 (3.04)	Ice creams/frozen yogourts	0.58 (2.86)	Other beef cuts	0.58 (3.22)
	Mixed chicken dishes	0.64 (2.99)	Pork	0.57 (2.81)	Pies/pastries	0.54 (3.00)
	Fried potatoes	0.61 (2.85)	Chocolate	0.52 (2.56)	High fat processed cheese	0.52 (2.89)
	Refined yeast breads	0.60 (2.80)	Sausages	0.47 (2.32)	Pork	0.50 (2.78)
	Chicken	0.58 (2.71)	Whole milk	0.45 (2.22)	Refined yeast breads	0.44 (2.44)
	Other beef cuts	0.53 (2.48)	Lower fat cream (<=15%)	0.45 (2.22)	Chocolate	0.42 (2.33)
	Total	10.76 (50.3)	**Total**	10.3 (50.7)	**Total**	9.60 (53.3)
	Mean Intake	21.4 g	**Mean Intake**	20.3 g	**Mean Intake**	18.0 g
Cholesterol (mg)	Egg-boiled	29.2 (13.6)	Chicken	25.7 (11.6)	Eggs-boiled	30.9 (14.6)
	Chicken	25.3 (11.8)	Eggs-boiled	20.0 (9.01)	Chicken	22.8 (10.8)
	Ground beef	10.9 (5.07)	Other beef cuts	12.5 (5.63)	Other beef cuts	11.6 (5.47)
	High fat natural cheese	9.89 (4.60)	High fat natural cheese	12.1 (5.45)	Mixed egg dishes	11.4 (5.38)
	Other beef cuts	9.76 (4.54)	Mixed egg dishes	12.0 (5.41)	Fried eggs	11.3 (5.33)
	Pork	9.30 (4.33)	Fried eggs	11.0 (4.95)	Ground beef	9.50 (4.48)
	Mixed chicken dishes	9.17 (4.27)	Ground beef	9.83 (4.43)	Pork	8.51 (4.01)
	Mixed egg dishes	6.34 (2.95)	Pork	9.61 (4.33)	High fat natural cheese	7.44 (3.51)
	Total	110 (51.2)	**Total**	101 (45.5)	**Total**	113 (53.3)
	Mean Intake	215 mg	**Mean Intake**	222 mg	**Mean Intake**	212 mg
Total Dietary Fiber (g)	Whole grain yeast breads	1.09 (8.45)	Whole grain yeast breads	1.46 (10.4)	Whole grain yeast breads	1.64 (11.0)
	Non-orange non-citrus fruits	1.03 (7.98)	Non-orange non-citrus fruits	1.44 (10.3)	Non-orange non-citrus fruits	1.59 (10.7)
	Low fiber cold cereals	0.73 (5.66)	Low fiber cold cereals	0.75 (5.36)	High fiber cold cereals	1.06 (7.11)
	Salty snacks	0.72 (5.58)	Potatoes-boiled	0.68 (4.86)	Potatoes-boiled	0.86 (5.77)
	Refined yeast breads	0.62 (4.81)	High fiber cold cereals	0.62 (4.43)	Carrots	0.60 (4.03)
	Potatoes-boiled	0.62 (4.81)	Salty snacks	0.55 (3.93)	Citrus fruits	0.57 (3.83)
	White semolina pasta	0.55 (4.26)	Refined yeast breads	0.53 (3.79)	Other green vegetables	0.56 (3.76)
	Citrus fruits	0.50 (3.88)	Other green vegetables	0.51 (3.64)	Refined yeast breads	0.53 (3.56)
	High fiber cold cereals	0.47 (3.64)	Carrots	0.48 (3.43)	White semolina pasta	0.49 (3.29)
	Citrus fruit juice	0.31 (2.40)	White semolina pasta	0.48 (3.43)	Other root vegetables	0.48 (3.22)

Total Dietary Fiber cont'd	**Total Mean Intake**	6.64 (51.5) 12.9 g	**Total Mean Intake**	7.50 (53.7) 14.0 g	**Total Mean Intake**	8.38 (56.2) 14.9 g
Calcium (mg)	2% Milk	94.7 (11.6)	High fat natural cheese	89.8 (11.4)	2% Milk	99.2 (13.3)
	1% Milk	89.6 (11.0)	2% Milk	85.2 (10.8)	Skim milk	63.2 (8.47)
	Skim milk	70.6 (8.68)	1% Milk	64.4 (8.18)	1% Milk	53.0 (7.10)
	High fat natural cheese	68.3 (8.40)	Skim milk	63.0 (8.01)	High fat natural cheese	52.4 (7.02)
	Refined yeast breads	38.7 (4.76)	Refined yeast breads	34.7 (4.41)	Refined yeast breads	34.1 (4.57)
	Yogourt <1% MF	21.7 (2.67)	Whole milk	25.1 (3.19)	Water	22.0 (2.95)
	Water	20.6 (2.53)	Water	23.4 (2.97)	Whole grain yeast breads	20.3 (2.72)
	Total	404 (49.7)	**Total**	386 (49.0)	**Total**	344 (46.1)
	Mean Intake	813 mg	**Mean Intake**	787 mg	**Mean Intake**	746 mg
Folate (mcg)	Citrus fruit juice	33.3 (14.9)	Lettuce/greens/cabbage	35.0 (14.5)	Lettuce/greens/cabbage	31.0 (12.6)
	Lettuce/greens/cabbage	17.6 (7.86)	Citrus fruit juice	22.6 (9.38)	Citrus fruit juice	26.7 (10.9)
	Refined yeast breads	12.6 (5.63)	Other green vegetables	12.3 (5.10)	Coffee/tea	13.5 (5.49)
	Citrus fruits	8.94 (3.99)	Coffee/tea	11.7 (4.85)	Other green vegetables	12.2 (4.96)
	Pizza (non "vegetarian")	8.44 (3.77)	Refined yeast breads	11.3 (4.69)	Whole grain yeast breads	11.8 (4.80)
	Whole grain yeast breads	7.63 (3.41)	Whole grain yeast breads	10.3 (4.27)	Citrus fruits	11.6 (4.72)
	Low fiber cold cereals	7.04 (3.14)	Citrus fruits	8.82 (3.66)	Refined yeast breads	10.7 (4.35)
	Legumes	6.44 (2.88)	Non-orange non-citrus fruits	6.35 (2.63)	Non-orange non-citrus fruits	8.00 (3.25)
	Coffee/tea	6.39 (2.85)	Pizza (non "vegetarian")	5.84 (2.42)	Other root vegetables	7.13 (2.90)
	Salty snacks	5.03 (2.25)	Other root vegetables	5.42 (2.25)	Pizza (non "vegetarian")	5.45 (2.22)
	Non-orange non-citrus fruits	4.69 (2.09)	Other botanical fruits/flowers..	4.83 (2.00)	Potatoes-boiled	4.93 (2.00)
	Total	118 (52.7)	**Total**	134 (55.6)	**Total**	143 (58.1)
	Mean Intake	224 mcg	**Mean Intake**	241 mcg	**Mean Intake**	246 mcg
Iron (mcg)	Low fiber cold cereals	1.55 (11.2)	Refined yeast breads	1.27 (9.62)	Refined yeast breads	1.16 (8.92)
	Refined yeast breads	1.42 (10.3)	Low fiber cold cereals	1.02 (7.73)	Whole grain yeast breads	0.90 (6.92)
	Whole grain yeast breads	0.54 (3.91)	Whole grain yeast breads	0.76 (5.76)	Low fiber cold cereals	0.68 (5.23)
	White semolina pasta	0.51 (3.70)	Other beef cuts	0.49 (3.71)	High fiber cold cereals	0.63 (4.85)
	Other beef cuts	0.40 (2.90)	White semolina pasta	0.47 (3.56)	Cakes/cookies	0.49 (3.77)
	Ground beef	0.36 (2.61)	Refined quick breads	0.41 (3.11)	Other beef cuts	0.48 (3.69)
	Mixed pasta dishes	0.33 (2.39)	Lettuce/greens/cabbage	0.37 (2.80)	White semolina pasta	0.46 (3.54)
	Chicken	0.33 (2.39)	Cakes/cookies	0.36 (2.73)	Potatoes-boiled	0.34 (2.62)
	Refined quick breads	0.32 (2.32)	Coffee/tea	0.33 (2.50)	Lettuce/greens/cabbage	0.33 (2.54)
	Potatoes-boiled	0.31 (2.25)	Ground beef	0.33 (2.50)	Hot cereals	0.33 (2.54)
	Hamburgers/cheeseburgers	0.31 (2.25)	Chicken	0.33 (2.50)	Coffee/tea	0.32 (2.46)

Iron (mcg) cont'd	Cakes/cookies	0.30 (2.17)	High fiber cold cereals	0.32 (2.42)	Ground beef	0.32 (2.46)
	High fiber cold cereals	0.28 (2.03)	Potatoes-boiled	0.30 (2.27)	Chicken	0.29 (2.23)
	Total	6.96 (50.4)	**Total**	6.76 (51.2)	**Total**	6.73 (51.8)
	Mean Intake	13.8 mg	**Mean Intake**	13.2 mg	**Mean Intake**	13.0 mg
Zinc (mg)	Other beef cuts	0.93 (8.86)	Other beef cuts	1.14 (11.1)	Other beef cuts	1.04 (10.7)
	Ground beef	0.84 (8.00)	Ground beef	0.74 (7.18)	Ground beef	0.72 (7.43)
	Chicken	0.44 (4.19)	Chicken	0.47 (4.56)	Whole grain yeast breads	0.47 (4.85)
	Seafood-non battered	0.42 (4.00)	Whole grain yeast breads	0.40 (3.88)	Chicken	0.44 (4.54)
	Refined yeast breads	0.34 (3.24)	High fat natural cheese	0.36 (3.50)	Water	0.33 (3.41)
	2% Milk	0.30 (2.86)	Water	0.35 (3.40)	2% Milk	0.32 (3.30)
	Hamburgers/cheeseburgers	0.30 (2.86)	Pork	0.32 (3.11)	Refined yeast breads	0.29 (2.99)
	Pork	0.30 (2.86)	Refined yeast breads	0.29 (2.82)	Pork	0.28 (2.89)
	High fat natural cheese	0.30 (2.86)	2% Milk	0.27 (2.62)	High fat natural cheese	0.22 (2.27)
	Water	0.30 (2.86)	Gravies	0.24 (2.33)	Seafood-non battered	0.21 (2.17)
	Low fiber cold cereal	0.29 (2.76)	Lunchmeats	0.21 (2.04)	Skim milk	0.20 (2.06)
	Whole grain yeast breads	0.29 (2.76)	Skim milk	0.20 (1.94)	Non milk based soups	0.18 (1.86)
	1% Milk	0.28 (2.67)	1% Milk	0.20 (1.94)	High fiber cold cereals	0.18 (1.86)
	Total	5.33 (50.8)	**Total**	5.19 (50.4)	**Total**	4.88 (50.4)
	Mean Intake	10.5 mg	**Mean Intake**	10.3 mg	**Mean Intake**	9.69 mg
Vit A (RE)	Carrots	310 (29.4)	Carrots	503 (42.6)	Carrots	609 (47.8)
	Sausages	126 (11.9)	Lettuce/greens/cabbage	76.9 (6.51)	Lettuce/greens/cabbage	66.0 (5.18)
	2% Milk	44.3 (4.20)	Organ meats	40.0 (3.39)	Other orange vegetables	57.5 (4.51)
	1% Milk	43.0 (4.07)	2% Milk	39.8 (3.37)	2% Milk	46.3 (3.63)
	Lettuce/greens/cabbage	42.6 (4.03)	Other dark yellow/orange veg	38.4 (3.25)	Mixed vegetables	35.7 (2.80)
	Non milk based soups	37.5 (3.55)	High fat natural cheese	34.1 (2.89)	Skim milk	31.0 (2.43)
	Total	603 (57.1)	**Total**	732 (62.0)	**Total**	846 (66.4)
	Mean Intake	1056 RE	**Mean Intake**	1181 RE	**Mean Intake**	1275 RE
Vit C (mg)	Citrus fruit juice	41.7 (31.1)	Citrus fruit juice	30.4 (22.9)	Citrus fruit juice	34.7 (25.1)
	Citrus fruits	16.1 (12.0)	Citrus fruits	16.4 (12.3)	Citrus fruits	21.4 (15.5)
	Fruit drinks/juice drinks	13.1 (9.78)	Other green vegetables	12.9 (9.70)	Other green vegetables	11.9 (8.62)
	Non-citrus fruit juice	9.95 (7.43)	Fruit drinks/juice drinks	9.12 (6.86)	Non-orange non-citrus fruit	8.65 (6.27)
	Other green vegetables	7.18 (5.36)	Non-orange non citrus fruits	7.38 (5.55)	Fruit drinks/juice drinks	6.09 (4.41)
	Other dark yellow/ orange veg	5.27 (3.93)	Lettuce/greens/cabbage	6.51 (4.89)	Lettuce/greens/cabbage	6.05 (4.38)
	Total	93.3 (69.6)	**Total**	82.7 (62.2)	**Total**	88.8 (64.3)
	Mean Intake	134 mg	**Mean Intake**	133 mg	**Mean Intake**	138 mg

APPENDIX E

DETERMINATION OF THE FOOD AND NUTRIENT INTAKE OF CANADIANS

SOCIODEMOGRAPHIC QUESTIONNAIRE

Enumeration Area ___ ___

Respondent Number: _____ (Name) ___ ___

Age Group: Adult 0 Child 1 ___

Language of Interview: English 1 French 2 Other 3: _____ ___

Respondent Gender: Male 1 Female 2 (non-pregnant) ___

Date of Interview: _____ ___ ___ (d) ___ ___ (m)

Day of the Week: 0 Sunday 1 Monday 2 Tuesday 3 Wednesday 4 Thursday 5 Friday 7 Saturday ___

Time Interview Started: _____ ___ ___ (h) ___ ___ (m)

To begin, I would like to ask you some general questions about you

1. In what country were you born? _____ ___ ___ ___
   * *Country of Origin code sheet*

2. Please tell me your civil status: ___
   1 Single
   2 Married/Common law
   3 Widowed
   4 Divorced/Separated

3. And your birth date? _____ ___ ___ ___ (d m y)
   calculate age to closest year _____

4. What is the last grade of schooling you completed? ___
   1 Elementary incomplete
   2 Elementary complete
   3 Secondary incomplete
   4 Secondary complete
   5 Technical/Trade school
   6 Junior college/CEGEP
   7 University
   8 Post-graduate education

5. Do you smoke more than five (5) cigarettes a day? ___
   1 Yes 2 No

6. In general, compared to people of your age, would you say your health is ___
   1 Excellent 2 Very Good 3 Good 4 Fair 5 Poor

   What is your height _____ ; _____ *cm* ___ ___ ___

   What is your weight _____ ; _____ *kg* ___ ___ ___ . ___

7. How many people live here on a regular basis? _____ ___ ___
   Be sure to include yourself.

   How many are: ___ ___ ___ ___
   < 13 y.o. _____ 13-17 _____ 18-65 _____ >65 _____

FOOD HABITS OF CANADIANS

Respondent # _____ ❑❑ ❑❑ ❑

Name

Day of the Week: 1 2 3 4 5 6 0 ❑
M T W T F S S

Date: _____ ❑❑ ❑❑
Day Month

24-HOUR RECALL				
Time	**Food Source***	**Code**	**Description of Food Eaten and How Prepared**	**Amount Eaten**
			water	
			supplement(s):	

* Where food came from, such as home, restaurant, takeout, delivery etc.