CONSUMER KNOWLEDGE AND PRACTICE PERTAINING TO SAFE FOOD-HANDLING IN HOUSEHOLDS

by

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ABSTRACT

Foodborne illness is the largest class of emerging infectious diseases in Canada. Health Canada estimates that every year in Canada there are 2.2 million cases of foodborne illnesses and 31 of these people die. Most of these cases are preventable. Health Canada estimates that the annual costs related to these illnesses and deaths exceed $2 billion due to medical and hospital expenses, lost income, time off work and loss of business to the food processor or retailer. In 2-3% of cases, foodborne illnesses can lead to chronic health problems. Illnesses such as chronic arthritis and hemolytic uremic syndrome (HUS), leading to kidney failure, have long-term consequences for the individuals affected and for society and the economy as a whole.

This study was conducted to, a) determine the knowledge residents of the Greater Vancouver Regional District (GVRD) have regarding preventative measures and causes of foodborne illness and, b) establish the practices of the target population in two important areas in the prevention of foodborne illness in the home: cross-contamination between raw meat and other foods, and cooking foods sufficiently to eliminate pathogens. A self-administered mail questionnaire was the contact method of choice. Municipalities of Greater Vancouver were stratified into three strata to ensure that the diverse population of the GVRD would be represented in the target population with regards to socio-ethnic variables. The survey was conducted between May 19th and June 30th 1998. Of the 1,600 households contacted, 582 returned a valid questionnaire.

A large segment of the persons who are primarily responsible for household meal preparation in the Greater Vancouver Regional District, specifically young adults under the age of 35 and males, reported using inappropriate hygiene practices during meal preparation to prevent foodborne illness. This segment of the population reported using incorrect methods to determine whether meat was cooked sufficiently to prevent foodborne illness and preparation practices that lead to cross-contamination between kitchen utensils and ready-to-eat foods. Furthermore, this population indicated they had incorrect knowledge of the causes and symptoms of foodborne illness. Use of simple techniques before, during and after food preparation will significantly reduce the risk of foodborne illness. Education of the general public, and in particular young adults and females, is important and suggested educational

approaches include food labelling, the media, health professionals, primary school curriculum, and offering of training courses in the community. However, further research is needed to determine the most effective way to educate the public to improve food safety knowledge and practices.

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This thesis is dedicated to Theo, Sophie, Simon and Adam. My four true loves.

INTRODUCTION

According to the World Health Organization (WHO), hundreds of millions of people worldwide are affected by diseases caused by contaminated food, with populations in developing countries suffering the most. A wide range of diseases results annually in 1.5 billion episodes in children under 5 years of age, leading to 3 million premature deaths (1). In industrialized countries foodborne diseases affect between 5-10% of the population each year regardless of safe water supplies, sound standards of hygiene and application of technologies such as pasteurization (2). Many industrialized countries have experienced an increase in the incidence of foodborne disease and extremely serious outbreaks have occurred on virtually every continent in recent years (2,3).

Many new important foodborne pathogens have been identified during the last two decades (4,5,6,7). New methods of transmission have been identified as well as survival of pathogens at refrigeration temperatures (4,8,9,10). The globalization of food trade and increasing problems worldwide with emerging and re-emerging foodborne illnesses have increased the risk of cross-border transmission of infectious agents (2,11). Intensification of food production and consolidation of food industries present opportunities for foodborne pathogens to infect large numbers of consumers around the world (11). In addition, the availability of a variety of foods, including imported foods, has increased, and competition in the marketplace is more intense (12).

Despite great national and international efforts, progress in combating foodborne disease has been offset by global trends such as increasing populations (particularly in urban areas), growing consumer demand for foods of animal origin, longer food distribution networks and many basic changes in the way food is produced, transported, processed, prepared and consumed (2). Additionally, the increased handling of foods and the extended shelf-life of products have increased the possibility of product abuse and growth of pathogens. The increased diversity of foods available can lead to confusion among consumers about safe and appropriate handling practices (11,12). It is estimated that many cases of foodborne illness occur as a result of improper food-handling and preparation by the consumer (2).

Genetic changes in microorganisms resulting in increased virulence and an increase in the

number of immunocompromised individuals also contribute to the problem (9,13). The main culprits of foodborne illness are the following group of foodborne zoonotic pathogens: *Campylobacter jejuni*, *Clostridium perfringens*, *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella enteritidis*, *Staphylococcus*, *Toxoplasma gondii*, *Yersinia enterocolitica*, and *Vibrio vulnificus* (14). According to Todd (15), three of these pathogens are causing the most disease in Canada, namely: *Salmonella*, *Escherichia coli* O157:H7, and *Campylobacter jejuni*. Since these organisms are perceived as the most significant threats to public health in this nation, and to limit the scope of this thesis, these three microorganisms were the focus in this study.

The World Health Organization published a report in 1997 which indicated that foodborne illnesses may be 300-350 times more frequent than the reported cases tend to indicate (1,2). In a report published in 1998, The Laboratory Centre for Disease Control illustrated the large incidences of underreporting of foodborne illness in Canada (16). A survey conducted by the Canadian Food Inspection Agency (CFIA) in 1998 showed that Canadians often misdiagnose foodborne illness as a case of the flu. The same survey revealed that Canadians believe that food safety problems are most likely to occur at food processing plants (31%) or in restaurants (19%). Only 16% believed that food safety problems are most likely to occur at home (17). Equally, although only 16% of the public in the U.S. believed that food safety problems were most likely to occur in the home (18,19) research indicated that improper food-handling in the home caused a major proportion of foodborne illnesses (8,20,21,22,23). CFIA's 1998 study on safe food-handling found that consumers were often unaware or misinformed about action they can take to protect themselves from harmful foodborne bacteria (17).

According to Health Canada's latest statistics, microbial foodborne illness is the largest class of emerging infectious diseases and costs Canadian health services, industry and society as a whole an estimated CND $2 billion a year (15,24,25). It is further estimated that every year in Canada, 2.2 million cases of foodborne illnesses occur and, of the individuals who become infected, 31 die (15,20,26).

In the U.S. it is estimated that 76 million Americans get sick every year from foodborne illness leading to 325,000 hospitalizations, and 5,000 deaths (27). Known pathogens account for

approximately 38.6 million of the 76 million illnesses (28). The U.S. Department of Agriculture's Economic Research Service estimates that the cost is at least US $9.2-10.2 billion or more per year. In 1998 and 1999 food safety funding from the U.S. Congress was US $75 million per year and in 2000 this was to be increased by US $62 million (27).

The above statistics on foodborne illness in Canada and the U.S. illustrate the uncertainty of these estimates. The difference in population size between Canada and the U.S. is a multiplier of ten, and thus the above numbers do not seem to correlate. If the Canadian estimates are correct the U.S. should have an estimate of 22 million annual cases of foodborne illnesses and 310 deaths and the cost to society should be CND $20 billion. Or vice-versa, if the U.S. estimates are correct Canada should have an estimate of 3.9 million annual cases of foodborne illnesses, 500 deaths, and a cost to society of U.S. $1 billion. Unfortunately, there is no research available that explains the discrepancy of these foodborne illness data. It is possible that there are other variables that make the above estimates for the U.S. and Canada valid. More research is needed in this area.

An increase in foodborne illnesses has also been observed in Europe. A literature review by Scott in 1996 found that most cases of foodborne illness caused by *Salmonella* and *Campylobacter* arise within the home in many European countries (29). An estimated 86% of outbreaks caused by *Salmonella* affected single households in England and Wales and 97% of outbreaks caused by *Campylobacter* were classed as family outbreaks (30). Data for Scotland indicated that the most common place of consumption of incriminated food was the private household (31). Survey data from The Netherlands suggested that 80% of *Salmonella* and *Campylobacter* infections were caused by inappropriate food-handling practices within the home (32). Reports of foodborne illness in Germany suggested that single cases and household outbreaks play a major role in the rising number of cases in that country (31,33). In Spain, detailed investigations indicated that private homes were the location of approximately 50% of all outbreaks (31). The high incidence of foodborne illness in France was largely attributed to household outbreaks (34).

In terms of human suffering (short- and long-term ill-health as well as death) and economic loss, these outbreaks affect individuals, families, industries, heath care systems and entire

communities. According to WHO, more than 70% of the costs are directly associated with sickness-related absences from schools and the workplace, medical care, and costs incurred by investigating and controlling outbreaks (2). Approximately 2-3% of cases of foodborne disease lead to long-term ill health, which is much more damaging to human health and the economy than the initial disease (2,35).

The FAO/WHO International Conference on Nutrition (Rome, 1992), declared that "...access to nutritionally adequate and safe food is a right of each individual". In a press release in 1997 Dr. Fritz Kaferstein, Director of the WHO Programme of Food Safety and Food Aid, explained that "although food safety is a major public health problem, many public health authorities do not appreciate its importance for community health and development" (36). The Food Safety Programme developed by WHO (2) states that food safety must thus be given a higher priority by governments, industry, and the consumers themselves. Governments are encouraged to establish effective guidelines for control of production, processing, distribution and sale of food. The whole food industry should embrace the full implementation of Hazard Analysis Critical Control Point (HACCP), since this system provides the most effective means for minimizing microbial contamination in food. The Food Safety Programme strongly promotes food-safety education programmes aimed at the general public and food-handlers, which focus on reducing the prevalence of food-handling, preparation, and consumption behaviours associated with foodborne diseases (2).

Unsafe food is a growing concern for consumers in industrialized nations. The Canadian Food Inspection Agency conducted a national survey in 1990, which indicated that the most dangerous food hazards were perceived to be pesticide residues and environmental contaminants/ pollution (17). By 1998 Canadians' perception had changed to the view that pathogens are the most dangerous food hazard. This trend has also been observed in the US where consumers a decade ago were concerned with low levels of chemical residues in foods. More recent studies have found that foodborne microbial pathogens have become the most alarming food safety issue in the U.S. (37). It is believed that this shift in public perceptions of food hazards originated in 1993 following the widely publicized outbreak of pathogenic *E. coli* in the Jack-in-the-Box restaurant chain in the US Northwest. Contaminated hamburgers, which

affected over 700 people and resulted in four deaths, caused the illness (38).

Increased consumer food safety awareness is essential to decrease foodborne illness. Consumer food safety awareness can occur in a number of different ways such as through media coverage, food labelling and community based education (e.g. school curricula, workshops, courses, training programmes). A survey conducted by Audits International in the U.S. in 2000 found that increased consumer food safety awareness can cause significant improvements in the home (39). Extensive improvements in preparation and cooking practices in U.S. homes occurred between 1997 and 1999 due to reoccurring negative media attention during this time which focused on hamburgers, raspberries, eggs, chicken, and lettuce (39). A national survey conducted annually in the U.S. since 1992 has shown that the media is the number one source of information for consumers on food safety issues, and most consumers believe most of what they see in the media (37).

OBJECTIVE

This research was undertaken to obtain estimates of the food safety knowledge and practices of residents in the Greater Vancouver Regional District (GVRD) in British Columbia by gathering and analyzing quantitative information relating to hygiene and cooking procedures followed by these individuals. The survey specifically attempted to gather information in the following two areas:

- Respondents' knowledge concerning the methods of prevention of foodborne illness in meals cooked in the household
- Food safety practices before, during and after meal preparation in the household

This information was solicited from the person(s) primarily responsible for household meal preparation. A survey was conducted from May 19 to June 30, 1998. The results of the survey were expected to provide a general framework for the potential development of education programmes to increase consumer food safety awareness.

SPECIFIC AIMS

The anticipated users of the data collected and analyzed are governmental (federal, provincial, and municipal) and non-governmental organizations, food industries and their associations, post secondary institutions, and the general public. Since the users of the information are non-specific, the surveyor anticipated the information needs of the user as described below. This was done through the use of previously conducted surveys from the Canadian Food Inspection Agency (CFIA), pamphlets published by the Government of Canada as well as numerous articles on this topic (1,2,3,8,9,11,17,40,41,42,43,44).

The results provided by this survey should enable the potential user to design effective education programmes to assist in minimizing the occurrence of foodborne illnesses in the GVRD. The anticipated quantitative information needs of the users are listed as follows:

I. The **knowledge** of safe food-handling practices (i.e. proper hygiene and cooking procedures) of the person(s) primarily responsible for meal preparation in households in the GVRD:

   A. Respondents' knowledge regarding possible health hazards found in foods

B. Respondents' knowledge regarding the risk of foodborne illness in different prepared foods

C. Respondents' sources of information about the proper way to cook, store and handle food

D. Respondents' trust in sources available for information about food safety

E. Respondents' knowledge of *Salmonella*, *E. coli*, and *Campylobacter*[15]

F. Respondents' knowledge regarding short- and long-term effects of foodborne illnesses in different age groups

G. Respondents' personal experience with foodborne illness in Canada

II. The **practices** of the person(s) primarily responsible for meal preparation regarding prevention of food borne illness

A. Respondents' practices during meal preparation when they cook raw meat and poultry regarding level of hygiene as well as how the respondents determine that the meat is ready for consumption

1. Determine whether respondents used the same cutting utensil and cutting board for cutting other food products after cutting raw poultry

2. Determine whether the respondents who used the same cutting utensil and cutting board sanitized these utensils after cutting raw poultry and before cutting other food products

3. Determine whether the respondents sanitized areas which potentially could cause cross-contamination (i.e. countertop, kitchen sink, dishcloth, and hands)

4. Determine the methods used by the respondents to decide whether meat is cooked enough for consumption

B. Respondents' **practices** when storing leftover foods:

1. Time from when the meal is cooked until it is stored (the respondent checks the appropriate time frame)

III. **Demographic information** about the respondent:

A. Age (categories 15-24; 25-34; 35-44; 45-54; 55-64; 65+)
B. Gender
C. Number of individuals in the respondent's household
D. Children under 5 years and individuals over 65 years of age in the household
E. Respondent's ethnic background

[15]According to Ewen C. D. Todd, these three pathogens cause the most disease in Canada (15). Since these three organisms are perceived as the most significant threats to public health in this nation, and to limit the scope of this thesis, these three organisms were the focus of this survey.

OUTLINE OF THE REMAINDER OF THE THESIS

The introduction has outlined some of the social and economic problems the world is facing today regarding foodborne pathogens and related illnesses. The literature review investigates the public's perception and misperceptions regarding foodborne illness as well as their food preparation practices. This is followed by a discussion on the federal government's commitment to public education in Canada and the U.S. and the issues related to educating the public in food safety. The methodology section lists the criteria involved in choosing a self-administered mail questionnaire as the contact method as well as the different methods used in this survey to reduce non-response errors. Data collection methodologies and the statistical methods used to analyze this data are described followed by a discussion of the results, which are compared with federally sponsored surveys conducted in Canada and the U.S. The future implications of this data are discussed. Finally, the reader is presented with conclusions, which highlight the most important findings of this research.

LITERATURE REVIEW

Introduction

Research on the issue of foodborne illness caused by home-prepared meals reveals misperceptions on the part of the public regarding the symptoms and causes of foodborne illness, which in turn leads to underreporting. It is well documented that the public often mistakes an illness caused by foodborne pathogens for the flu and that the public rarely relates foodborne illness to home cooked meals. The Canadian and U.S. Federal governments have since the mid-nineties committed more money to decrease cases of foodborne illness and to educate the public about simple methods of prevention during food preparation in the home. However, the numbers of cases do not seem to be decreasing. This section of the thesis will review the literature on the public's knowledge, attitudes about of foodborne illnesses and food-handling practices. This will be followed by a discussion on the type and focus of educational programmes that are needed to properly inform the public as well as a description of the commitment by the federal governments of Canada and the U.S. to reverse the current increasing trends of foodborne illnesses.

Public perception and experience with foodborne illness

The public fails to recognize the symptoms of foodborne illness and the fact that most cases of foodborne illness originate from home-cooked meals. This section of the literature review will describe the public's perceptions and examine their origins.

Most cases of foodborne illnesses in North America, Europe and Australia are caused by home-prepared food (8,21,22,23,45,46). Research, however, indicates that the public believes that food safety problems are most likely to occur at food manufacturing facilities or restaurants and least likely to occur in the home (8,18,19). Furthermore, many studies have found that the public has incorrect knowledge about the characteristic symptoms of foodborne illness, which may systematically cause the public to fail to recognize when foodborne illness occurs (47,50,52).

Changes in society such as changes in family structure, increased use of convenience foods, and decrease in the extent of training that individuals receive in proper food-handling may lead to such assumptions about food safety and ensuing complacency (48). This could cause consumers to discount the personal risk from foodborne illness and fail to engage in safe food-handling

practices and improved consumption behaviours. Furthermore, the public has misconceptions about the nature and origin of foodborne illness, and underestimates their serious consequences. Underreporting of foodborne illness incidences is a fact, and Todd (15) estimated that the reported number of incidences each year should be multiplied by 350 to determine the probable number of incidences (49). Todd estimated, in 1989, that there were 2.2 million cases of foodborne illnesses in Canada each year (15).

In 1998 the Canadian Food Inspection Agency (CFIA) conducted a survey on safe food-handling across Canada (50). This survey was a follow-up to an earlier survey, conducted in 1990, to determine whether there were any changes in consumer knowledge and attitudes toward safe food-handling at home, especially as it relates to the prevention of foodborne illness. CFIA's survey consisted of 2,013 in-home interviews with Canadians aged 18 and older across the country. The vast majority (88%) of Canadians believed that they never had foodborne illness (which is slightly higher than in 1990). Only eight percent believed they had had foodborne illness once, two percent believed they had had it twice, and two percent believed that they had had it three or more times during the past year. Of the eight percent who believed they had experienced foodborne illness during the past year, 72% attributed their illness to contaminated food eaten away from home, while 13% believed that they became ill from food eaten at home. These proportions were very similar to the findings of the 1990 survey. After receiving an explanation of the symptoms of foodborne illness, 11% of Canadians believed they had had foodborne illness once but mistook it for the flu. Seven percent believed they had had foodborne illness two or more times but had mistaken it for the flu (50). Thus, when people are informed about the symptoms of foodborne illness they realize that past illness attributed to the flu could have been due to foodborne illness. This result reinforces Todd's argument that underreporting of foodborne incidences is very prevalent in Canada.

In 1988 and 1993 the U.S. Food and Drug Administration (FDA) conducted two national surveys about food safety (data collection in the latter survey ended before the Jack-in-the-Box incident) (52). In the 1988 survey 3,200 people were interviewed. That survey showed that 6% had experienced foodborne illness. The 1993 survey interviewed 1,620 people and found that 11% believed they had experienced foodborne illness in the past year. These results are similar

to the Canadian data found in both CFIA surveys.

Thus, public misperceptions about the symptoms of foodborne illness and its origins indicates that the total estimated number of foodborne illness cases occurring each year probably should be revised higher. It is evident from the foregoing reports cited that it is important to educate the public about the causes and symptoms of foodborne illness so that they will recognize these situations when they are suffering from foodborne illness in order to reduce the number of cases of foodborne illness. This knowledge should help the consumer focus their attention to the exact causes of the illness and in the cases when the illness originated from a meal cooked at home, hopefully a learning process will take place so that the food safety mistake(s) will not be repeated.

Consumer knowledge and preparation practices associated with increased risk of foodborne illness in Canada and the U.S.

People who prepare home cooked meals are responsible for most cases of foodborne illness. Use of simple techniques before, during and after food preparation will significantly reduce the risk of foodborne illness (51,52,53).

Raw foods of animal origin are a principal source of foodborne pathogens and improper handling and preparation of such foods in the kitchen are the main factors contributing to foodborne illness (8,21). There are four main methods to prevent foodborne illness: personal hygiene, adequate cooking, avoiding cross-contamination and keeping foods at safe temperatures (40,41,54). Food pathogens on raw foods of animal origin can be readily transferred to hands, cutting boards and utensils and other kitchen surfaces during food preparation and then cross-contaminate fresh vegetables or other ready-to-eat foods if these surfaces are not decontaminated (55). Bacterial populations transferred to these surfaces can approximate those on the contaminated meat and the bacteria can survive for at least 4 hours (55). Application of a kitchen disinfectant can greatly reduce bacterial contamination on cutting boards (55,56). Inadequate handwashing is repeatedly reported in the literature (57,58,59,60). The general public is aware of the importance of frequent handwashing before, during and after food preparation, however, most consumers do not use this knowledge in practice (17,72). This problem is encountered in food processing plants, in food service settings as well as the domestic kitchen (57,58,59,60).

Elimination of foodborne pathogens during the cooking process is essential. Ground meat and poultry should be cooked thoroughly until the juices run clear or the meat is not pink; eggs should be cooked until the yolk is firm and foods containing eggs should be cooked thoroughly (51,61).

The Canadian Food Inspection Agency's 1998 Safe Food-handling Survey found that most Canadians were well aware of the potential hazards of eating improperly cooked meats (92%) and of allowing raw meat to come in contact with other foods (87%). However, few Canadians were aware of the risk of developing foodborne illness from consuming raw eggs (45%) or an egg that has been boiled for three minutes (18%) (50).

The FDA-sponsored telephone survey mentioned earlier, which was conducted in 1993, found that risky food consumption and preparation behaviours were common in the U.S. A quarter of the respondents used the same cutting board to cut raw meat or chicken and for cutting other foods without prior cleaning after handling the raw beef or chicken. Only 66% of the respondents washed their hands after handling raw meat or poultry to prevent cross-contamination. It was further inferred that 53% of respondents consumed raw eggs and 23% consumed undercooked hamburgers (53). Epidemiological data of foodborne illnesses reported by the Centers for Disease Control and Prevention (CDC) in the U.S. from 1972 to 1987 found that 21% of reported cases occurred in home settings (62). The actual percentage of outbreaks that occur in the home, however, is likely to be much larger because small outbreaks that occur in the homes are often unreported or not investigated (28,62,63).

An Australian video study of domestic food preparation practices found that the main causes of foodborne illness were lack of segregation of raw and cooked foods, leaving cooked food at room temperature for extended periods of time, inadequate sanitation of kitchen surfaces allowing contaminated raw-meat packaging to remain in the work area during food preparation, infrequent and improper hand-washing method, and poor personal hygiene. It was also found that there was a significant difference between 'stated' practices as described in a questionnaire and 'actual' kitchen practices as seen on a video from the same households (22). A national Australian food safety telephone survey revealed that almost 25% of respondents did not know that hand washing before and during food-handling was important in reducing the risk of cross-

contamination and foodborne illness. The same survey found that 75% of respondents had a high chance of foodborne illness occurring in the home. Australian media coverage of the causes of foodborne outbreaks around the world caused 25% of respondents to change their eating habits (23).

Safe food-handling surveys conducted in Europe and the U.S. have found that older people and women are more likely to follow appropriate safe food-handling practices as compared to younger people and men (3,64,65,92). This may be due to an increased interest in food related hazards by more experienced consumers.

A barrier to consumer perception of the relevance of food safety information may be caused by 'optimistic bias' (66). This occurs when people believe that they are at less risk from foodborne illness than an average member of society. This type of an individual is more likely to engage in risky behaviour (3,25,66,67,68). Research has revealed that the public feels that the lowest personal risk is from home cooked meals that they prepare themselves. Furthermore, the public often feels that their knowledge of hazards is greater than that of other people, giving rise to an illusion of knowledge (66). This mantle of personal invulnerability may result in the failure of public information campaigns since any information is assumed to apply to other members of society (29,66).

Thus, people who prepare and consume food at home play an essential role in foodborne illness prevention. It seems that younger people in particular have little knowledge and poor safe food-handling practices. It is therefore essential that this segment of the population be educated in safe food-handling practices.

Public education and federal commitment to public education in Canada and the U.S.

The high incidence of foodborne illness originating in the home, the possibility of long-term illness and death associated with foodborne illness, the excessive cost to society of foodborne illness, and the relative simple steps individuals can take to prevent foodborne illness require that the public be more informed about relevant risks to which they might be exposed (69). These factors made this aspect of food safety the number one concern of federal food inspection agencies, during the nineties, in both Canada and the U.S.

Following the Jack-in-the-Box outbreak in January 1993 the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) initiated the Pathogen Reduction Program to reduce the risk of foodborne illness and consumer education was a key component of this strategy. In February 1993 a consumer action group known as "Beyond Beef" filed a suit against FSIS. The outcome of this suit was a court-sanctioned agreement that compelled FSIS to mandate safe handling instructions on raw and partially cooked meat and poultry (70). The USDA had long been committed to an extensive consumer education programme to help prevent foodborne illness caused by improper handling. However, it was deemed necessary to introduce a more direct method of placing food safety information in the hands of consumers (71). A copy of the label that became a requirement in 1994 is found in Appendix I.

In 1995 and 2000, consumers in the U.S. were questioned about their recollection of the instructions found on the food labels (72,73). The finding indicated that, when read, safe handling instructions on labels improved food safety awareness of consumers. Overall, 51% reported having seen the labels in 2000 versus 37% in 1995. Of the consumers who had seen the labels in both surveys, 80% recalled a food safety message, and 41% of these reported that they changed their food preparation practices as a result (versus 37% in 1995). It was found that individuals who most often prepared meals at home were better able to recall the instructions on the labels. Women were more likely than men to recall the instructions, as were individuals over 30 years of age compared to individuals between 18 and 29 years. Both label awareness and risky food-handling behaviours increased with income and education, suggesting that safe food-handling labels have limited influence on consumer practices (73). Results from the survey in 2000 also indicate that the labels are more effective in preventing cross-contamination and less effective at informing the consumer about appropriate methods to determine whether meat has been cooked enough to prevent foodborne illness. The safe food-handling label is only a segment of food safety education programmes that are necessary to inform consumers about proper food-handling and preparation practices, and to motivate persons, who have risky food-handling and preparation practices, to change these behaviours (73).

In 1995, a committee involving officials from Health Canada and Agriculture and Agri-Food

Canada was assembled to evaluate whether similar labeling requirements would reduce the risk of foodborne illness due to preparation and consumption of meat and poultry in Canada (74). This committee proposed two labels for safe handling instructions (see Appendix II). The Canadian-proposed labels have minute differences from the U.S. labels. The Canadian-proposed labels emphasize proper center temperatures that should be reached during cooking and the importance of sanitizing work areas and utensils after cleaning with hot soap and water (74). The use of the proposed labels was voluntary and the Canadian Council of Grocery Distributors was very opposed to using them, and thus use of the labels was rejected by this organization (74). To date, Canadian agencies have not legislated safe handling and cooking labelling requirements similar to the U.S. requirements (74).

In November 1998 a national campaign was launched to inform Canadians about the risk of foodborne illness and how to prevent it. The campaign is called FightBAC!™. An alliance of different food sector organizations[16] called The Canadian Partnership for Consumer Food Safety Education initiated the campaign which was developed by the United States Partnership for Food Safety Education. The goal of the Canadian Partnership is to "*Contribute to the reduction of foodborne illness in Canada by increasing awareness of safe food-handling practices through the coordination and delivery of food safety education programmes focused on the consumer*". The campaign includes industry, health, environment, and consumer groups. The information is being distributed through public health units; public service announcements on radio and television; printed materials and displays in supermarkets, food fairs and trade shows; and community centres, seniors' residences and schools. Formation of The Canadian Partnership for Consumer Food Safety Education will augment the food safety initiatives on farms, at processing plants, in retail stores, in restaurants and in homes (75).

A media analysis, conducted two months after the launch of FightBAC!™,revealed that the campaign was an initial success with the media. Over 10.9 million Canadians were exposed to

[16] Consumer, Health and Environmental Organizations: Canadian Home Economics Association, Consumers Association of Canada, Environmental Health Foundation of Canada, Kidney Foundation of Canada. Industry Organizations: Beef Information Centre, Canadian Council of Grocery Distributors, Canadian Egg Marketing Agency, Canadian Federation of Independent Grocers, Canadian Meat Council, Canadian Poultry and Egg Processors Council, Canadian Turkey Marketing Agency, Chicken Farmers of Canada, Chicken Farmers of Ontario, Crop Protection Institute of Canada, Dairy Farmers of Canada, Further Poultry Processors of Canada. Government Organizations: Canadian Food Inspection Agency, Federal/Provincial/Territorial Committee on Food Safety, Health Canada, Ontario Ministry of Agriculture, Food and Rural Affairs, Vancouver/Richmond Health Board. Affiliate Member: Unites States Partnership for Food Safety Education.

the campaign and its messages. The media content was found accurate, consistent and positive (76).

Numerous pamphlets have been published by the Government of Canada about Food Safety. The most recent pamphlet 'Food Safety and You' was published in 2000 and mailed to all households in Canada (77). This pamphlet describes the safe food supply we enjoy in Canada, the governments role and commitment to food safety, the importance of food labelling and the approval process of new foods. Different food safety tips are also included throughout the pamphlet. Health and Welfare Canada distributed in 1993 a pamphlet, which is similar to the one mentioned above, to all Canadian households. It was called 'Food Safety – It's all in your hands' (78). This pamphlet focused more on the causes of foodborne illness through different case studies. A series of true/false statement were included in the case studies and a small pullout poster was inserted as the center page which described the four main methods to prevent foodborne illness before, during and after food preparation: avoid cross-contamination, cook meats thoroughly, cool foods within two hours and store foods below 4°C or above 60°C. Other pamphlets/dispatches/articles have been published by the government on the causes of foodborne illness as well as food safety tips and facts, which now can be found on the Canadian Food Inspection Agency website (79). Some examples are: 'Food Safety Tips on Barbecuing', 'Food Safety Facts on Eggs' and 'Food Safety Facts for Kitchen Safety'.

The U.S. Department of Health and Human Services (USDHHS) developed a plan in 1990 called *Healthy People 2000*. The objective was to decrease the incidences of infections caused by foodborne pathogens by year 2000 (80). This publication suggested a need for a new approach to food safety education, one that focuses on positive behaviour change rather than knowledge alone. Motivation to practice safe food-handling behaviour depends upon a belief that the individual could be personally harmed if safe food-handling practices are not followed, and that behaviour could have a positive impact on the prevention of foodborne illness (80). This, however, needs to be done in such a way that the consumer is not alarmed into boycotting the relevant food. Emphasis must be put on the fact that the risk is controllable (80). It is important that the public feels they have a high degree of control of safe food-handling in the home. Furthermore, it is critical that the food safety message informs the public about the symptoms of foodborne illness (including information on the delay of up to 4

days before symptoms of some illnesses are displayed).

An educational approach where participants are taught critically to think through the food safety process to determine how foodborne illness could occur has been reported to be effective (81). This approach was incorporated into the hazard analysis critical control points (HACCP) plan first developed by Pilsbury, the National Aeronautics and Space Administration, and the U.S. Army research laboratory (82). Although the HACCP system was developed in the mid-seventies it is a relatively new approach to the prevention and control of foodborne illness in the food industry. HACCP has become synonymous with food safety. Recognized worldwide, it has become a food safety yardstick acceptable both to industry and government. HACCP provides a systematic and proactive evaluation of foods by determining the risks from biological, chemical and physical hazards at any stage of food production, processing or preparation (83). Food safety educators can adopt components of conventional HACCP implementation strategies to a domestic environment as a method of risk assessment and use this knowledge to educate the public (84,85,86,87,88,89). The HACCP approach can be used in the home to assess risks associated with preparation and storage of foods and to identify critical control points. Food preparation practices in individual homes may vary; however, types of food, fuel and energy sources, cooking facilities, economic resources and cultural influences often are similar within subgroups of a society (90).

A frequent topic in public controversies about food safety risk is the notion that the public needs to be better educated about science (91,92). Public opinion polls about scientific literacy indicate that public understanding of science will resolve technological controversies (93). However, risk communication theory argues that trust is more important than science in the public arena; thus it is important that scientists and government regulators take an active role in the public discussion. However, this requires a better understanding of the public by scientists and government regulators (91). Many studies have indicated that the public has less confidence and trust in government and industry as risk communicators and educators whereas consumer organizations and parts of the mass media are highly trusted by the public (66).

In 1995, an electronic bulletin board Food Safety Network (FSnet) was established to provide scientists, government regulators and others with current, generalized public risk perception

information about rapidly changing food safety issues selected from journalistic and scientific sources around the world (93). As of 1999, FSnet is distributed to approximately 2,500 individuals in over 40 countries. FSnet postings are distributed, free with ongoing funding support from government and industry (93). A review was done on the FSnet and the conclusion was that FSnet was meeting its intended goal "as an electronic communication tool to assist in risk analysis activities, to rapidly identify issues for risk management and communication activities, to enhance awareness of public concerns in scientific and regulatory circles, and to exchange timely and current information for direction of research and for diagnostic or investigative activities." (93).

On January 25, 1997 President Clinton announced in a radio address that the U.S. government made it a top priority to modernize the food safety system. The Food and Drug Administration's Center for Food Safety and Applied Nutrition (CFSAN) was responsible for implementing this initiative. On November 8, 1997 the *Safe Food Act* was introduced. A single, independent agency was created to enforce food safety regulations from farm to table. A nationwide early warning system, established to track outbreaks of foodborne illness, is administered by FoodNet (Foodborne Diseases Active Surveillance Network) and supported by the FDA, the Centers for Disease Control and Prevention (CDC) and the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS). This early warning system is intended to facilitate earlier detection of outbreaks as well as data collection and analysis to prevent outbreaks in the future. Furthermore, it would use state-of-the-art DNA fingerprinting methods to trace pathogenic bacteria to their source and ensure that outbreak information immediately reaches hospitals and public agencies throughout the US. Other key elements of President Clinton's initiative were increased inspection, risk assessment, bioscience research, education, outbreak coordination and strategic planning of the reduction of the incidence of foodborne illness (6,94,95).

In 1998, Guzewich, Bryan and Todd published a 4-part series of articles on the surveillance of foodborne disease (96). In these articles they argue the necessity of surveillance to identify and control outbreaks, the importance of gathering data on incidence of diseases and prevalence of etiologic agents, vehicles and reservoirs. The authors further argue the necessity of the identification of factors that leads to outbreaks, the estimation of health and economic impact

of the diseases as well as the importance of establishing a data bank for HACCP systems and risk assessment. A surveillance system would also provide information as the basis for rational food safety program goals and priorities (96). These arguments are well supported in the literature (94,97,98,99).

In 1997, The National Academy of Sciences' Committee was charged with assessing the effectiveness of the food safety system at that time and for providing recommendations to ensure an effective science-based system. In March 1998 the Institute of Food Technologists (IFT) submitted a document to this committee, *Guiding Principles for Optimum Food Safety Oversight and Regulation in the United States*, on Ensuring Safe Food from Production to Consumption (100). These guiding principles were endorsed by 13 professional and scientific societies[17]. In 1999, President Clinton affirmed his administration's commitment to improving the safety of the US food supply, and several initiatives were announced during that summer. One was the establishment of a joint USDA-FDA research institute, which is to work with industry, state and local public health, agriculture and research agencies to identify and solve food safety issues (61).

A systematic review was commissioned by the Ontario Ministry of Health to summarize evidence on the effectiveness of public health interventions regarding food safety in homes and other community-based settings (eg. community centres, churches and schools). It was found that selected community based programmes are increasingly becoming more innovative and can increase public knowledge of food safety (101). The development of community-based food safety education is a complex undertaking because it involves diverse target audiences (e.g., homemakers, extended families, volunteer cooks), many different settings (e.g., schools, community centres, churches), diverse strategies (e.g., school curricula development, workshops, dissemination of resources, peer education), and many different ethnocultural groups each with their own food preparation practices (101).

[17] American Association of Cereal Chemists, American Council on Science and Health, American Dairy Science Association, American Dietetic Association, American Meat Science Association, American Oil Chemists Society, American Society for Clinical Nutrition, American Society of Agronomy, American Society of Animal Science, Crop Science Society of America, Federation of Animal Science Societies, National Association of State Universities and Land-Grant Colleges, Soil Science Society of America.

Health professionals (e.g., doctors, nurses, dietitians, nutritionists, and pharmacists) are perceived to be very reliable sources of information by the public (102). A recent survey in Italy found that respondents who had been informed by physicians about foodborne illnesses had significantly better food-handling practices (65). The primary expertise of food and nutrition educators (i.e. dietitians and nutritionists) is health promotion, and thus, individuals from these professions should provide food-handling recommendations to susceptible individuals[18] or their care-givers to minimize risks of foodborne illness (86,103,104). Food and nutrition educators can also play an important role in developing, presenting and evaluating food safety education programmes. Additionally, food safety researchers can use nutrition education research as a guide in developing behavioural theories and evaluating the effectiveness of educational programming.

In conclusion, strategies for achieving a reduction in foodborne illness have been the subject of debate during the last decade. It seems that a dual approach is advocated based upon legislation (e.g. food labelling) and comprehensive and coordinated public education. The value of considering behavioural aspects of the educational process (e.g. improve positive behaviour change rather than knowledge alone) should be stressed.

[18] See definition for 'susceptible individuals' in the Glossary.

METHODS

The contact method chosen for this survey was a self-administered mail questionnaire. Data collection in the form of mailed questionnaires has been implemented across diverse fields such as marketing, advertising, business, and the political and social sciences (105). This is in part due to the high degree of utility offered by this method. However, poor response rates have been a problem for many survey practitioners (105,106,107). A review of the literature suggested a number of techniques that have shown to increase response rates (105,108,109,110,111,112). As many of these techniques as was possible were included in this survey to maximize response rate (see below).

- Insuring the respondents about confidentiality
- Focus on question development as well as questionnaire layout (a total of ten drafts were produced)
- An introductory letter was included with the questionnaire (which indicated that the survey was part of the completion of a Masters degree from a university and the letter was personalized by an individual signature on each letter)
- A follow-up letter (including a copy of the questionnaire) was mailed out five weeks after the questionnaire was first sent out
- Individual interviews and a pilot-survey were conducted

Collection Methodology

A self-administered mail questionnaire was chosen for data collection for this survey based on the following list of criteria:

- Very few "contingencies" were necessary, where a question depends on a previous response
- The respondent would be able to see the context of a series of questions
- Questions would mostly be written in closed-ended style
- The questionnaire would only be moderately long
- The complexity of the questions were low for this survey, thus, it was not necessary to have an interviewer explain questions
- Respondents could answer the questions at times that were convenient
- The respondents could provide and record their own responses (however, it is difficult to control respondent selection within a household)
- A mail questionnaire insulates the respondent from the expectations/bias of the interviewer

Reduction of non-response errors

Available techniques discussed below were applied in this survey to reduce non-response.

Introductory Letter

An introductory letter was written to explain the study and the general procedures to the potential respondent, as well as motivating the potential respondent to participate (See Appendix III). This letter attempted to anticipate respondents' questions about the survey and answer them in a clear manner. Contents of the letter were discussed with the individuals who participated in the individual interviews (as described later) and the final draft was pre-tested during the pilot survey. The letter was one page long, and easy to read in terms of type size, layout, reproduction quality, and language level.

It has been shown that respondents are more likely to respond to surveys that are sponsored by well-known universities or governmental agencies since they consider the survey more important or prestigious (113,114). Thus, the introductory letter was printed professionally on Food Science letterhead with the University of British Columbia logo. The surveyor was introduced as a student in an attempt to appeal to the potential respondent's wanting to 'help out the student'. The purpose of the study was explained. However, when explaining the purpose of the study no information was included which could 'lead' the respondent when he/she answered the questionnaire. It was explained why this study was important and useful and emphasis was put on the importance of participation for the success of the survey. It was explained how the surveyor got the respondent's name and address and information was included regarding confidentiality of individual responses. It was emphasized that participation in the survey was voluntary. The respondent was given an accurate estimation of how long the process would take[19]. It was made clear how the respondent could get in contact with the surveyor if he/she had any questions (phone numbers and e-mail). It was also explained how to return the questionnaire. A blue slip of paper was included which respondents could return with the questionnaire if they were interested in receiving a summary of the study results.

[19] This timeframe was determined during the individual interviews conducted before the pilot survey.

Confidentiality

Respondents are generally more likely to respond if they feel that their answers are kept confidential instead of being attributed to them directly (115). The following was done to ensure confidentiality of the respondents: No names or addresses were printed directly on the questionnaire or introductory letter. Instead a unique respondent identifying number was recorded at the back page of the questionnaire in the bottom right corner. A list of the names and addresses, which corresponded with the code numbers, was kept separately and out of view of people who are not involved in this survey. When questionnaires were returned they were collected in a locked file cabinet and kept in a locked room. The answers from individual questionnaires were not discussed with people who were not involved in this survey. And finally, the data from this survey will not be reported in a manner that allows the readers to figure out who the respondents are.

Question Composition

Development of the questionnaire was recognized as the most important part of the survey. This is a science as well as an art. It is a science since rules are applicable when forming the questions to elicit accurate information (116). Because questionnaires are based on language it is an art and it is difficult to make language precise. Words often assume different shades of meaning in different parts of a country and more so in different parts of the world (115). This is of particular interest when developing a questionnaire for which respondents are of different cultural backgrounds such as in the Greater Vancouver Regional District. Meanings also vary between socio-economic groups and age groups. It can be necessary to use different words or groups of words to stimulate the recall of the same event by different respondents (115). Thus, language is of great importance when attempting to convey to all respondents as consistent a request for information as possible (116). An attempt was made to develop questions that were clear and straightforward in four important aspects: simple language, common concepts, manageable tasks, and widespread information. The language used was polite and respectful.

The questionnaire was written in English. It could be argued that the questionnaire should have been translated into other languages, such as French, Chinese, or Punjabi due to the ethnic make-up of the population of Greater Vancouver. However, the safe handling instructions which have been proposed by officials from Health Canada and Agriculture and Agri-Food

Canada on packages of raw meat and poultry products will be written in English and French only and thus, the consumer to whom these labels are aimed is one who is able to read and understand one of these two languages. Only 0.038% of the population of the GVRD speak French only[20], which was not enough to justify the cost of translating the questionnaire into French (117).

There were not enough funds to translate the questionnaire into any other language. However, a statement was developed which was translated into Punjabi and Chinese which read:

> "If there is no one available in this household who reads and writes English well enough to complete this questionnaire, please check this box and return the questionnaire in the postage paid envelope provided. Thank you very much".

It was decided to place these two sentences on the front page of the questionnaire to ensure that as many respondents as possible would see them.

An attempt was made to maximize the quality of the information (i.e. low distortion/bias) by designing the questions to motivate the respondent and to facilitate recall where this was needed. Every effort was made to design a questionnaire that was interesting and which avoided questions that were difficult to answer, time-consuming, embarrassing, or personally threatening.

Layout of the questionnaire

The questionnaire was divided into five sections (sections A through E, see Appendix IV). Each section was introduced with a short explanation of the purpose of the questions in that particular section. The sequence of the questions was very deliberate: the first half focused on the respondents' behaviour and the last half focused on the respondents' knowledge. It was anticipated that this order would prevent respondents from obtaining new knowledge that could influence their responses concerning meal preparation practices.

The first page displayed the title of the survey: "Food-handling Survey of Households in the Greater Vancouver Regional District". The University of British Columbia's official seal was printed with the university name above and the department through which the survey was

[20] Total population of GVRD in 1991 Census was 1,542,744 and only 585 people speak French only.

conducted beneath (Food Science Department). The top third of the second page re-emphasized who was conducting the survey and how to get in contact with the surveyors.

The purpose of section A (page 2) was to ensure that the person who was most involved with cooking in the household completed the questionnaire. Questions in section B (pages 3-5) were aimed at the respondents' preparation practices (whether the respondent separated utensils to prevent cross-contamination and if not, whether and how they are sanitized). Questions in section C (pages 5-7) focused particularly on cooking practices (i.e. how the respondent determined whether different cuts of poultry and beef patties were cooked enough to prevent foodborne illness). Section D was designed to determine the respondents' knowledge of food safety and foods/organisms that can cause foodborne illness. Knowledge about the short- and long-term problems associated with foodborne illness was also surveyed in this section. The last section, E, was only demographic information: age, gender, ethnic origin, number of people in the household, and whether individuals who are susceptible to foodborne illness are a part of the respondent's household. On the back of the questionnaire there was a section where the respondent could make comments. An expression of appreciation was followed by a diagram showing two hands joined together to emphasize the appreciation of the surveyor. The mailing address was displayed at the bottom of the page in case the respondent had lost the postage-paid envelope.

Individual Interviews

Individual interviews were used in three stages of the questionnaire development: the second, third and fourth drafts were used in the interviews. The purpose of these interviews was to determine how well the interviewees understood the individual questions in the questionnaire and the degree to which her/his answers could fit into the selection of answers given. The questions that arose from this inquiry prompted brief discussions from which the surveyor discovered the manner of thinking as well as behaviour of the interviewees regarding food preparation and cooking behaviour. These interviews also helped the surveyor evaluate assumptions concerning vocabulary and the way people understand terms or concepts that were to be used in the questionnaire.

The population chosen for the interviews lived in the UBC Family Housing complex. The

surveyor knocked on doors and briefly explained the purpose of the interview, and asked if the person who cooks more than half the meals was available and if this person could take about half an hour out of her/his time. Only a few households declined because they were too busy to help or the appropriate person was not available.

The surveyor asked the subject of her/his first impression of the questionnaire regarding the 'look' of the questionnaire as well as the length of the questionnaire ("does the questionnaire seem short, long, or of medium length?"). The surveyor also asked the interviewee to critique any questions that were difficult to understand, or were difficult to answer because the interviewee's answer wouldn't fit into the answers provided (in a closed-ended question).

Listening to what people had to say broadened the surveyor's perspective about the realities that were being studied and how people think about them. These interviews led to some helpful discussions about the different questions. English was the second language for many of the subjects, and it was very interesting to discover the problems which were encountered, both with the questions and the answers. The importance of specific and clear questions became clear to the surveyor.

Twelve of the 25 interviewees had Eastern- and Western European origin and the rest had other origins (e.g. Chinese, Hindi, Mexican, Iranian, Pakistani, Filipino, and Korean). The first round of interviews included seven individuals. The questions seeking demographic information and the food safety questions did not pose any major problems for any of the interviewees. However, many of the questions on food preparation and cooking practices were rating scale questions where the answers were set-up in table form. Most of the subjects had a very difficult time trying to answer these questions. Usually they understood the question but they could not understand how to answer. This question structure was changed in the following draft to provide more checklist questions and open-ended questions. More alternative answers (suggested by some of the subjects) were included in closed-ended questions. Many subjects found that some of the questions were overlapping, and that some were redundant. This was corrected by removing some questions and fusing others in the following draft. It took the subjects approximately 30-45 minutes to answer the second draft questionnaire, including the discussion that occurred.

The third draft of the questionnaire was tested with 13 individual interviewees. The changes that were made in the fourth draft included the rotation of all close-ended answers, adding 'Viruses which may cause food poisoning' to question number 29 and adding all the closed-ended answers found in question number 47. Draft number four was the subject of five individual interviews. The changes that occurred from these discussions were mainly in formulation of some of the questions. It took these five individuals between 10 and 25 minutes to complete the questionnaire. Additional drafts were developed which mainly focused on question composition. A total of ten drafts were made before the supervisory committee and the surveyor were confident that the questionnaire was ready to be mailed out.

Ethical Review

A request for an ethical review was submitted in December 1997. A certificate of approval was received on February 9, 1998 from the Behavioral Research Ethics Board, University of British Columbia.

Return Postage

To increase response rate the respondent was supplied with a return envelope pre-addressed to the surveyor, stamped with return postage. Business reply envelopes were used since the post office only charged for the questionnaires that were returned. The disadvantage of business reply mail is that it gives more of the appearance of impersonality compared to a stamped return envelope.

Outgoing Mail

Metered mail using a postage meter was used on the outgoing mail. This greatly reduced the cost of the outgoing postage. The questionnaire was folded in half and mailed with the introductory letter and the 'Respondent request for information' slip in an envelope with the institutional logo and return address. The address of the sampling unit was printed onto the envelope. It was anticipated that using an official institutional envelope would increase response rates slightly as discussed above, and respondents should be less likely to assume the mail is "junk mail' and would be more likely to open the letter.

Follow-up Mailings

The single most important technique used to increase survey response rates is follow-up

mailings (118,119). It is recommended that the first follow-up mailing arrive at the respondents' addresses around the 14th day. Since it is recommended to aim for at least 75% response rate, and because an initial response rate of approximately 40% was anticipated for this survey (as found in the pilot survey described later), four mailings were planned - the initial mailing and then three follow-up mailings. Each mailing should be spaced two weeks apart giving approximately the following pattern of return: 40% + 20% + 10% + 5% = 75% (118). Thus, the total mailing period was anticipated to take 9 weeks. The first and third follow-up survey was planned to be a postcard reminder. A telephone follow-up was contemplated and was tested in the pilot survey.

However, after sending out the first mailing it was decided to limit the follow-up mailings to one due to the high expense of printing and mailing and the time involved in mailing out the questionnaires (writing the code number on each individual questionnaire, signing each letter, etc.). The follow-up occurred five weeks after the first mail-out and included a copy of the questionnaire, a new introductory letter (Appendix V) and a 'Respondent request for information' slip (Appendix VI).

Sample Design

Dominion Directories Information Services™ provided the sampling units for this survey. This company uses Telus' telephone listings to accumulate the sampling frame. Dominion Directories updates its lists monthly to increase the chance that the sampling frame will represent the target population at that time.

Sampling frames accumulated from telephone listings have a disadvantage, which is coverage error. Households without a telephone or those who do not wish to be listed and the homeless have zero probability of being sampled. Thus, those households or the homeless were not represented in the sampling frame. According to Statistics Canada, 98.8% of the population in B.C. had a telephone in 1996. If this number is broken down according to household income, the percentage distribution is seen in Table 1.

Table 1 shows that households in B.C. with a household income of less than $10,000 and between $15,000 -$19,999 are not as well represented as other household income levels. Therefore, using this sampling technique, this survey is likely to find somewhat higher levels of

income and income-related behaviours among its respondents than exists in the overall population.

Table 1. Distribution of households within household income groups in B.C. who had a telephone in 1996 (120).

Household income group	Households with telephones (%)
Less than $10,000	93
$10,000-$14,999	99
$15,000-$19,999	95
$20,000-$24,999	98
$25,000-$29,999	98
$30,000-$34,999	100
$35,000-$44,999	99
$45,000-$54,999	100
$55,000-$69,999	100
More than $70,000	100

Source: Statistics Canada. 1996.

Telus estimates that approximately 5% of households who have a telephone, choose to be unpublished (not printed in a local telephone directory, but accessible through directory information) or choose not to be listed (not accessible at all). The figures in Table 1 do not show these households. This is another potential source of noncoverage error that is introduced if a list is generated through Dominion Directories. Dominion Directories also ensures that multiple-line households are represented only once in this directory.

Determination of Sample Size

The desired margin of error (precision) of 0.03 and a confidence interval of 95% governed the calculation of the sample size for this survey based on the following information needs and available resources.

The variability among units in the population was expected to be high (0.50) due to the large differences in knowledge and behaviour anticipated in the population. Since information was collected on more than one item the desired margin of error was specified for the items regarded

as the most vital for the survey. These items include the respondents' different types of behaviour in the prevention of foodborne illness.

The population in 1995 of the GVRD was 1,819,532. It was estimated that the response rate would be quite high due to the many follow-up mailings and the questionnaire design. Since this survey estimated proportions the confidence interval was expressed as: $p \pm d$ or equivalently $p \pm z^* \frac{S}{\sqrt{n}}$. This means that $d = z^* \frac{\sqrt{p(1-p)}}{\sqrt{n}}$

where: p = sample estimate of the proportion (0.50)
d = margin of error (0.03)
z = 1.96 for a 95% confidence interval
S = inherent variability in population
n = sample size

With a preset margin of error of 0.03 and a confidence interval of 95% it is found that the sample size should be:

$$\sqrt{n} = \sqrt{p(1-p)} * \frac{z}{d}$$

$$\sqrt{n} = \sqrt{0.5(1-0.05)} * \frac{1.96}{0.03}$$

$$\sqrt{n} = 0.5 * 65.33$$

$$\sqrt{n} = 32.67$$

$$n = 32.67^2$$

$$n = 1067$$

In the planning stage for this survey it was hoped that a response rate of 75% would be reached. Thus, when adjusting for non-response (by dividing 1067 by 0.75) it is seen that at least 1421 potential respondents had to be contacted to get a final sample size of approximately 1067. A total of 1,500 respondents were contacted as described above.

Stratified Random Sampling

Municipalities of Greater Vancouver were stratified into three strata based on the Forward Sortation Areas (FSA's) to ensure that the diverse population of the GVRD would be represented in the target population with regards to different socio-ethnic variables. This

method would increase the precision of the sample estimate of the population mean since there are many characteristics which are concentrated in certain geographic areas, such as ethnic origin, income, level of schooling, and occupation. The heterogeneity of the population should become more homogenous with regards to these characteristics and population variability should be reduced. This would ensure that smaller groups (e.g. of different ethnic origin) in GVRD were represented in the sample proportionate to their size.

The stratification of these municipalities was based on geography and number of households. In January 1998 a list of 5,000 random residential listings from these three strata was purchased from Dominion Directory Information Services. One-thousand-six-hundred-and-sixty-seven listings were selected from each strata. Strata numbers one and three were approximately equally represented, however, strata number two was not as well represented (Table 2). Thus, it was decided that all the results from this survey should be displayed with the weighted percentages.

Table 2. Stratification of the GVRD municipalities into strata and the frequency distribution of respondents and non-respondents.

Strata number	Number of households per strata	Sampling frame	Sampling units	Frequency of respondents (%)	Frequency of non-respondents	Weight[1]
1[2]	227,162	1667	500	181 (35)	319 (33)	1255
2[3]	229,980	1667	500	147 (28)	353 (36)	1565
3[4]	231,865	1667	500	192 (37)	308 (31)	1208
Total	689,007	5000	1500	520 (100)	980 (100)	1325

[1]One respondents' representation (i.e. number of people represented by each respondent within each strata)
[2]North Vancouver, Port Moody, Port Coquitlam, Coquitlam, Burnaby, New Westminster, Pitt Meadows and Maple Ridge
[3]West Vancouver and Vancouver
[4]Richmond, Delta, Tsawassen, Surrey, White Rock and Langley

Representativeness of the sample

It was important to determine whether the sample was representative with respect to the characteristics relevant to the substantive interest of this study. Therefore, questions such as age, gender, ethnic group, household size and information on the age of the members of the

household were included in the questionnaire. Information about the respondents' socio-ethnic background was collected to estimate the survey sample's representativeness of the target population (the population of the GVRD).

Validity

The validity of the survey was maximized in this survey by working extensively with the questionnaire design, as this was one of the most crucial aspects of the research. The draft questionnaire was analyzed and discussed thoroughly within the supervisory committee and professional statisticians were consulted[21] to ensure that the survey design, questionnaire format and question formulation would lead to a close estimate of the sample population. Furthermore, twenty-five individual interviews were conducted to observe problems encountered by respondents when answering the questionnaire. These interviews contributed to important improvements in question formulation; particularly questions 29 - 33 (Appendix IV).

In February 1998, a pilot survey was conducted to identify problems that were not obvious except when the questionnaire was used in practice sessions (see description of the pilot survey below). Furthermore, to increase the validity of the data collected from this survey, statements in the cover letter and the first question in the questionnaire sought to ensure that the individual answering the questionnaire was the person primarily responsible for meal preparation in the household.

Definitions for 'household' and 'ethnic group' defined by Statistics Canada were used for this survey (121). To be able to compare the results of this survey with the CFIA's 1990 National Food-handling Survey some of the questions of interest were also asked in this survey (i.e. 'frequency of meal preparation', 'responsibility for food safety at home', 'seriousness of food hazards', 'refrigerating leftovers', 'source of knowledge about food preparation', 'had foodborne illness in the past year', 'source of foodborne illness') (17).

Pilot Survey

A pilot survey was conducted in February 1998. The survey questionnaires were mailed out to 100 randomly selected households. Through systematic sampling a computer programme

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selected every 50th household from the residential listing of 5,000 households purchased from Dominion Directory. The questionnaire was mailed out on February 2. Twenty-nine households responded to the first mail-out (29% response rate). A follow-up letter including the questionnaire was mailed out on February 25 which prompted nine more responses. From April 1 to April 22 all non-respondents (a total of 62 households) were contacted by telephone. Six more responses resulted from the telephone follow-up. Thus, a total of 44 responses was received from the pilot survey (44%).

The data analysis of the pilot survey indicated that there were no major problems with the questionnaire. However, a few minor changes were made: Question number 30 was changed to a simpler layout (the results indicated some confusion when respondents answered this question as it was originally designed) and question number 50 was expanded to include more ethnic groups. It was decided that the main survey would not include a telephone follow-up since the time commitment was not worth the increased number of respondents generated in the pilot survey.

DATA COLLECTION AND PROCESSING

Distribution and collection of the questionnaire

The selected sampling units were recruited by mailing out the questionnaire (Appendix IV) with an introductory letter (Appendix III). The objectives of the study were explained to the potential respondents. The first contact with the respondents was mailed out on May 19, 1998. Four weeks was the time frame given for the respondents to respond to the questionnaire. The follow-up letter was mailed out on June 15 (Appendix V). A copy of the questionnaire, a postage paid business reply mail envelope and the 'Request for Information Slip' was included again.

Coding of the questionnaires

The data for this study was processed using SPSS software (122). Codes for the answers were printed directly on the questionnaire to decrease the possibility of keying an answer into a wrong field. These codes were printed inconspicuously in small print to every 5^{th} answer to avoid confusing the respondents. The section labels that were applied to the four sections (A-D) of the questionnaire and the question numbers were used for the coding (i.e. question number 1 was coded A1, question number 2.1 was coded A2.1, etc.)

Fixed-width coding was used for this survey. In fixed-width coding, each unit of data (i.e. each question for which there is an answer) is assigned a column number large enough to accept the largest possible answer. Fixed width coding is easy to apply when designing the questionnaire, however, when processing the data each record must be read fully (including the unanswered questions).

Statistical methods

To conclude that a population has correct knowledge and follows appropriate practices to prevent foodborne illness it could be argued that everyone in the population should fall within defined criteria of knowledge and practices; otherwise there would be a risk for foodborne illness situations. However, this would be an unrealistic target as one could not realistically expect that every person in the population has received and retained the knowledge and that the appropriate practices were learned as well (3,25). Thus, the target set for this survey to determine whether the population as a whole applies correct practices and has pertinent

knowledge was arbitrarily set at 80%. This target was, however, an informed choice since research shows that approximately 20% of a population consciously chose to ignore food safety principles[22].

The definitions for correct knowledge and appropriate practices in four areas were defined as shown in Figure 1. The proportions of the respondents who applied one or more of the appropriate methods within each area were grouped together. The confidence interval for proportions was calculated to estimate with a 95% certainty the interval within which the population proportion lay. If more than 80% of the sample population used one or more of these methods or indicated correct knowledge, it was concluded that the population as a whole used appropriate methods and/or had pertinent knowledge to prevent foodborne illness.

Determination of whether the use of an appropriate method is dependent on different demographic variables

Through the use of Pearson's Chi-square it was determined whether the use of an appropriate method was dependent on or independent of different demographic variables (the SPSS software calculated these numbers, see Tables 16-18 and 20-21). When a variable was dependent upon age groups, gender or susceptible households, multiple comparison tests (Tukey[23] and the 'least significant difference test' (LSD)) were done to determine exactly which age groups showed a significant difference. This information is described in the Results section.

Coding

When a filter question (e.g. questions number 7,9,11,13,14,16,17 and 19) was left blank by the respondent it was assumed that the answer to this filter question was no. And if the follow-on question (e.g. questions number 8,10,12,15,18 and 20) was left blank it was assumed that the respondent reported correct practices. These answers were defined as

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[22] The 80% target was somewhat arbitrarily chosen; however, results from a survey conducted by Audits International in 2000 in the U.S gave some guidance (Food Technology 55(4):132). This survey found that 20% of respondents consciously chose to ignore the safety principles (e.g. "I've always done it this way, and I think it is safe"). Increased consumer safety awareness would likely be ignored by this segment of the population and thus a target of 100% is unrealistic (39).

[23] Tukey, J.W. 1953. The problem of multiple comparisons. Department of Statistics, Princeton University (Unpublished). In: Biostatistical Analysis. 2nd edn. J.H. Zar., Prentice-Hall, New Jersey, p. 185-186.

A. Treatment of food contact surfaces to prevent cross-contamination

Respondents who indicated use of at least one of the methods listed below for each surface area were considered to be using correct practices:

Cutting utensil:

- A separate cutting utensil is used for cutting raw poultry and other foods **OR**
- When using the same cutting utensil for cutting raw poultry and other foods, the utensil is rinsed, wiped and/or soaked in diluted bleach, or washed with disinfectant soap or in the dishwasher

Cutting board:

- A separate cutting board is used for cutting raw poultry and other foods **OR**
- When using the same cutting board for cutting raw poultry and other foods, the board is rinsed, wiped and/or soaked in diluted bleach, or washed with disinfectant soap or in the dishwasher

Kitchen counter:

- The kitchen counter never comes in contact with raw poultry **OR**
- When the kitchen counter does come in contact with raw poultry, it is rinsed/wiped with diluted bleach and/or disinfectant soap

Kitchen sink:

- The kitchen sink never comes in contact with raw poultry **OR**
- When the kitchen sink does come in contact with raw poultry, it is rinsed/wiped with diluted bleach and/or disinfectant soap

Hands:

- Washed with disinfectant soap **OR**
- Rinsed with diluted bleach

Dishcloth:

- Rinsed with a disinfectant soap and/or diluted bleach **OR**
- Washed in the washing machine or in the dishwasher

B. Method to determine whether the meat is cooked enough

Respondents who indicated use of at least one of the methods listed below were considered to be using correct practices.

- Make sure the juices run clear **OR**
- Make sure the meat is not pink **OR**
- Use a meat thermometer

Figure 1. Definitions of Correct Knowledge/Practices

C. Knowledge regarding the cause of foodborne illness

Respondents who selected the following answers were considered to have correct knowledge:

- Eating a beefsteak, which is still pink inside, has no risk of causing foodborne illness
- Eating chicken, which is still pink inside, has a high risk of causing foodborne illness
- Eating an egg, which has been boiled for 3 minutes, has a high risk of causing foodborne illness
- Eating barbecued hamburgers, which have been on the same plate that was used to carry the raw hamburger meat to the barbecue, has a high risk of causing foodborne illness
- Eating vegetables which have been cut on the same cutting board right after cutting raw meat has a high risk of causing foodborne illness
- Eating cheddar cheese that has some mold on it has a high, moderate, or low risk of causing foodborne illness ("don't know" is also a correct answer)

D. Knowledge of some of the organisms that cause foodborne illness

Respondents who answered "yes" to the questions about whether they have heard of *Salmonella*, *E. coli*, and *Campylobacter* respectively, were considered knowledgeable.

Figure 1. Definitions of Correct Knowledge/Practices (continued)

'system missing' in the SPSS programme. These correct responses were then grouped with the correct answers in the follow-on questions as described above under Statistical Methods. When a respondent answered yes in the filter question but did not answer any of the follow-on questions or vice-versa (left the filter question blank but answered the follow-on question) this group of responses were also considered 'system missing' and by default considered correct answers. Thus, the results found for the 'correct answers' are slightly inflated. The respondents who didn't check yes in questions 14 and 17 and then skipped to questions 16 and 19 respectively were considered to be using an inappropriate method.

RESULTS

This survey was conducted between May 19th and June 30th 1998. On May 19th questionnaires were mailed out to 1,500 randomly chosen households (systematic sampling where $K=3^{24}$). From the first mailing 397 respondents returned the questionnaire (26.5%). On June 15th 1,123 follow-up letters and questionnaires were mailed to the non-respondents as of that date. From the follow-up mailing 154 respondents returned the questionnaire (10.2%). Of the total number of returned questionnaires (551) 13 were discarded. Four of these indicated that no one in the household was able to read and write English well enough to fill out the questionnaire. Three of the returned questionnaires had only the first three questions answered. Thus, it was assumed that these respondents were vegetarians. The remaining six questionnaires were rejected because there were a large number of incomplete answers.

Since there were only minor differences in results between the pilot survey questionnaire and the final questionnaire, the 44 questionnaires from the pilot survey were included in the data. Thus, a total of 582 respondent (out of 1,600 households contacted) questionnaires were accepted, resulting in a response rate of 36.4%.

Overall the demographic background of the respondents (distribution of age, gender and number of individuals in the household) were very similar to Census Canada's 1996 statistics. With a few exceptions, all of the ethnic groups reported in the census taken in the GVRD in 1996 were represented (Table 3). However, the ethnic distribution of the respondents in this survey was, for most ethnic groups, lower than the distribution found in the GVRD in 1996. This was especially true for the respondents with multiple origins. There were many ethnic groups that the respondents added to the 'other' option in question number 50 that were not found in the list of ethnic groups. These were added to the geographic groupings found in Table 3, which were constructed by Census Canada (123).

[24] A list of 5,000 telephone listings were purchased from Dominion Directories. All Forward Sortation Areas (FSAs) of the Greater Vancouver Regional District were stratified into 3 strata. From these 3 strata 5,000 listings were selected through systematic sampling (1,667 listings from each strata). A sub-sample of 1,667 was randomly selected from the list of 5,000 households were K=3. One hundred of these were used for the pilot survey.

Table 3. Population by ethnic origin showing single and multiple responses for the Greater Vancouver Regional District[1].

Ethnic background in geographical groupings	Current survey			Census Canada 1996[2]	
	Frequency	Single Origin (%)	Multiple Origin (%)	Single Origin (%)	Multiple Origin (%)
British Isles origin	248	22.5	20.1	18.2	32.0
French origins	26	1.0	3.4	1.5	6.8
Western European origins	75	5.2	7.7	6.1	11.4
Northern European origins	39	2.9	3.8	1.7	5.2
Eastern European origins	41	1.0	6.0	4.6	7.4
Southern European origins	26	0.7	4.8	5.4	3.9
Arab origins	2	0.3	0.0	0.4	0.2
West Asian origins	0	0.0	0.0	1.2	0.2
South Asian origins	14	2.2	0.2	8.7	1.1
East and Southeast Asian origins	81	12.9	1.0	28.4	2.3
African origins	1	0.2	0.0	0.5	0.4
Pacific Island origins	0	0.0	0.0	0.3	0.2
Latin, Central and South American origins	1	0.2	0.0	0.7	0.4
Caribbean origins	0	0.0	0.0	0.3	0.4
Aboriginal origins	4	0.0	0.5	1.0	2.1
Other origins					
American origins	3	0.5	0.0	0.2	1.1
Australian origins	1	0.2	0.0	0.0	0.2
Canadian origins	18	1.4	1.7	9.9	11.4
New Zealander origins	2	0.3	0.0	0.0	0.1
Quebecois origins	0	0.0	0.0	0.0	0.1
Total	582				

[1]Includes the 'other' origins that were added in question number 50.
[2]Nation Series CD ROM - Data from Census Canada 1996.

The respondents were mainly women (74%) of all age groups above 15 years of age (Tables 4 and 5) and residing in the Greater Vancouver Regional District (GVRD). The age distribution of the respondents is a good reflection of the age distribution of the GVRD as a whole, with the exception of the age group between 15 and 24 where only 6% were represented in this survey and 16% lived in the GVRD (Table 5).

The distribution of households which included individuals susceptible to long-term effects of food borne illness was as follows (Table 6): 12% of the respondents had children under 5 years

of age living in their household, and 18% had individuals over 65 years of age. These percentages are not mutually exclusive, i.e. it is possible that some of the households included both types of individuals. This distribution was very close to the distribution found in the GVRD in 1996 (123) (see Table 6).

Ninety percent of the households of the respondents in the current survey contained one to four persons (Table 7). This is almost the same distribution as found in the GVRD in 1996 where 89% of the households contained one to four persons (124). However, the study sample contained substantially fewer one-person households (Table 7).

Table 4. Distribution of respondents by gender.

Gender	Frequency	Percent	Valid Percent[1]
Female	431	74	75
Male	146	25	25
Total	577	99	100
Missing	5	1	
Total	582	100	

[1]Valid percent: Percent distribution excluding the data from the respondents who did not provide this information.

Table 5. Distribution of respondents by age.

Age group	Frequency	Percent	Valid percent	GVRD (%)[1]
15 - 24	34	6	6	16
25 - 34	115	20	20	22
35 - 44	139	24	24	22
45 - 54	127	22	22	17
55 - 64	86	14	14	10
65+	75	13	14	14
Total	576	99	100	100
Missing	6	1		
Total	582	100		

[1]Greater Vancouver Key Facts 1995. Strategic Planning Department, Greater Vancouver Regional District.,. http://www.gvrd.bc.ca

Table 6. Percent distribution of households which include individuals susceptible to long term effects of foodborne illness.

	Current survey	GVRD 1996[1]
Households which include children under 5 years of age	12	13
Households which include individuals over 65 years of age	18	16
Total	30	29

[1] GVRD data from Census Canada, 1996 (123).

Table 7. Percent distribution of the number of persons in respondents' households.

Number of persons in the household	Current survey	GVRD[1]
1	17	27
2	35	31
3	19	15
4	19	16
5	7	7
6	3	3
7	0	1
8	0	0
9	0	0
Total	100	100

[1]GVRD data from Census Canada, 1996 (123).

Frequency of Food Preparation

Fifty percent of the respondents cooked 7 meals or more per week (Table 8). Five to six meals per week were cooked by 34% of the respondents and 13% of the respondents cooked 3-4 meals per week. Only 3% of the respondents cooked 1-2 meals per week (Table 8). It was primarily females who prepared most of the meals in all three categories (<50%, 50-75%, >75%); males prepared less of the meals in the household as the percentage of meals increased (Figure 2 and Table 9). As respondents get older they prepare more meals: respondents who prepared <50% of the meals were mainly 25-34 yeas of age; respondents who prepared 50-75% of meals were mainly 25-44 years of age; respondents who prepared >75% of the meals in the

household were mainly 35-54 years of age (Figure 3 and Table 10).

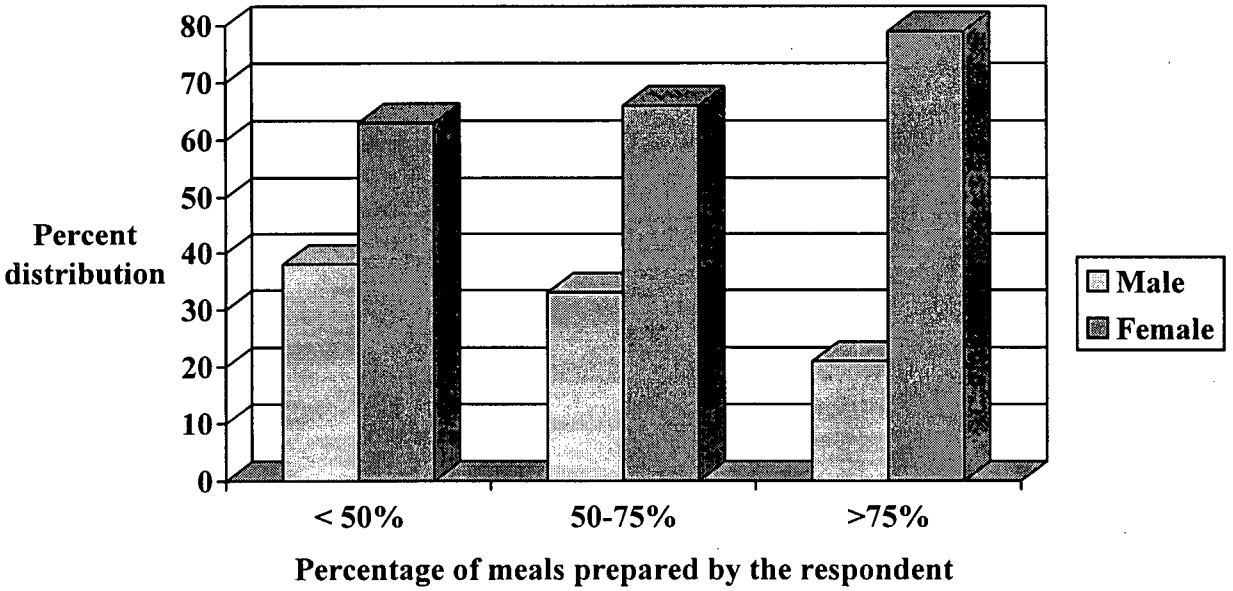


Figure 2. Gender distribution and percentage of meals prepared by the respondents

Table 8. Number of meals cooked per week in the responding households.

Number of meals	Percent
1-2 meals	3
3-4 meals	13
5-6 meals	34
7 meals or more	50
Total	100

Table 9. Percent distribution of the gender of the person in the household who prepared most of the meals.

Percentage of meals prepared by the respondents	Male	Female	Total
Less than 50%	38	63	100
50 - 75%	33	66	100
More than 75%	21	79	100

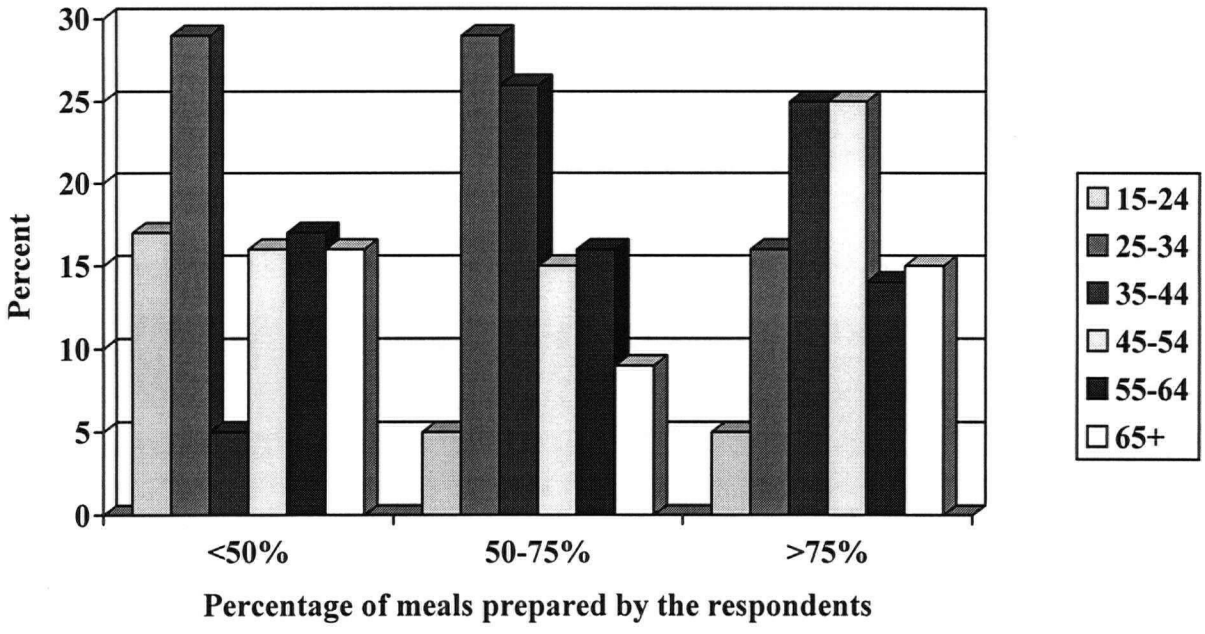


Figure 3. Age distribution and percentage of meals prepared by the respondents

Preparation Practices

A knife was the most commonly used cutting utensil for cutting raw poultry (92%) (Table 11)[25]. Approximately 14% of respondents used a pair of poultry scissors and 11% used a cleaver. The most common type of cutting board used by the respondents was a plastic cutting board (53%). Thirty-five percent of the respondents used a wooden cutting board, 14% used glass, two

[25] In the 'other' section of the questionnaire a typical comment was that the person usually only purchases pre-cut meat and thus doesn't use a knife to cut raw poultry. Another cutting utensil mentioned was an electrical knife or kitchen saw.

percent used marble, and two percent of the population used a ceramic cutting board (Table 12)[26].

Table 10. Percent distribution of the age of the person in the household who prepares most of the meals.

	Percentage of meals prepared by the respondents		
Age group	Less than 50%	50-75%	More than 75%
15-24	17	5	5
25-34	29	29	16
35-44	5	26	25
45-54	16	15	25
55-64	17	16	14
65+	16	9	15
Total	100	100	100

Table 11. Use of cutting utensils.

Type of cutting utensil	Frequency	Percent
Knife	535	92
Poultry scissors	76	14
Cleaver	64	11
Other	15	3

The single most commonly used method of cleaning the cutting utensil and cutting board was washing with detergent & water (35% and 41% respectively) (Table 13). This method was also most commonly used for the kitchen counter, kitchen sink and the dishcloth/sponge (26%, 39% and 41% respectively). The most common method used for cleaning hands was soap and water (61%) (Table 13).

[26] 'Other' types of cutting boards used: a plate, granite, stainless steel (built into kitchen sink), Plexiglas, paper bag, arborite-, melamine-, corian-, formica- or laminate- covered wood or leftover kitchen counter.

Table 12. Type of cutting board used to cut raw poultry (92% used a cutting board).

Type of cutting board	Frequency	Percent
Plastic	307	53
Wood	204	35
Glass	75	14
Marble	13	2
Ceramic	13	2
Other	33	6

Other methods used by the respondents for cleaning the cutting utensil, cutting board, kitchen counter, and kitchen sink were to: rinse with hot, boiling, or scorching water, and then dry with a paper-towel (which was then disposed of). Brand names of disinfectants used by respondents (which they mentioned in the 'other' section of questions 8,12,15,18) were: Lysol®, Javex®, Ajax Cleaner®, Dutch Cleaner®, Spectrum®, Vim®, Mr. Clean®, Comet® or a cleaner that contains bleach. Other disinfectants mentioned were ammonia, salt, undiluted bleach, and lemon juice.

Less than 80% of the respondents used an appropriate method[27] for treating any of the six surface types that were included in the survey (Table 14). Only 60% (± 4%) (see Appendix VII for margin of error calculation) used an appropriate method for treating the cutting utensil, 59% (± 4%) used an appropriate method for treating the cutting board, 71% (± 4%) used an appropriate method for treating the kitchen counter, and 68% (± 4%) used an appropriate method for treating the kitchen sink. When treating the hands (31% ± 4%) and the dishcloth/sponge (45% ± 4%) less than half of the respondents used an appropriate method (Table 14).

[27] See definition of 'appropriate' methods in Figure 1.

Table 13. Treatment of different surfaces after cutting raw poultry and before cutting other foods (frequency/percent).

Method of cleaning/sanitizing	Cutting utensil	Cutting board	Kitchen counter	Kitchen sink	Dish cloth	Hands[1]
Wash with detergent and water	201/35	231/41	152/26	222/39	240/41	351/61
Wipe with a dishcloth/sponge	55/10	59/10	82/15	35/6	N/A	18/3
Rinse with water only	70/12	47/8	N/A[2]	N/A	97/18	79/13
Wipe with vinegar	3/1	6/1	7/1	71	4/1	N/A
Wash with a disinfectant soap	29/5	49/9	71/13	75/13	14	171/30
Rinse/wipe with diluted bleach	11/2	34/6	41/8	47/9	48/9	11/2
Soak in diluted bleach	9/2	11/8	N/A	N/A	N/A	N/A
Wash in the dishwasher	44/8	37/7	N/A	N/A	47/8	N/A
Washing machine	N/A	N/A	N/A	N/A	139/26	N/A
Nothing	7/1	5/1	N/A	N/A	11/2	N/A
Other	14/3	25/4	26/5	25/4	40/8	25/5

[1]Soap instead of detergent
[2]N/A: this answer was not included in this particular closed-ended question

Table 14. Percent distribution of respondents who used appropriate[1] or inappropriate[2] methods of treatment of kitchen utensils during meal preparation and appropriate and inappropriate methods to determine whether meat is cooked enough to prevent foodborne illness.

Treatment of kitchen utensils for meal preparation	Appropriate Method	Inappropriate Method	Total	Missing[3] (if applicable)	Total
Cutting utensil	60	40	100	*	-
Cutting board	59	41	100	*	-
Kitchen counter	71	29	100	*	-
Kitchen sink	68	32	100	*	-
Hands	31	69	100	*	-
Dishcloth/sponge	45	47	92	8	100

[1]Appropriate method: Rinse, wipe or soak with diluted bleach; wash in disinfectant soap; wash in dishwasher.
[2]Inappropriate method: wash with detergent and water; rinse with water; wipe with dishcloth/sponge; wipe with vinegar; nothing.
[3]This group of 'system missing' (except for the dishcloth/sponge category which didn't have a filter question) separated their utensils, which was defined as an appropriate method and thus was added to the group of respondents that treated the utensils appropriately.

Tables 15 through 17 indicate the percentage distribution of respondents, according to demographic categories (age, gender and susceptible households), who used appropriate and inappropriate methods of treating the kitchen surfaces. Treatment of kitchen utensils during meal preparation was dependent on age groups in the following areas: individuals between 25-34 were significantly more likely to use an appropriate method to treat their cutting board after cutting raw poultry and before cutting other foods compared to individuals between 15-24. (Table 15) (P=0.023). Individuals between 15-24 were significantly more likely to use an appropriate method to wash their hands after cutting raw poultry and before cutting other foods compared to individuals between 45-54 (Table 17) (P=0.018). Females were significantly more likely to use an appropriate method to treat the kitchen sink as well as the dishcloth/sponge compared to males (Tables 16 and 17, respectively) (P=0.021 and P=0.002 respectively).

An interesting pattern seems to emerge in the distribution of appropriate responses of sanitizing the hands when comparing the different age groups. There was a decrease in the proportion of appropriate responses among older respondents (Table 17).

Respondents who had children under 5 years of age living in their household were significantly more likely to use an appropriate method to clean the kitchen counter compared to other respondents (Table 16) (P=0.012). Likewise, respondents who had children under 5 years of age living in their household were significantly more likely to use an appropriate method to clean their hands compared to other respondents (Table 17) (P<0.001).

Conversely, households with individuals over 65 years of age were more likely to use an appropriate method to clean kitchen surfaces and utensils compared to other households (Tables 15 - 17). Appropriate treatment of the kitchen counter was significantly less likely in households with individuals over 65 years of age (Table 16) (P=0.008). On the other hand, respondents in households with individuals over 65 years of age were significantly less likely to use an appropriate method to clean their hands than others (Table 17) (P=0.002).

Cooking Practices

Less than 80% of the respondents used an appropriate method to determine whether whole poultry, large and small pieces of poultry and beef patties were cooked enough to prevent foodborne illness (Table 18). An appropriate method was used by 69% (± 4%) when cooking whole poultry, 78% (± 3%) when cooking large pieces of poultry, 71% (± 4%) when cooking small pieces of poultry, and 71% (± 4%) when cooking beef patties.

The use of an appropriate method to determine whether meat is cooked enough to prevent foodborne illness was not dependent on age groups, gender or susceptible households with the following three exceptions (Table 19 and 20). There were significantly more respondents 35-44 years of age who used an appropriate method for determining whether large pieces of poultry were cooked enough to prevent foodborne illness than respondents 45-54 years of age (Table 19) (P=0.031). Significantly more females than males used an appropriate method when cooking large pieces of poultry (Table 19) (P=0.027).

Use of an appropriate method when cooking small pieces of poultry was also found to be age-dependent (Table 20). Significantly more respondents 25-34 years of age used an appropriate method for determining whether small pieces of poultry were cooked enough to prevent foodborne illness than respondents 55-64 years of age (Table 20) (P=0.002).

Table 15. Percentage distribution of respondents, according to demographic categories, who used appropriate[1] or inappropriate[2] methods of treating the cutting utensil and cutting board after cutting raw poultry and other foods.

	Cutting utensil			Cutting board		
	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]
Age groups:						
15-24	54 (18)	46 (16)		36 (12)	64 (22)	
25-34	63 (72)	37 (43)		63 (72)	37 (43)	
35-44	55 (76)	45 (63)		53 (74)	47 (65)	
45-54	63 (80)	37 (47)		60 (76)	40 (51)	
55-64	62 (53)	38 (33)		61 (52)	39 (34)	
65+	71 (53)	29 (22)	0.612	58 (43)	42 (32)	0.023*
Gender:						
Female	60 (259)	40 (172)		56 (241)	44 (190)	
Male	65 (95)	35 (51)	0.126	66 (96)	34 (50)	0.203
Household with individuals:						
< 5 years	41 (29)	59 (41)		49 (34)	51 (36)	
> 5 years	65 (333)	35 (179)	0.919	60 (307)	40 (205)	0.596
> 65 years	73 (77)	27 (28)		60 (63)	40 (42)	
< 65 years	60 (286)	40 (191)	0.266	58 (277)	42 (200)	0.584

[1]Appropriate method: Separating the cutting board /utensil used for cutting raw poultry and other foods or when using the same cutting d/utensil for cutting raw poultry and other foods the utensil is rinsed, wiped and/or soaked with diluted bleach, washed with disinfectant soap and/or washed in the dishwasher

[2]Inappropriate method: No sanitizing action at all, wash with detergent and water, rinse with a dishcloth/sponge and/or wipe with vinegar.

[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

* Significant difference (P<0.05)

Table 16. Percentage distribution of respondents, according to demographic categories, who used appropriate[1] or inappropriate[2] methods of treating the kitchen counter and kitchen sink after cutting raw poultry and other foods.

	Kitchen counter			Kitchen sink		
	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]
Age groups:						
15-24	40 (14)	60 (20)		58 (20)	42 (14)	
25-34	31 (36)	69 (79)		31 (36)	69 (79)	
35-44	39 (54)	61 (85)		41 (57)	59 (82)	
45-54	31 (39)	69 (89)		34 (43)	66 (84)	
55-64	32 (28)	68 (58)		33 (28)	67 (58)	
65+	53 (40)	47 (35)	0.351	36 (27)	64 (48)	0.991
Gender:						
Female	34 (147)	66 (284)		38 (164)	62 (267)	
Male	29 (42)	71 (104)	0.688	28 (41)	72 (105)	0.023*
Household with individuals:						
< 5 years	53 (37)	47 (33)		45 (32)	55 (39)	
> 5 years	30 (154)	70 (358)	0.016*	34 (174)	66 (338)	0.973
> 65 years	21 (22)	79 (83)		34 (36)	66 (69)	
< 65 years	34 (162)	66 (315)	0.020*	36 (172)	64 (305)	0.385

[1]Appropriate method: The kitchen counter/sink never comes in contact with raw poultry or if the kitchen counter/sink comes in contact with raw poultry it is rinsed, wiped and/or soaked with diluted bleach, and/or washed with disinfectant soap

[2]Inappropriate method: Wash with water or detergent and water, rinse with a dishcloth/sponge and/or wipe/rinse with vinegar.

[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

* Significant difference (P<0.05)

Table 17. Percentage distribution of respondents, according to demographic categories, who used appropriate[1] or inappropriate methods of treating the hands and dishcloth/sponge after cutting raw poultry and other foods.

	Hands			Dishcloth/sponge		
	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]
Age groups:						
15-24	47 (16)	53 (18)		45 (15)	55 (19)	
25-34	35 (40)	65 (75)		45 (52)	55 (63)	
35-44	36 (50)	64 (89)		51 (71)	49 (68)	
45-54	31 (39)	69 (88)		44 (56)	56 (71)	
55-64	29 (25)	71 (61)		42 (36)	58 (50)	
65+	15 (11)	85 (64)	0.017*	39 (29)	61 (46)	0.897
Gender:						
Female	33 (142)	67 (289)		48 (207)	52 (224)	
Male	27 (39)	73 (107)	0.132	35 (51)	65 (93)	0.003*
Household with individuals:						
< 5 years	59 (41)	41 (29)		61 (43)	39 (27)	
> 5 years	28 (143)	72 (369)	0.000**	43 (312)	57 (292)	0.063
> 65 years	18 (19)	82 (86)		44 (46)	56 (59)	
< 65 years	34 (162)	66 (315)	0.005*	45 (215)	55 (262)	0.910

[1]Appropriate method: Rinse with diluted bleach and/or disinfectant soap
[2]Inappropriate method: No sanitizing action at all, rinse/wash with detergent/soap and water, rinse/wipe with vinegar and/or rinse with water only, .
[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%
* Significant difference (P<0.05)
**Significant difference (P<0.001)

Table 18. Percent distribution of respondents who used appropriate[1] or inappropriate[2] methods to determine whether meat is cooked enough to prevent foodborne illness.

Method to determine whether meat is cooked enough to eat	Appropriate Method	Inappropriate Method	Sub-total	Missing
Whole poultry	69	16	85	15
Large pieces of poultry	78	20	98	2
Small pieces of poultry	71	27	98	2
Hamburger beef patty	71	9	80	20

[1]Appropriate method: Make sure the juices run clear and/or the meat is not pink and/or use of a meat thermometer
[2]Inappropriate method: Tasting the meat, poke to feel firmness, wait until the bones fall apart, twist the leg bone, cook the meat for a certain amount of time

Table 19. Percentage distribution of respondents, according to demographic categories, who used appropriate[1] or inappropriate[2] methods of determining whether poultry is cooked enough to eat.

	Whole poultry			Large pieces of poultry		
	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]
Age groups:						
15-24	58 (20)	42 (14)		76 (26)	24 (8)	
25-34	66 (76)	34 (39)		85 (98)	15 (17)	
35-44	78 (108)	22 (31)		83 (115)	17 (24)	
45-54	71 (90)	29 (37)		74 (94)	26 (33)	
55-64	71 (61)	29 (25)		79 (68)	21 (18)	
65+	58 (44)	42 (32)	0.127	66 (50)	34 (26)	0.031*
Gender:						
Female	70 (302)	30 (129)		79 (340)	21 (91)	
Male	66 (96)	34 (50)	0.289	72 (105)	28 ()	0.018*
Household with individuals:						
< 5 years	77 (54)	23 (16)		79 (55)	21 (15)	
> 5 years	68 (348)	32 (164)	0.204	72 (369)	28 (143)	0.319
> 65 years	63 (66)	37 (39)		72 (76)	28 (29)	
< 65 years	70 (334)	30 (143)	0.275	79 (377)	21 (100)	0.109

[1]Appropriate method: Make sure the juices run clear and/or the meat is not pink and/or use a meat thermometer

[2]Inappropriate method: Tasting the meat, poke to feel firmness, wait until the bones fall apart, twist the leg bone, cook the meat for a certain amount of time

[3]P-value:Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

* Significant difference (P<0.05)

Table 20. Percentage distribution of respondents, according to demographic categories, who used appropriate[1] or inappropriate[2] methods of determining whether small pieces of poultry and hamburger patty are cooked enough to eat.

	Small pieces of poultry			Hamburger patty		
	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]	Percent appropriate responses (n)	Percent inappropriate responses (n)	P-value[3]
Age groups:						
15-24	73 (25)	27 (9)		78 (27)	22 (7)	
25-34	84 (97)	16 (18)		70 (81)	30 (35)	
35-44	77 (107)	23 (32)		75 (104)	25 (35)	
45-54	70 (89)	30 (38)		67 (85)	33 (42)	
55-64	55 (47)	45 (39)		68 (58)	32 (28)	
65+	59 (44)	41 (31)	0.001*	72 (54)	28 (21)	0.767
Gender:						
Female	72 (310)	28 (121)		72 (310)	28 (121)	
Male	70 (102)	30 (44)	0.702	69 (101)	31 (45)	0.480
Household with individuals:						
< 5 years	77 (54)	23 (16)		72 (50)	28 (20)	
> 5 years	71 (364)	29 (148)	0.261	71 (364)	29 (148)	0.360
> 65 years	69 (72)	31 (46)		69 (72)	31 (33)	
< 65 years	73 (348)	27 (129)	0.147	71 (339)	29 (128)	0.535

[1]Appropriate method: Make sure the juices run clear and/or the meat is not pink and/or use a meat thermometer

[2]Inappropriate method: Tasting the meat, poke to feel firmness and/or cook the meat for a certain amount of time

[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

* Significant difference (P<0.05)

Eighty percent of the respondents cooked beef patties. Only one third of these respondents preferred to eat beef patties that were well done (68%) (Figure 4 and Table 21). However, as many as 18% preferred medium well-done patties, 9% preferred medium done patties, and 4% preferred medium-rare patties. Most respondents (93%) were aware of the need to put leftovers from a meal into the refrigerator or freezer within two hours of cooking the meal (Table 22)[28].

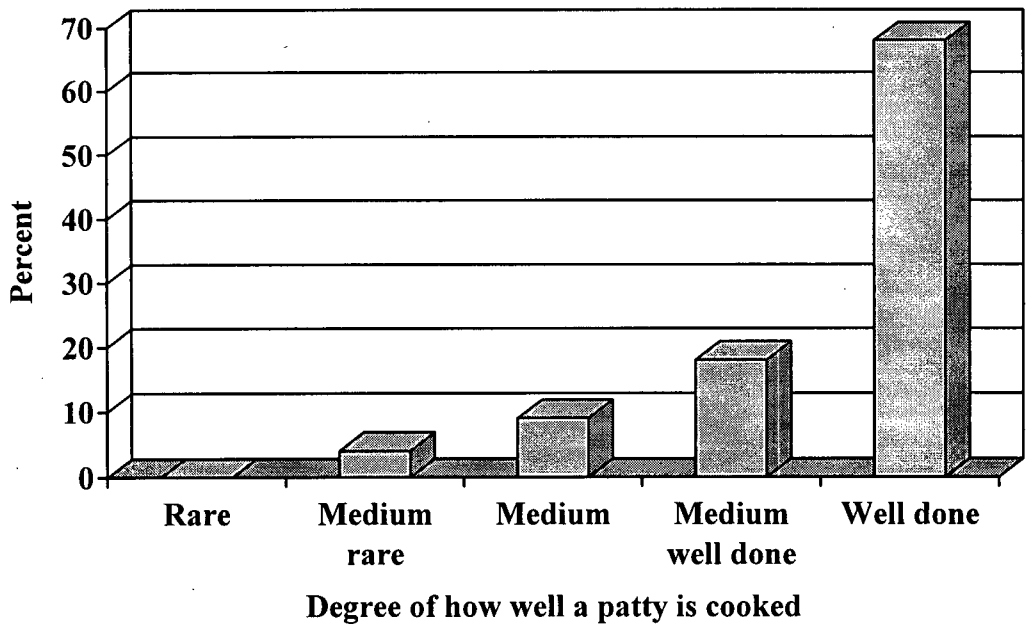


Figure 4. Respondent's preference on how they want their patty cooked.

Table 21. Respondents preference regarding degree of cooking of beef patties.

Degree of cooking	Percent	Valid percent
Rare	0	0
Medium rare	3	4
Medium	8	9
Medium well done	15	18
Well done	54	68
Respondents who never eats beef patties	1	1
Total	81	100
Missing response	20	
Total	100	

[28] 'Other' methods for deciding whether the hamburger is cooked enough to eat: cut the hamburger in half to check that the inside is brown, BBQ until black outside, overcook the hamburger.

Table 22. Time from finishing cooking a meal to putting the leftovers into the refrigerator.

Time period	Percent	Valid percent
Within 2 hours	91	93
Within 4 hours	5	5
Within 6 hours	1	1
More than 6 hours	1	1
Total	98	100
Missing answer	2	
Total	100	

Food Safety Knowledge

Two possible food hazards considered to be a serious health hazard by more than eighty percent of the population were bacteria (85%) and viruses (80%) (Table 23). Problems associated with parasites, pesticide residues and pollution were perceived as a serious health hazard by approximately three-quarters of the population (77%, 74% and 70% respectively). Natural chemicals or poisons present in some foods were considered a serious health hazard by 50% of the population. Problems associated with cholesterol, fat, sugar, salt and food additives were least often considered a serious health hazard (25% and 22% respectively). However, over half of the population considered the latter two categories somewhat of a hazard (57% and 50%) (Table 23).

The most common sources from which the respondents reported receiving information about the proper way to cook, store and handle food were cookbooks (67%), friends and family (65%), instructions on product / packages (56%) and magazines / newspaper articles (52%) (Table 24). The least likely sources of this information were retailer / store clerks (12%) and on-the-job knowledge (12%)[29].

[29] 'Other' sources of information: (many years of) experience in the kitchen, common sense, public health offices, food safety course, community centre, seniors group, and books.

Table 23. Percent[1] distribution of the respondent's ratings of possible health hazards.

Health hazard	A serious hazard	Somewhat of a hazard	No hazard	Don't know	Total	Missing responses
Food additives	22	50	18	10	100	3
Pesticide residues	74	22	2	2	100	2
Pollution	70	23	4	3	100	3
Problems associated with cholesterol, fat, sugar, or salt	25	57	18	0	100	2
Bacteria which may cause foodborne illness	85	14	1	0	100	2
Viruses which may cause foodborne illness	80	12	4	4	100	2
Parasites present in food	77	16	4	3	100	3
Natural chemicals or poisons present in some foods	50	33	13	4	100	3

[1] Percent of total number of households who were a part of each cross-tabulation

Health professionals were trusted 'a lot' by 74% of the population (Table 25). Consumers Association of Canada and government agencies were trusted 'a lot' by about half of the respondents (49% and 48% respectively) (Table 25). On the contrary, retailer/store clerks, food processors/ manufactures, producers of food (farmers, fishermen, etc.) were 'not trusted at all' by 33%, 23%, and 22% of the population[30].

About three-quarters of the respondents rated the following situations correctly with regard to the level of risk of causing food borne illness: chicken that is pink inside (76% ± 4%), a hamburger which has been on a plate with raw meat juice (77 ± 3%), and vegetables which have been cut on a cutting board with raw meat juice (71 ± 4%) (Table 26). Just over half of the population (54% ± 4%) considered eating beefsteak that is pink inside to be of no risk. Very few of the respondents correctly rated the level of risk of eating a three-minute egg (7% ± 2%).

Table 24. Respondents' sources about the proper way to cook, store and handle food.

Information sources	Percent
Cookbooks	67
Friends / family	65
Instructions on product / packages	56
Magazines/newspaper articles	52
Articles	44
Product ads	13
Public service announcements	22
Television and/or radio	47
Programmes	35
Product ads	12
Public service announcements	24
Consumer information brochures	31
School, college or university	21
Government brochures	19
Health professional	17
Retailer / store clerks	12
On the job	12
Other	10
Don't know	1

[30] 'Other' sources of information that respondents trust (question number 32) include: cookbooks, common sense, home economics teacher, own experience/education, university nutrition courses, public health offices, local butcher, well-known chefs in the media, organic farmers, naturopaths, professional books, health board, my own sense of smell, internet, health food stores/magazines, environmental agencies, health providers involved with alternative/ preventative medicine, allergy association, confirmation from multiple independent sources, instructions on food packages, and special advocacy groups.

Over 80% of the population (87% ± 3%) rated the risk of molded cheese correctly. However, since there is no scientific consensus on the level of risk of moldy cheddar cheese the only wrong answer was 'no risk' and the other four categories were grouped together as the correct answer.

Correct knowledge regarding foods which can cause foodborne illness was dependent on age groups, gender, and susceptible households[31] as described in the following (Tables 27-29). Tukey's multiple comparisons test revealed that significantly more respondents above 65 years of age were not aware that there is a low/no risk associated with eating a pink beefsteak compared to respondents between 15-54 years of age (P=0.006 for age group 15-24, P=0.002 for age group 25-34, P<0.001 for age group 35-44, P=0.017 for age group 45-54) (Data not shown). Significantly more respondents 65 years and older knew that there is a high risk of foodborne illness when consuming chicken which is pink inside compared to respondents aged 15-24 and 25-34 (P=0.012 and P=0.043) (Data not shown) (Table 27).

Although few respondents knew that there is a high risk of foodborne illness when consuming a 3-minute egg, significantly more respondents 65 years and older had this knowledge as compared to respondents under the age of 34 (P=0.026 for age group 15-24 and P=0.033 for age group 25-34) (data not shown) (Table 28).

The Pearson chi-square test revealed that there was a significant difference (P=0.014) between age groups regarding knowledge about eating vegetables which have been cut on the same cutting board right after cutting raw meat (Table 29). However, when the Tukey multiple comparison test was done to determine which age group(s) were significantly more likely to have this knowledge this test did not find any significant difference. When the "least significant difference" test (LSD) was done on the same data it was found that respondents between 15 and 24 were less likely to know that there is a high risk of foodborne illness associated with eating vegetables which have been cut on the same cutting board right after cutting raw meat compared with respondents in age groups 35-44, 55-64 and 65+ (P= 0.022, P=0.037, and P=0.009 respectively) (data not shown).

[31] See definition for 'susceptible households' in the Glossary.

Significantly more men than women knew that eating a pink beefsteak has a low risk for foodborne illness (P=0.002) (Table 27). Significantly more females knew that there is a high risk of foodborne illness when consuming pink chicken compared to males (P<0.001) (Table 27). Furthermore, significantly more females knew that there is a high risk of foodborne illness when consuming cooked beef patties and vegetables which have come in contact with a cutting board with raw meat compared to males (P<0.001 for both) (Tables 28 and 29).

Respondents living in households with children under 5 years of age were significantly more likely to know that eating a beef patty (P=0.018) and vegetables (P=0.044) which have been on a cutting board with raw meat has a high risk of causing foodborne illness (Tables 28 and 29). Respondents in households with individuals over 65 years of age were less likely to know that a pink beefsteak has a low/no risk of causing foodborne illness (P=0.000) (Table 27).

Most of the respondents had heard about *Salmonella* and *E. coli* (90% and 87% respectively) (Figure 5), but only 37% knew that *Salmonella* can cause foodborne illness and 30% knew that *E. coli* can cause foodborne illness (Table 30). Only 12% had heard about *Campylobacter* and none had any suggestions about the nature of *Campylobacter* (Table 30). Table 31 contains a categorization of all the explanations given by the respondents as to what these three organisms are (answers to the three open-ended questions: numbers 36, 39 and 42). The most common sources of knowledge regarding *Salmonella* and *E. coli* were television / radio and magazines / newspaper articles (Table 31).

It was shown in a cross-tabulation that of the respondents who had heard about these organisms and who lived in households with children under five years of age 91% had heard of *Salmonella*, 87% had heard about *E. coli*, and 14% had heard about *Campylobacter* (Figure 5). And of the respondents who had heard about these organisms and who lived in households with individuals over 65 years of age 90% had heard of *Salmonella*, 84% had heard about *E. coli*, and 10% had heard about *Campylobacter* (Figure 5). Thus, respondents from households with children under 5 years and/or individuals over the age of 65 recognized these organisms to the same extent as respondents from all households who participated in the survey (Figure 5).

Table 25. Respondents' trust in different sources of information on the safety of food[1].

Sources of information	Degree (in percent) to which the respondent trusts the information					
	A lot	A little	Not at all	Don't know	Total	Missing cases
Government agencies	48	41	6	6	100	5
Friends or family	44	52	4	1	100	6
Health professional	74	20	2	5	100	6
Retailer / store clerk	5	55	33	6	100	8
Newspaper or magazine	25	65	8	1	100	6
Radio / TV	25	62	8	5	100	7
People who supply food	13	55	22	10	100	8
Food processor /manufacturer	13	56	23	8	100	9
Consumers' Association of Canada	49	34	3	15	100	5

[1] Valid percent

Table 26. Percent distribution of respondents who do and who do not have correct knowledge regarding foods that can cause of foodborne illness.

	Respondents who have correct knowledge[1]	Respondents who have inorrect knowledge	Total	Missing
Knowledge about foods that can cause foodborne illness				
Pink Beef steak	54	45	99	1
Pink chicken	76	22	98	2
3-minute egg	7	91	98	2
Cooked hamburger contaminated with raw meat juice	77	21	98	2
Vegetables contaminated with raw meat juice	71	27	98	2
Molded cheddar cheese	87	11	98	2

[1]Correct knowledge: Eating a beefsteak, which is still pink inside, has low risk of causing foodborne illness; eating chicken, which is still pink inside, has a high risk of causing foodborne illness; eating an egg, which has been boiled for 3 minutes, has a high risk of causing foodborne illness; eating barbecued hamburgers, which have been on the same plate that was used to carry the raw hamburger meat to the barbecue, has a high risk of causing foodborne illness; eating vegetables which have been cut on the same cutting board right after cutting raw meat has a high risk of causing foodborne illness; eating cheddar cheese that has some mold on it has a high, moderate, or low risk of causing foodborne illness ("don't know" is also a correct answer).

Table 27. Percent distribution of respondents with correct[1] or incorrect[2] knowledge of two situations (pink beef and chicken) liable to cause foodborne illness by age and gender groups.

	Pink beef steak			Pink chicken		
	Respondents with correct knowledge[1] (n)	Respondents with incorrect knowledge (n)	P-value[3]	Respondents with correct knowledge[2] (n)	Respondents with incorrect knowledge (n)	P-value[3]
Age groups:						
15-24	70 (24)	30 (10)		60 (20)	40 (14)	
25-34	58 (67)	42 (48)		71 (82)	29 (33)	
35-44	65 (90)	35 (49)		78 (108)	22 (31)	
45-54	54 (69)	46 (58)		75 (95)	25 (32)	
55-64	44 (38)	66 (57)		76 (65)	24 (21)	
65+	31 (23)	69 (52)	0.000**	88 (66)	12 (9)	0.010*
Gender:						
Female	51 (220)	49 (211)		79 (340)	21 (91)	
Male	65 (95)	35 (51)	0.002*	67 (98)	33 (48)	0.000**
Household with individuals:						
< 5 years	57 (40)	43 (30)		75 (53)	25 (18)	
> 5 years	53 (271)	47 (241)	0.357	76 (389)	24 (123)	0.798
> 65 years	36 (38)	64 (67)		82 (86)	18 (19)	
< 65 years	57 (272)	43 (205)	0.000**	74 (353)	26 (124)	0.104

[1]Correct knowledge: Eating a beef steak, which is pink inside, has no risk of causing foodborne illness
[2]Correct knowledge: Eating a chicken, which is pink inside, has a high risk of causing foodborne illness
[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%
*Significant difference (P<0.05)
**Significant difference (P<0.001)

Table 28. Percent distribution of respondents with correct[1] or incorrect[2] knowledge of two situations (3-minute egg and barbecued beef patty which has been in contact with raw meat juice) liable to cause foodborne illness by age and gender groups.

	3-minute egg			BBQ'ed beef patty + raw meat juice		
	Respondents with correct knowledge[1] (n)	Respondents with incorrect knowledge (n)	P-value[3]	Respondents with correct knowledge[2] (n)	Respondents with incorrect knowledge (n)	P-value[3]
Age groups:						
15-24	3 (1)	97 (33)		60 (20)	40 (14)	
25-34	4 (5)	96 (110)		72 (83)	28 (32)	
35-44	5 (7)	95 (132)		81 (113)	19 (26)	
45-54	9 (11)	91 (116)		78 (99)	22 (28)	
55-64	10 (9)	90 (77)		76 (65)	24 (21)	
65+	10 (8)	90 (68)	0.007*	84 (63)	16 (12)	0.053
Gender:						
Female	7 (30)	93 (401)		82 (353)	18 (78)	
Male	5 (7)	95 (139)	0.313	61 (89)	39 (57)	0.000**
Household with individuals:						
< 5 years	5 (4)	95 (67)		86 (60)	14 (10)	
> 5 years	7 (36)	93 (476)	0.403	76 (389)	24 (123)	0.018*
> 65 years	8 (12)	92 (97)		81 (85)	19 (20)	
< 65 years	6 (29)	94 (448)	0.336	76 (363)	24 (114)	0.318

[1]Correct knowledge: Eating an egg, which has been boiled for 3 minutes, has a high risk of causing foodborne illness

[2]Correct knowledge: Eating barbecued hamburgers, which have been on the same plate as that which was used to carry the raw hamburger meat to the barbecue, has a high risk of causing foodborne illness

[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

*Significant difference (P<0.05)

Table 29. Percent distribution of respondents with correct[1] or incorrect[2] knowledge of two situations (ready-to-eat vegetables which have been in contact with raw meat juice and cheese with mold) liable to cause foodborne illness by age and gender groups.

	Vegetables contaminated with raw meat			Cheese with mold		
	Respondents with correct knowledge[1] (n)	Respondents with incorrect knowledge (n)	P-value[3]	Respondents with correct knowledge[2] (n)	Respondents with incorrect knowledge (n)	P-value[3]
Age groups:						
15-24	47 (16)	53 (18)		94 (32)	6 (2)	
25-34	66 (76)	34 (39)		86 (99)	14 (16)	
35-44	74 (103)	26 (36)		89 (124)	11 (15)	
45-54	74 (94)	26 (33)		88 (112)	12 (15)	
55-64	72 (62)	28 (24)		85 (73)	15 (13)	
65+	79 (59)	21 (16)	0.014*	92 (69)	8 (6)	0.400
Gender:						
Female	77 (332)	23 (99)		87 (375)	13 (56)	
Male	54 (79)	46 (67)	0.000**	91 (133)	9 (13)	0.257
Household with individuals:						
< 5 years	79 (55)	21 (15)		93 (65)	7 (5)	
> 5 years	70 (358)	30 (154)	0.044*	88 (451)	12 (61)	0.854
> 65 years	78 (82)	21 (22)		92 (97)	9 (14)	
< 65 years	70 (334)	30 (143)	0.116	88 (420)	12 (57)	0.182

[1]Correct knowledge: Eating vegetables which have been cut on the same cutting board right after cutting raw meat has a high risk of causing foodborne illness

[2]Correct knowledge: Eating cheddar cheese that has some mold on it has a high, moderate, or low risk of causing foodborne illness ("don't know" is also a correct answer)

[3]P-value: Determination whether use of an appropriate method is dependent or independent upon different demographic variables as determined by Pearson's Chi-square with a confidence interval of 95%

*Significant difference (P<0.05)

**Significant difference (P<0.001)

About half of the respondents (49%) knew that foodborne illness can cause kidney failure and 40% believe that foodborne illness can cause an allergic reaction (Table 32). Thirty percent of the respondents did not know whether foodborne illness could cause long-term health problems. About one fifth of the respondents believed that foodborne illness can cause cancer, heart disease and birth defects (17%, 18%, and 19% respectively). Seven percent believed that foodborne illness does not cause long-term health problems (Table 32).

Almost all of the respondents associated vomiting and diarrhea with foodborne illness (95% and 94% respectively) (Table 33). Three-quarters associated stomach upset other than vomiting and diarrhea with foodborne illness (76%), and approximately half of the respondents associated headaches and dizziness with foodborne illness (46% and 53% respectively). One third believed that allergic reactions and lethargy are associated with foodborne illness (30% and 33% respectively) (Table 33).

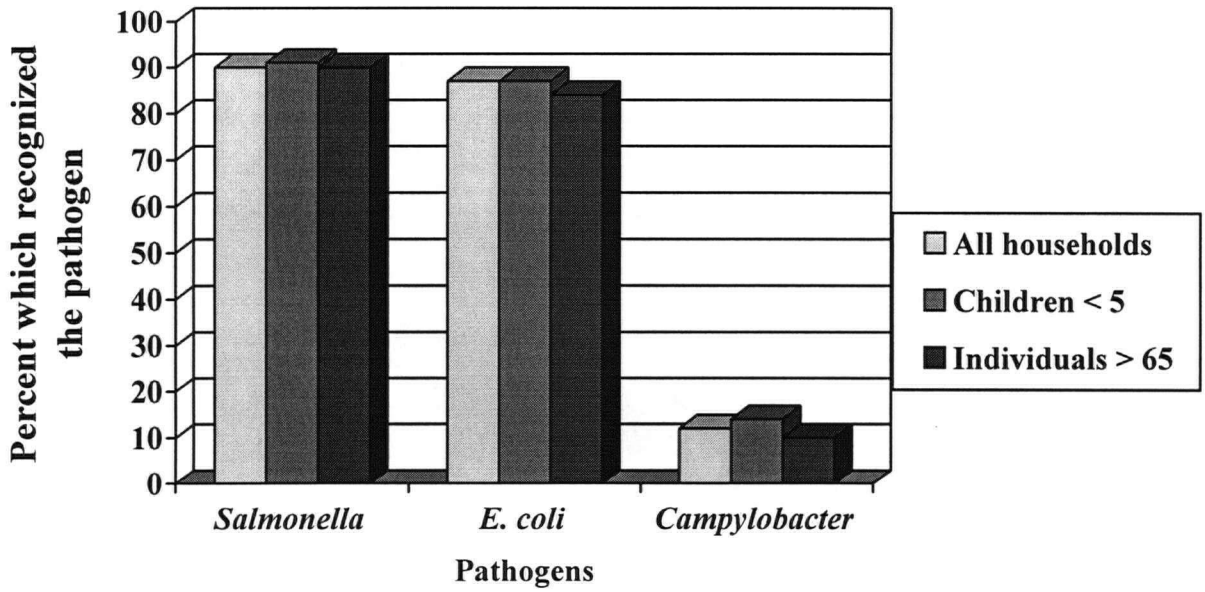


Figure 5. Respondents' recognition of the three pathogens *Salmonella*, *E. coli*, and *Campylobacter*.

Table 30. Frequencies (and percent distribution) of respondents' explanations of what *Salmonella,* and *E. coli* is (there were no suggestions at all for *Campylobacter*).

Explanation categories	*Salmonella*	*E. coli*	*Campylobacter*
A bacteria	152 (21)	184 (26)	-
A bacteria that causes food poisoning	166 (23)	133 (20)	-
Food poisoning	99 (14)	68 (10)	-
A parasite	7 (1)	5 (1)	-
A virus	11 (2)	19 (3)	-
A poison/poisonous	5 (1)	3 (0)	-
Found in:			
Poultry	52 (7)	11 (2)	-
Beef	25 (3)	28 (4)	-
Raw meat products	27 (4)	29 (4)	-
Sea food	8 (1)	3 (0)	-
Fruit / vegetables	2 (0)	5 (1)	-
Eggs	23 (3)	0 (0)	-
Food (unspecified)	29 (4)	18 (23)	-
Found in food that is not cooked enough	75 (10)	86 (12)	-
Problem with cross-contamination	7 (1)	7 (1)	-
E. coli is more serious than Salmonella	0 (0)	25 (4)	-
Salmonella is more serious than E. coli	12 (2)	0 (0)	-
It is found in the digestive tract/fecal	11 (2)	66 (10)	-
Wrong answer (i.e. entirely unrelated)	9 (1)	17 (2)	-
Total	721(100)	697 (100)	-

Table 31. Respondents' first source of information about *Salmonella*, *E. coli,* and *Campylobacter.*

First source of information	*Salmonella*	*E. coli*	*Campylobacter*
Friends/family	39	26	1
Magazines/newspaper	44	43	2
Television/radio	53	65	2
On the job	12	10	3
School	23	15	3
Don't remember	12	6	3
Other	5	3	2

Table 32. Respondents' beliefs that foodborne illness can cause long term health problems.

Long term health problems	Frequency	Percent
Cancer	97	17
Kidney failure	285	49
Allergic reaction	231	40
Arthritis	50	9
Heart disease	105	18
Birth defects	109	19
None of the above	41	7
I don't know	176	30
Other long-term health implications	43	7

Table 33. Symptoms that respondents associate with foodborne illness.

Symptoms	Frequency	Percent
Vomiting	551	95
Diarrhea	548	94
Other stomach upset	442	76
Headaches	266	46
Dizziness	309	53
Allergic reaction	176	30
Tired /lethargic	194	33
Other immediate health implications	32	6

A total of 39% of the respondents believed they had foodborne illness in Canada (data not shown). Of those 63% had it 1-2 times, whereas only 15% had it 3-5 times (Table 34). About one third of the respondents who had experienced foodborne illness in Canada contracted it from a meal at a restaurant (31%), 7% contracted it from a meal at a banquet, reception or other catered function, 7% contracted it from a meal prepared at home and 6% contracted it from a meal at family/friends home (Table 35). About five percent (5%) contracted foodborne illness from a meal delivered from a restaurant, 4% from packaged ready to eat food, 3% from school

or a post secondary institution, 1% from a packaged meal heated at home, and 4% didn't know where they had contracted the illness from (Table 35).

Table 34. Number of incidences of foodborne illness in Canada (a total of 226 or 39%) of respondents who believe they had a case of foodborne illness in Canada.

Number of incidences of foodborne illness	Frequency	Percent	Valid percent
1-2 times	149	26	63
3-5 times	35	6	15
More than 5 times	26	5	11
Don't know	26	5	11

*Missing responses: 346 (60 %)

Table 35. Type of meal from which respondents believe they contracted food borne illness.

Type of meal	Frequency	Percentage
A meal at a restaurant	180	31
A meal at a banquet, reception or catered function	44	7
A meal prepared at home	42	7
A meal at family/friends home	37	6
A meal at school, college or university	16	3
A meal delivered from a restaurant	26	5
A packaged meal heated at home	6	1
Packaged ready to eat foods	21	4
Don't know	25	4
Other	22	4

Typical comments made by respondents in the comment section on the last page of the questionnaire are found in Appendix VIII.

DISCUSSION

Numerous surveys conducted in Europe and North America have found that poor food-handling and hygiene practices in the domestic kitchen cause a significant amount of foodborne illness (8,22,23,45,21). Certain high-risk practices are fairly common and a large percentage of the population is unaware of preventative measures to prevent foodborne illness when preparing a home-cooked meal. This survey supports these findings. Between half and two-thirds of the respondents reported using appropriate food-handling practices before and during meal preparation in the home (Table 14), two-thirds were aware of a correct method of determining whether poultry and beef patties were cooked enough to avoid foodborne illness (Table 18) and between half to two-thirds of the respondents demonstrated that they were knowledgeable about food safety practices necessary to prevent foodborne illness (Table 26). The present study further indicated that older respondents and females were more likely to follow appropriate hygienic and cooking practices and more likely to have more correct knowledge when rating the risk of foodborne illness when consuming different types of foods.

The Canadian Food Inspection Agency (CFIA) sponsored in 1998 a national 'Safe Food-handling Survey' which measured consumer knowledge and attitudes toward safe food-handling in the home as it relates to foodborne illness (17). This survey was compared to a similar survey sponsored by the CFIA in 1990. The 1998 survey revealed that Canadians were aware of the potential hazards of eating improperly cooked meat, which is similar to the findings in 1990. However, Canadians in 1998 were aware of the potential hazards of allowing raw meat to come in contact with other foods, compared to 1990. However, few Canadians were aware of the potential hazard related to the consumption of raw eggs.

Only between half to two-thirds of the respondents in the present survey reported appropriate food preparation practices to prevent cross-contamination when preparing a meal (Table 14). The CFIA 1998 survey found that few of the Canadians surveyed (16%) felt that the most important thing they do to keep food safe from bacteria is to keep foods separate to prevent cross-contamination. The current survey focused on the practices of the respondents regarding methods of treatment of kitchen surfaces and utensils.

The current survey found that almost all the respondents washed their hands after cutting raw

poultry; however, only one-third used a correct method to clean their hands (Table 13). An interesting pattern emerges in the distribution of appropriate responses of sanitizing the hands when comparing the different age groups: a decrease in appropriate responses among older respondents. One can speculate that this is the result of education campaigns on proper handwashing methods in schools that have targeted generations who are now getting older. As mentioned in the literature review the general public understands the importance of frequent handwashing before, during and after food preparation but most consumers don't actually follow this knowledge when preparing food. This contradiction is often discussed in the literature (17,57,58,72). This survey defined an appropriate handwashing method as one where the hands had to be washed with disinfectant soap or rinsed with diluted bleach. It could be argued that it is too ambitious to expect the public to use this method and that the first step would be to educate the public in the importance of simply washing their hands with non-disenfectant soap and water before, during and after meal preparation. When it is found that this goal has been reached it might then be possible to educate the public in using this method to sanitize their hands.

CFIA's 1998 survey found that 92% of Canadians knew that it is important to wash their hands after handling raw meat to avoid foodborne illness. This result is in contrast to the survey conducted in the U.S. where one-third did not wash their hands or take precautions to prevent cross-contamination (92). A recent Italian study showed that approximately half of the respondents reported washing hands before handling raw food (65).

The respondents of the current survey (Table 37) generally had less correct knowledge about food preparation activities that can cause foodborne illness (e.g. eating chicken that is not cooked enough) than Canadians across the country, as found in the CFIA's 1998 survey (17). However, the way this question was posed in the two surveys was slightly different and the analysis of these results could cause some of the discrepancies. CFIA designed a yes/no question ('could this activity cause foodborne illness'), whereas this survey asked the respondent to rate the risk of foodborne illness (high, moderate, low and no risk). The respondents who rated the risk correctly were grouped together and the percentage was calculated. Thus, the respondents who rated the risk slightly different (i.e. moderate versus

high) were not accounted for in the 'correct answer'.

The current survey found that three-quarters of the respondents knew that eating a chicken that is pink inside has a high risk of causing foodborne illness whereas the CFIA survey found that almost all Canadians questioned knew this (Table 37). Only 7% of respondents in the current survey knew that the risk of foodborne illness is very high when consuming a 3-minute egg; in the 1998 CFIA survey, 18% of Canadians knew this. The current survey found that 77% of respondents knew that the risk of foodborne illness is very high when consuming a cooked hamburger with raw meat juice on it; in the 1998 CFIA survey, 86% of Canadians across the nation knew this. Seventy-one percent of the respondents in this survey were aware that chopping raw vegetables and uncooked chicken at the same time on the same cutting board could cause foodborne illness whereas CFIA's 1998 survey found that 87% Canadians knew this (17) (Table 38).

The FDA conducted a national survey in 1993, which found that most American consumers had the correct knowledge about safe food-handling practices (e.g. washing hands, preventing cross-contamination, and adequate cooking of meat), however, they failed to act on it (92). For example, although 86% knew that hand washing reduces the risk of foodborne illness only 66% washed their hands after handling raw meat or poultry to prevent cross-contamination. Eighty percent of the respondents knew that serving a steak on a plate that had held the raw steak increased the risk of foodborne illness, however, only 67% cleaned the cutting board after contact with raw meat or poultry (92). The same survey found that 67% of the respondents knew that cooking meat until well done reduces the risk of foodborne illness and 71% of the respondents served adequately cooked hamburgers.

Safe food-handling surveys conducted in Europe and the U.S. have found that older people are more likely to follow appropriate safe food-handling practices as compared to younger people (3,17,92,125). The present study supports these finding. Respondents between the ages of 45-54 were more likely to use correct hygienic practices on cutting boards and hands than respondents under the age of 45 were. Respondents aged 35-44 were more likely to use a correct practice to determine whether large and small pieces of poultry were cooked enough to prevent foodborne illness than the age group 45-54. Respondents over the age of 65 were more likely to know that

chicken which is pink inside has a high risk of causing foodborne illness compared to respondents under the age of 65. Respondents over the age of 65 were more likely to know that a 3-minute egg has a high risk of causing foodborne illness compared to respondents under the age of 35. Respondents over the age of 25 were more likely than respondents aged 15-24 to know that ready-to-eat vegetables that have been in contact with raw meat juice have a high risk of causing foodborne illness. However, respondents over the age of 65 were more likely to believe that a steak that is pink inside has a high risk of causing foodborne illness compared to age groups 15-54. One can speculate whether this is due to this age group generally being more cautious about food safety.

This study also found that females were more likely to follow appropriate hygienic and cooking practices than male respondents. This was the case for the kitchen sink and the dishcloth/ sponge. Females were more likely than males to use appropriate practices to determine whether meat is cooked enough to prevent foodborne illness. This was the case when determining whether large pieces of poultry were cooked enough. Females were also more likely to have more correct knowledge when rating the risk of consuming different types of food. Females were more likely to know that there is a high risk of contracting foodborne illness when consuming cooked chicken which is pink inside and cooked meat and ready-to-eat vegetables which have been in contact with raw meat juice. However, males were more likely to know that there is a low risk of consuming a beefsteak that is pink inside.

Table 36. Comparison of the current survey with the CFIA's 1998 and 1990 surveys regarding the correct knowledge foods that can cause foodborne illness.

	Current Survey (%)	CFIA's 1998 Survey (%)	CFIA's 1990 Survey (%)
Eating a pink beef steak	54	N/A[1]	N/A
Eating chicken which is pink inside	76	92	84
Eating a 3-minute egg	7	18	14
Cooked hamburger with raw meat juice on it	77	86	66
Vegetables with raw meat juice on them	71	87	68
Molded cheese	87	35	35

[1]N/A shows that these hazards were not included in the survey

Respondents from the current survey rated health hazards in foods higher as compared to Canadians in general as seen in Table 38. However, when placing the hazards in order of seriousness the ratings are comparable (Table 38). The three most serious perceived health hazards were pathogens (including bacteria, virus and parasites), pesticide residues in food and environmental contaminants or pollutants. The least serious perceived health hazards were natural chemicals or poisons present in some foods, problems associated with cholesterol, fat, sugar or salt, and finally additives. CFIA's 1998 survey found the same order of seriousness of these health hazards with the exception that problems associated with cholesterol, fat, sugar or salt as well as additives were perceived as being more serious than natural chemicals or poisons present in some foods. The current survey found that respondents who themselves were over 65 years of age or had individuals over 65 years of age in the household were slightly more concerned about the listed health hazards (data not shown). CFIA's 1990 survey found that Canadians showed less concern about pathogens, whereas pesticide residues and environmental contaminants/ pollutants were rated as serious health hazards (Table 38).

The most common sources from which respondents of the current survey received information about the proper way to cook, store and handle food were very similar to CFIA's surveys in 1998 and 1990: through family and friends (65%), cookbooks (65%), magazine / newspaper articles (52%), and TV/radio (47%). The current survey also found that 20% of the respondents received information from school, college or university; 12% from retailer/store clerks; 12% on the job; 18% from government brochures; 31% from consumer information brochures; 56% from instructions on product/packages; and 17% from health professionals. CFIA's survey in 1998 found that respondents were more likely to have been both self-taught and taught by family and friends than the current survey found. CFIA also found that 59% of Canadians, who were interested in more information about the proper way to cook, store and handle food, preferred to receive that information through pamphlets at grocery stores.

A large proportion of the total sample in the current survey claimed to have heard about *Salmonella* and *E. coli* (90% and 87% respectively) whereas *Campylobacter* was a poorly recognized pathogen (12%). These results are comparable to the FDA sponsored survey

mentioned earlier (92). The recent Italian survey mentioned earlier found that 56% of the respondents had knowledge about *Salmonella* (that survey did not include *E. coli* or *Campylobacter*).

Table 37. Percent distribution of the rating of serious/somewhat serious health hazards in foods by respondents in the current survey as well as CFIA's 1990 and 1998 surveys.

Health hazard	Current Survey (%)	CFIA's 1998 Survey (%)	CFIA's 1990 Survey (%)
Bacteria which may cause foodborne illness	85/14[1]	69/28	72/26
Virus which may cause foodborne illness	80/13	N/A[2]	N/A
Parasites in food	78/16	N/A	N/A
Pesticide residues	73/22	64/31	69/22
Pollution	70/23	59/37	69/24
Foods that cause allergic reactions	N/A	47/41	N/A
Food irradiation	N/A	28/38	N/A
Genetically engineered foods	N/A	26/34	N/A
Natural chemicals or poisons present in some foods	50/33	23/51	43/39
Problems associated with cholesterol, fat, sugar, or salt	26/56	28/53	48/42
Food additives	22/50	26/55	26/56

[1]The two numbers displayed show the rating in percent of 'serious'/ 'somewhat serious' health hazards
[2]N/A shows that these hazards were not included in the survey

In the current survey, a total of 39% of the respondents reported having had foodborne illness while in Canada. Most of these respondents had 1-2 incidences of foodborne illness (63%). This is in strong contrast to CFIA's 1998 survey where only 12% of Canadians believed that they had had foodborne illness (17). However, it is important to note that the CFIA 1998 survey specifically asked respondents how many incidences of foodborne illness they had had the past year, whereas this survey did not specify any time period.

Limitations of the survey

The definition for correct methods of sanitizing the hands in this survey was either to wash hands with disinfectant soap or in diluted bleach. However, it would have been more appropriate if this action had included that the hands be washed with soap and water first to remove lipid particles from the hands, which likely would be deposited after handling poultry.

It could be argued that there is a high sampling error in the current survey and consequently poor accuracy as well. This would hinge on the argument that a scientifically acceptable response rate should be above 50%, whereas in this study the response rate was 36% (126). This argument notwithstanding, many of the results of this survey are comparable to CFIA's 1998 survey and the FDA sponsored survey in the U.S. from 1993. Furthermore, the fact that the demographic factors associated with this survey's respondents are comparable to the GVRD's population demographic strengthens the argument that this survey is valid. Finally, since this survey was constructed and executed in a professional and exact manner and utilized all academically accepted norms and practices concerning survey design and application, a reasonable claim for validity can be made.

CONCLUSIONS

The results of this survey support earlier findings from other geographical areas that certain food-handling practices, which are at high risk of producing foodborne illness, are fairly common in the GVRD and a large percentage of the population in the GVRD was unaware of preventative measures to prevent foodborne illness when preparing a home-cooked meal.

The current survey demonstrated that persons primarily responsible for household meal preparation in the Greater Vancouver Regional District (GVRD) did not use appropriate food safety procedures before, during and after meal preparation in the household to prevent foodborne illness. Young people between the ages of 15-34 and males were less likely to follow appropriate safe food-handling practices and less likely to have correct knowledge when rating the risk of foodborne illness when consuming different types of foods.

The main problem was the potential for cross-contamination between kitchen utensils and ready-to-eat foods. Furthermore, the population surveyed in the current survey did not use an appropriate method when determining whether poultry (whole or in pieces), beef patties and eggs were cooked enough to prevent foodborne illness. This population, when asked to rate the risk of foodborne illness in different types of foods, also lacked knowledge of the causes of foodborne illness. Thus, in many households cross-contamination between raw meat and other foods, as well as improperly cooked foods, could potentially cause foodborne illness.

It can thus be concluded that residents in the GVRD who were responsible for preparing most of the meals in the household, in particular females and younger residents, need to be better educated in preventing cross contamination before, during and after meal preparation through increased awareness of the causes of foodborne illness. Furthermore, it is recommended that this population be informed about the correct methods to use when determining whether meat, poultry or eggs are cooked enough to prevent foodborne illness.

A review of the literature shows that the knowledge base about foodborne illness, in particular the causes and symptoms of foodborne illness, should be increased with a focus on increasing the public's scientific literacy. This knowledge should be communicated through the media, food labels, primary school curriculum, health professionals and training courses in a

community setting. Furthermore, an education campaign should include positive behaviour change rather than knowledge alone. Consumers should be motivated to practice safe food-handling practices through a belief that the individual could be personally harmed if safe food-handling practices are not followed, and that behaviour could have a positive impact on the prevention of foodborne illness.

IMPLICATIONS AND RECOMMENDATIONS

The present study indicates that while most people practiced appropriate safe food-handling practices and had a high level of food safety awareness, a significant proportion of the respondents did not. Given the contamination rates of some foods, this gives rise to an important risk of foodborne illness. The results found in this survey, together with similar results in other surveys, show that education campaigns should target the broad public, with particular focus on the younger age groups (under 35 years of age). One way in which this could be accomplished would be to target an education campaign on food safety to primary school children (kindergarten – grade 12). The Canadian Partnership for Food Safety Education has developed education materials for grades K-12 recommended for this purpose.

Results from this and other surveys emphasize the need to target women in education campaigns since it is mainly women who prepare meals in the domestic kitchen. This survey found that males consistently seem to be less likely to have correct knowledge and follow safe food-handling practices but it is not recommended that this demographic specifically should be targeted in an education campaign since males generally prepare few meals in the domestic kitchen.

Further research is needed to determine how the available data on the public's food-handling practices and knowledge best can be translated into improved food-handling practices.

It is recommended that food safety labels becomes required by law in this country. This has proven to be an effective method to educate the public about food safety in the U.S. Other effective methods for educating the public in food safety are training courses in a community setting (e.g. community centres, churches), primary school curricula and through health professionals in their vocational settings. Furthermore, this survey supports the findings of other surveys, which have found that the media is a common source of information about foodborne illness. Efforts to educate and inform media personnel on food safety matters should be undertaken as part of any campaign.

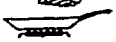
APPENDIX I. U.S. Labels for Raw Meat and Poultry Products

Safe Handling Instructions

This product was prepared from inspected and passed meat and/or poultry. Some food products may contain bacteria that could cause illness if the product is mishandled or cooked improperly. For your protection, follow these safe handling instructions.

Keep refrigerated or frozen.
Thaw in refrigerator or microwave.

Keep raw meat and poultry separate from other foods. Wash working surfaces (including cutting boards), utensils, and hands after touching raw meat or poultry.



Cook thoroughly.

Keep hot foods hot. Refrigerate leftovers immediately or discard.

APPENDIX II. Proposed Canadian Labels for Raw Meat and Poultry Products.

Please note that icons which are representative of the individual statements are also recommend but are not included here.

SAFE POULTRY COOKING & HANDLING

Some food products may contain bacteria that could cause illness if cooked or handled improperly.

For your protection:

Keep refrigerated or frozen. Thaw in refrigerator or microwave.

Cook thoroughly until there is no pink meat and juices are clear

Wash hands, utensils and working surfaces thoroughly with hot water and detergent, then sanitize, e.g. with diluted bleach, after contacting raw foods

Keep hot foods hot. Refrigerate leftovers within 2 hours of serving.

Notes:

A 2nd option for the introductory statement is "Raw poultry from any source may contain bacteria that could cause illness if cooked or handled improperly." The last statement, "Keep hot foods hot. Refrigerate leftovers within 2 hours of serving" is recommended but may be deleted if space restrictions require a reduction in the amount of information.

SAFE GROUND MEAT COOKING & HANDLING

Some food products may contain bacteria that could cause illness if cooked or handled improperly.

For your protection:

Keep refrigerated or frozen. Thaw in refrigerator or microwave.

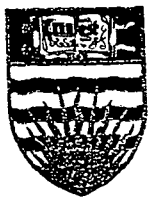
Cook thoroughly until there is no pink meat and juices are clear

Wash hands, utensils and working surfaces thoroughly with hot water and detergent, then sanitize, e.g. with diluted bleach, after contacting raw foods

Keep hot foods hot. Refrigerate leftovers within 2 hours of serving.

APPENDIX IV. Survey Questionnaire

University of British Columbia



Food Science Department

Food Handling Survey of Households in the Greater Vancouver Regional District

☐ 如果家里没有人能閱讀及書寫英語來完成此調查表, 請在方格内打勾, 并用我們所提供的已付郵費信封把調查表寄還給我們. 謝謝.

☐ ਇਸ ਪ੍ਰਸ਼ਨਾਵਲੀ ਨੂੰ ਪੂਰਾ ਕਰਨ ਲਈ ਜੇ ਤੁਹਾਨੂੰ ਪਰਿਵਾਰ ਵਿਚ ਕੋਈ ਅਜਿਹਾ ਵਿਅਕਤੀ ਨਾ ਮਿਲੇ ਜੋ ਕਿ ਇੰਗਲਿਸ਼ ਚੰਗੀ ਤਰ੍ਹਾਂ ਪੜ ਅਤੇ ਲਿਖ ਸਕਦਾ ਹੋਵੇ, ਕ੍ਰਿਪਾ ਕਰਕੇ ਖਾਨੇ (ਬਾਕਸ) ਦੀ ਜਾਂਚ-ਪੜਤਾਲ ਕਰੋ ਅਤੇ ਇਸ ਪ੍ਰਸ਼ਨਾਵਲੀ ਨੂੰ ਟਿਕਟ ਸਹਿਤ ਲਿਫਾਫੇ ਨਾਲ ਵਾਪਿਸ ਭੇਜੋ। ਤੁਹਾਡਾ ਬਹੁਤ-ਬਹੁਤ ਧੰਨਵਾਦ।

B. PREPARATION PRACTICES. This section will help us understand what practices you usually follow when you are preparing a meal. This information will be helpful in developing material for public education.

5. Do you ever cook **poultry** (i.e. chicken, turkey, duck and goose)?

☐ 1 Yes **If no**, please **skip** to question number 25.

6. Please check the type of **cutting utensil(s)** that you **usually** use to cut raw (uncooked) poultry. *Please check all that apply.*

☐ 1 A knife
☐ Poultry scissors
☐ A cleaver (chopping tool)
☐ Other (*please specify*) _____

7. When you are cooking a meal where you have cut raw (uncooked) poultry do you **usually then** use the **same** cutting utensil to cut other food products?

☐ 1 Yes **If no**, please **skip** to question number 9.

8. **If yes,** what do you **usually** do to the cutting utensil **before** you cut other food products? *Please check all that apply.*

☐ 1 Nothing
☐ Wash with detergent and water
☐ Rinse with water only
☐ Wipe with a dishcloth / sponge
☐ 5 Rinse / wipe with diluted bleach
☐ Soak in diluted bleach
☐ Wipe with vinegar
☐ Wash with a disinfectant soap
☐ Wash in the dishwasher
☐ 10 Other (*please specify*) _____

9. Do you ever use a cutting board to cut raw (uncooked) poultry?

☐ 1 Yes **If no**, please **skip** to question number 13.

10. Please check the type of cutting board(s) you **usually** use to cut raw (uncooked) poultry. *Please check all that apply.*

☐ 1 A wooden cutting board
☐ A glass cutting board
☐ A plastic cutting board
☐ A marble cutting board
☐ A ceramic cutting board
☐ 5 Other (*please specify*) _____

11. When you are cooking a meal where you have cut raw (uncooked) poultry on a cutting board do you **usually** use the **same** cutting board for other food products?

☐ 1 Yes **If no**, please **skip** to question number 13.

12. **If yes,** what do you **usually** do to the cutting board **before** you cut other food products on it? *Please check all that apply.*

☐ 1 Wash with detergent and water
☐ Wash with a disinfectant soap
☐ Wipe with a dishcloth/sponge
☐ Rinse/wipe with diluted bleach
☐ 5 Soak in diluted bleach
☐ Wipe with vinegar
☐ Rinse with water only
☐ Wash in the dishwasher
☐ Nothing
☐ 10 Other (*please specify*) _____

13. When you are preparing raw (uncooked) poultry does it ever come in contact with the kitchen counter?

☐ 1 Yes **If no**, please **skip** to question number 16.

14. **If yes**, do you wash the kitchen counter **before** you put **any** other food products on it?

☐ 1 Yes **If no**, please **skip** to question number 16.

15. **If yes**, how do you wash the kitchen counter? *Check all that apply.*

☐ 1 Wipe with a disinfectant soap
☐ Wipe / rinse with vinegar
☐ Wipe with a dishcloth / sponge
☐ Wipe / rinse with diluted bleach
☐ 5 Wipe with water or detergent and water
☐ Other (*please specify*) _____

16. When you are preparing raw (uncooked) poultry does it ever come in contact with the kitchen sink?

☐ 1 Yes **If no**, please **skip** to question number 19.

17. **If yes**, do you wash the kitchen sink **before** you put **any** other food products on it?

☐ 1 Yes **If no**, please **skip** to question number 19.

18. **If yes**, how do you wash the kitchen sink? *Check all that apply.*

☐ 1 Rinse with water or detergent and water
☐ Wipe with a dishcloth / sponge
☐ Wipe / rinse with vinegar
☐ Wipe / rinse with diluted bleach
☐ 5 Wash with a disinfectant soap
☐ Other (*please specify*) _____

19. **After** you cut raw (uncooked) poultry and **before** you cut any other food products do you **usually** wash your hands?

☐ 1 Yes

If no, please **skip** to question number 21.

20. **If yes**, how do you wash your hands? *Please check all that apply.*

☐ 1 Wash with a disinfectant soap
☐ Rinse with water only
☐ Rinse with diluted bleach
☐ Wipe with a dishcloth / sponge
☐ 5 Wash with soap and water
☐ Other (*please specify*) _____

21. If you use a dishcloth / sponge to clean any utensil or surface after cutting raw (uncooked) poultry, what do you **usually** do to it before using it again?
Please check all that apply.

☐ 1 I don't use a dishcloth / sponge
☐ Rinse with vinegar
☐ Rinse with a disinfectant soap
☐ Nothing
☐ 5 Rinse with water only
☐ Rinse with diluted bleach
☐ Rinse with detergent and water
☐ Wash in the dishwasher
☐ Wash in the washing machine
☐ 10 Other (*please specify*) _____

C. COOKING PRACTICES. This section will help us understand what practices you usually follow when you are cooking. This information will also be helpful in developing material for public education.

22. How do you decide when **whole poultry** is cooked enough to eat?
Please check all that apply.

☐ 1 I **never** cook whole poultry
☐ I make sure the juices run clear
☐ I use a meat thermometer
☐ I taste the meat
☐ 5 I poke the meat to feel firmness
☐ I wait until it falls apart
☐ I twist the leg bone
☐ I cook the meat for a certain amount of time
☐ I make sure the meat is not pink
☐ 10 Other (*please specify*) _____

23. How do you decide when **large pieces of poultry** (for example: drumsticks or breast pieces) are cooked enough to eat? *Please check all that apply.*

- ☐ 1 I poke the meat to feel firmness
- ☐ I taste the meat
- ☐ I twist the legbone
- ☐ I cook the meat for a certain amount of time
- ☐ 5 I make sure the juices run clear
- ☐ I make sure the meat is not pink
- ☐ I use a meat thermometer
- ☐ I **never** cook large pieces of poultry
- ☐ Other (*please specify*) _____

24. How do you decide when **small pieces of poultry** (for example: small pieces in a stew, soup, or stir-fry) are cooked enough to eat? *Please check all that apply.*

- ☐ 1 I poke the meat to feel firmness
- ☐ I taste the meat
- ☐ I make sure the juices run clear
- ☐ I make sure the meat is not pink
- ☐ 5 I cook the meat for a certain amount of time
- ☐ I **never** cook with small pieces of poultry
- ☐ Other (*please specify*) _____

25. Do you **ever** cook **hamburgers (beef patties)**?

☐ 1 Yes

If no, please **skip** to question number 28.

26. How do you like **your hamburger (beef patty)** done?

- ☐ 1 Rare
- ☐ Medium rare
- ☐ Medium
- ☐ Medium well done
- ☐ 5 Well done
- ☐ I never **eat** hamburgers (beef patties)

27. How do you decide when **hamburgers (beef patties)** are cooked enough to eat? *Please check all that apply.*

- ☐ 1 I taste the meat
- ☐ I cook the meat for a certain amount of time
- ☐ I use a meat thermometer
- ☐ I make sure the juices run clear
- ☐ 5 I make sure the meat is not pink
- ☐ I poke the meat to feel firmness
- ☐ Other (*please specify*) _____

28. When there are **meat or poultry leftovers of any kind** that you want to save, how soon after cooking do you put the leftovers in the refrigerator or freezer?
Please check the appropriate amount of time.

- ☐ 1 Within 2 hours
- ☐ Within 4 hours
- ☐ Within 6 hours
- ☐ After more than 6 hours

D. FOOD SAFETY. This section will provide us with information on what your views are on food safety in Canada and which sources you trust the most for information on food safety.

29. How do you rate each of the following items as possible **health** hazards?
*Please **circle** 1, 2, 3, or 4 for each part.*

	Serious	Somewhat serious	Not serious	Don't know
Food Additives.....	1	2	3	4
Pesticide Residues.....	1	2	3	4
Environmental contaminants or pollution in food.....	1	2	3	4
Problems associated with cholesterol, fat, sugar, or salt...	1	2	3	4
Bacteria which may cause food poisoning.....	1	2	3	4
Viruses which may cause food poisoning.....	1	2	3	4
Parasites present in food.....	1	2	3	4
Natural chemicals or poisons present in some foods.....	1	2	3	4

30. Where do you get **information** about the **proper way to cook, store and handle food**? *Please check all that apply.*

- ☐ 1 Friends or family
- ☐ School, college or university
- ☐ Government brochures
- ☐ Retailer / store clerks
- ☐ 5 On the job
- ☐ Television and/or radio
  - ☐ Programs
  - ☐ Product ads
  - ☐ Public service announcements
- ☐ 10 Don't know
- ☐ Other (*please specify*) _____
- ☐ Consumer information brochures
- ☐ Instructions on product / packages
- ☐ Health professional (doctor, nurse, dietitian, pharmacist, etc.)
- ☐ 15 Cookbooks
- ☐ Magazines and/or newspapers
  - ☐ Articles
  - ☐ Product ads
  - ☐ Public service announcements

31. How much do you **trust** each of the following sources of information on the **safety of food**? *Please circle 1, 2, 3, or 4 for each source.*

	I trust the information a lot	a little	not at all	I don't know
Government agencies	1	2	3	4
Friends or family	1	2	3	4
Health professional (doctor, nurse, dietitian, pharmacist, etc.)	1	2	3	4
Retailer / store clerk	1	2	3	4
Newspaper or magazine	1	2	3	4
Radio / TV	1	2	3	4
People who supply food such as farmers and fishermen	1	2	3	4
Food processor or manufacturer	1	2	3	4
Consumers Association of Canada	1	2	3	4

32. Are there other sources of information you trust (*please specify*) _____

_____

33. How do you **rate the risk of food poisoning** in each of these situations. *Please circle 1, 2, 3, 4, or 5 for each situation.*

	Level of risk: High	Moderate	Low	No risk	Don't know
Eating a **beef steak** which is still pink inside	1	2	3	4	5
Eating **chicken** which is still pink inside	1	2	3	4	5
Eating an **egg** which has been boiled for 3 minutes	1	2	3	4	5
Eating **barbecued hamburgers** (beef patties) which have been on the same plate that was used to carry the raw hamburger meat to the barbecue	1	2	3	4	5
Eating **vegetables** which have been cut on the same cutting board right after cutting raw meat	1	2	3	4	5
Eating cheddar **cheese** that **has** some mold on it	1	2	3	4	5

34. Have you ever heard of **Salmonella**?

☐ 1 Yes **If no**, please **skip** to question number 37.

35. Where did you first hear about **Salmonella**? *Please check all that apply.*

☐ 1 Friends or family
☐ Magazines / newspaper articles
☐ Television / radio
☐ On the job
☐ 5 School
☐ I don't remember
☐ Other (*please specify*) _____

36. What do you think **Salmonella** is? *Please explain.* _____

_____

37. Have you ever heard of **E. coli**?

☐ 1 Yes **If no**, please **skip** to question number 40.

38. Where did you first hear about **E. coli**? *Please check all that apply.*

☐ 1 Friends or family
☐ Magazines / newspaper articles
☐ Television / radio
☐ On the job
☐ 5 School
☐ I don't remember
☐ Other (*please specify*) _____

39. What do you think **E. coli** is? *Please explain.* _____

_____

40. Have you ever heard of **Campylobacter**?

☐ 1 Yes **If no**, please **skip** to question number 43.

41. Where did you first hear about **Campylobacter**? *Please check all that apply.*

☐ 1 Friends or family
☐ Magazines / newspaper articles
☐ Television / radio
☐ On the job
☐ 5 School
☐ I don't remember
☐ Other (*please specify*) _____

42. What do you think **Campylobacter** is?

_____

_____

43. Do you believe any of the following **long-term health problems** can be caused by food poisoning? *Please check all that apply.*

- ☐ 1 Cancer
- ☐ Kidney failure
- ☐ Allergic reaction
- ☐ Arthritis
- ☐ 5 Heart disease
- ☐ Birth defects
- ☐ None of the above
- ☐ I don't know
- ☐ Other long-term health implications (*please specify*) _____

_____

44. Which of the following **symptoms** do you associate with food poisoning? *Please check all that apply.*

- ☐ 1 Vomiting
- ☐ Diarrhea
- ☐ Other stomach upset
- ☐ Headaches
- ☐ 5 Dizziness / disorientation
- ☐ Allergic reaction
- ☐ Tired / lethargic
- ☐ Other immediate health implications (*please specify*) _____

_____

45. Have you ever had food poisoning in Canada?

- ☐ 1 Yes
- ☐ No → **If** your answer is **no** or **don't know**, please **skip** to question number 48.
- ☐ I don't know →

46. How many times have you had food poisoning in Canada? *Please check **one** only.*

- ☐ 1 1 - 2 times
- ☐ 3 - 5 times
- ☐ More than 5 times
- ☐ I don't know

47. Can you trace your food poisoning experiences to any of the following? *Please check all that apply.*

- ☐ 1 A meal at a restaurant / cafeteria
- ☐ A meal at a banquet, reception or catered function
- ☐ A meal prepared at home
- ☐ A meal prepared at family / friend's home
- ☐ 5 A meal prepared at school, college, university, or other institution
- ☐ A meal delivered from a restaurant
- ☐ A packaged meal heated at home (e.g. TV dinner, pot pie, etc.)
- ☐ Packaged ready to eat foods (e.g. sandwich, hot-dog, etc.)
- ☐ I don't know
- ☐ 10 Other (*please specify*) _____

E. DEMOGRAPHIC INFORMATION: This section will give information about you and your household. We want to make sure that the people who answer this questionnaire statistically represent the population of the Greater Vancouver Regional District.

48. How old are you now?

☐ 1 15-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 5 55-64 ☐ 65+

49. What is your gender? ☐ 1 Female ☐ Male

50. To which ethnic or cultural group do you or did your ancestors belong?
Please check all that apply.

☐ 1 British
☐ German
☐ Italian
☐ Dutch
☐ 5 Aboriginal
☐ Spanish
☐ Polish
☐ Vietnamese
☐ Irish
☐ 10 Ukrainian
☐ African
☐ Korean
☐ Métis
☐ Don't know
☐ 15 Chinese
☐ French
☐ East Indian
☐ Filipino
☐ Arabic
☐ 20 Portuguese
☐ Greek
☐ Hungarian
☐ Scottish
☐ Jewish
☐ 25 Pakistan
☐ Japanese
☐ Persian
☐ Other (*please specify*) _____

51. How many people are there in your household, including yourself?

There are ____ people in my household.

52. Are there any children under the age of 5 presently living in your household?

☐ 1 Yes ☐ No

53. Are there any persons over the age of 65 presently living in your household?

☐ 1 Yes ☐ No

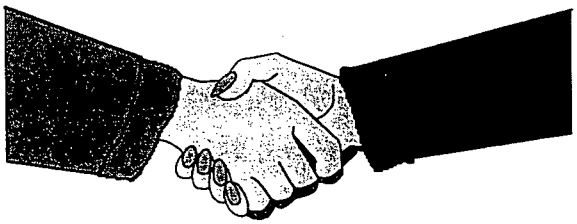
Do you have any comments? _____

_____

_____

_____

Thank you very much for taking the time to answer this questionnaire!



Please mail back the completed questionnaire in the postage-paid envelope provided. If you have lost this envelope, please mail the questionnaire to:

Marianne Wyne
Food Science Department
6650 N.W. Marine Drive
Vancouver, B.C., V6T 1Z4

APPENDIX VI. Sample of the Respondents 'Request for Information' Slip.

If you are interested in receiving a summary of the survey results, please provide your **e-mail address, fax number** or **mailing address** below.

Please be assured that this piece of paper will be separated from the questionnaire. The information you provide is **strictly confidential**. If you provide your e-mail address, fax number, or name and address, these will **only** be used to send you a summary of the final results.

_____

_____

_____

_____

Calculation of the Confidence Interval (95%):

	Question number	Question text	Correct method (expected p)	1-p	n	Sample proportion standard deviation	Square root (sample proportion std. dev.)	t (sub .95) (critical stat.)	Margin of error	p (predicted) minus margin of error	p (predicted) plus margin of error
BEHAVIOR	B8	Cutting board	0.602	0.398	582	0.000411677	0.020289824	1.96	0.040	0.562	0.642
	B12	Cutting utensil	0.588	0.412	582	0.000416247	0.020402143	1.96	0.040	0.548	0.628
	B15	Kitchen counter	0.709	0.291	582	0.000354500	0.018828170	1.96	0.037	0.672	0.746
	B18	Kitchen sink	0.678	0.322	582	0.000375113	0.019367845	1.96	0.038	0.640	0.716
	B20	Hands	0.311	0.689	582	0.000368177	0.019187938	1.96	0.038	0.273	0.349
	B21	Dishcloth/sponge	0.447	0.553	582	0.000424727	0.020608901	1.96	0.040	0.407	0.487
	C22	Whole poultry	0.687	0.313	582	0.000369469	0.019221578	1.96	0.038	0.649	0.725
	C23	Large pieces of poultry	0.777	0.223	582	0.000297716	0.017254463	1.96	0.034	0.743	0.811
	C24	Small pieces of poultry	0.712	0.288	582	0.000352330	0.018770453	1.96	0.037	0.675	0.749
	C27	Hamburger beef patty	0.707	0.293	582	0.000355930	0.018866095	1.96	0.037	0.670	0.744
KNOWLEDGE	D33.1	Beef steak	0.533	0.467	582	0.000427682	0.020680477	1.96	0.041	0.492	0.574
	D33.2	Pink chicken	0.758	0.242	582	0.000315182	0.017753370	1.96	0.035	0.723	0.793
	D33.3	3 minute egg	0.066	0.934	582	0.000105918	0.010291624	1.96	0.020	0.046	0.086
	D33.4	Beef-patty + raw juice	0.769	0.231	582	0.000305222	0.017470594	1.96	0.034	0.735	0.803
	D33.5	Vegetables + raw juice	0.712	0.288	582	0.000352330	0.018770453	1.96	0.037	0.675	0.749
	D33.6	Molded cheese	0.218	0.782	582	0.000292914	0.017114733	1.96	0.034	0.184	0.252
	D34	*Salmonella*	0.901	0.099	582	0.000153263	0.012379939	1.96	0.024	0.877	0.925
	D37	*E. coli*	0.866	0.134	582	0.000199388	0.014120493	1.96	0.028	0.838	0.894
	D40	*Campylobacter*	0.115	0.885	582	0.000174871	0.013223885	1.96	0.026	0.089	0.141

APPENDIX VIII. Typical comments made by respondents in the comment section on the last page of the questionnaire:

- I hope this kind of questionnaire/research will help educate others and improve the future regarding foodborne illness
- My family and I have survived 40 years of my cooking, why should it be any different now?
- Why are there so many food-related problems today versus 30 years ago?
- I have eaten raw ground meat all my life as did my parents and my children
- I only buy ground beef from the same butcher/store
- More education is needed for food handlers from developing countries where the standards of hygiene are not the same as ours
- This was quite interesting - I realized that I don't know much about the topic
- I would like some more information about how to prevent food poisoning

GLOSSARY

Accuracy. The closeness of computations or estimates to the exact or true values (127). The extent to which the survey results approach the true (but unknown) value of a characteristic of interest in the population (134).

Anonymity. In a survey, anonymity exists if the identity of each respondent who has returned a completed questionnaire is not known to anyone other than the respondent and no respondent can be identified by inference from the results of the survey. If code numbers or other identifiers are put on the questionnaire when sent out, anonymity does not exist (134).

Attribute. A characteristic of a person, object or concept which can be described only in terms of categories (e.g. marital status, gender, hair colour, etc.), rather than being described in quantitative or numerical units (134).

Bias. Generally, an effect which deprives a statistical result of representativeness by *systematically* distorting it, as distinct from a random error which may distort on any one occasion but balances out on the average (127).

Cluster. When the basic sampling unit in the population is to be found in groups or clusters, e.g. human beings in households, the sampling is sometimes carried out by selecting a sample of clusters and observing all the members of each selected cluster. This is known as cluster sampling. If the elements are closely grouped they are said to be compact. If they are almost equivalent to a geographically compact group from the point of view of investigational convenience they are said to be quasi-compact (127).

Coefficient of variation. The standard error of an estimate, expressed as a ratio or percentage of the estimate. It is a measure of the relative dispersion of distributions and is useful because it is independent of the unit of measurement by which the basic variable is measured (134). The standard deviation of a distribution divided by the arithmetic mean; sometimes multiplied by 100. K. Pearson (1895) proposed it for the purpose of comparing the variabilities of frequency distributions, but the coefficient of variation is sensitive to errors in the means and is of limited use (127).

Confidence interval. A statement to the effect that the true value for the population lies within a given range of values at a specified level of confidence (134). If it is possible to define two statistics t_1 and t_2 (functions of sample values only) such that, θ being a parameter under estimate, Pr ($t_1 \leq \theta \leq t_2$) = α, where α is some fixed probability, the interval between t_1 and t_2 is called a confidence interval. The assertion that θ lies in this interval will be true, on the average, in a proportion α of the cases when the assertion is made (127).

Confidence limits. The values t_1 and t_2 which form the upper and lower limits to the confidence interval (127).

Confidentiality. The situation where the privacy of information provided by individual respondents to a survey is maintained, and the information about individual respondents cannot be

derived from the published survey results (134).

Cross-tabulation. Arrangement of data in categories of those variables of interest which are being compared, usually in a tabular format with the rows being categories of one variable and the columns being categories of the other variable (134).

Data capture. The process of transferring survey data from questionnaires or coding forms to a machine-readable medium (tape, cards, discs, etc.) (134).

Data. Collective reference to individual items of information (always plural) (134).

Demographic variable. A characteristic pertaining to the size, geographic distribution and density of human populations. Classic demographic variables include only age, sex, marital status, fertility, mortality, and migration, but common usage has tended to include a wider variety of social characteristics such as: education, income, employment, etc. (134).

Elementary unit. One of the individuals which, in the aggregate, compose a population: the smallest unit yielding information which, by suitable aggregation, leads to the population property under investigation. Cases occur where the term may be ambiguous; e.g. if an age distribution is to be estimated from a sample of households then the person is the elementary unit; but if, at the same time, the size of household is to be estimated, the household is elementary unit (127).

Error. In general, a mistake or error in the colloquial sense. There may, for example, be gross error or avoidable mistake; an error of reference, when data concerning one phenomenon are attributed to another; copying errors; an error of interpretation. In a more limited sense the word 'error' is used in statistics to denote the difference between an occurring value and its 'true' or 'expected' value. There is here no imputation of mistake on the part of a human agent; the deviation is a chance effect. In this sense we have, for example, errors of observations, errors in equations, errors of the first and second kinds in testing hypotheses, and the error band surrounding an estimate; and also the Normal curve of errors itself (127).

Food infections. Food infections are the outcome when foods containing pathogenic bacteria that colonize, grow and cause tissue damage in the intestinal tract of the host are consumed causing characteristic symptoms. Growth of the pathogen in the food is not required for an infection to occur, however, the probability of infection increases if growth does occur (131).

Food intoxications. State of being intoxicated, esp. being poisoned by a toxic substance (130). An example of a food intoxication is *S. aureus* where the living cells do not need to be consumed. It is the preformed toxin, from *S. aureus* growing in the food, that causes illness when the food is consumed (128).

Food toxicoinfections. Food toxicoinfections are a combination of food intoxications and food infections. The pathogen must grow to high numbers in the food for a disease to occur. When the pathogens are ingested with the food, the growth of the pathogen continues in the intestine. The symptoms of the illness occurs when the toxin is released (131).

Forward Sortation Area (FSA). A code that represents a mailmans' walking route.

Greater Vancouver Regional District (GVRD). The GVRD is located at the southwest corner of the British Columbia mainland. The GVRD occupies 3,292 square kilometers at the mouth of the Fraser River. The metropolitan community is centered on the City of Vancouver on the Burrard Peninsula. The adjoining municipalities to the east, Burnaby, New Westminster, Coquitlam, and Port Moody share the Burrard Peninsula. West Vancouver, Lions Bay, North Vancouver City and District, are located on the south slope of the Coastal Mountain range separated from the peninsular communities by Burrard Inlet. South of the Burrard peninsula are the municipalities of Richmond, Delta, Surrey, White Rock, Langley City and Township. Maple Ridge and Pitt Meadows are located east of the Pitt River and north of the Fraser River. Together, these twenty municipalities make up the Greater Vancouver Regional District (GVRD) (129).

Hemolytic uremic syndrome (HUS). An acute condition consisting of anemia in the small blood vessels (microangiopathic hemolytic anemia), abnormal decrease in number of blood platelets (thrombocytopenia), and acute nephropathy (inflammation of the kidney) (130).

Intoxication or true food poisoning. This is caused by ingestion of foods containing toxic substances produced by bacteria. The organism that produced the toxin may be dead, but the toxin is still present (130,131,132).

Non-response error. Errors occurring due to non-response to a question on a questionnaire

Non-response. In sample surveys, the failure to obtain information from a designated individual for any reason (death, absence, refusal to reply) is often called a non-response and the proportion of such individuals of the sample aimed at is called the non-response rate. It would be better, however, to call this a 'failure' rate or a 'non-achievement' rate and to confine 'non-response' to those cases where the individual concerned is contacted but refuses to reply or is unable to do so for reasons such as blindness or illness. Non-availability of information in other situations, e.g. arrival of the investigator for crop cutting experiments after harvesting, may also be termed non-response, or better, non-achievement. When several items of information are to be collected for the same sample unit, it may so happen that information is not available for some of the items but available for others. The term non-response is usually not applied in such a situation; but incomplete response or incomplete achievement may be used (127).

Non-sampling error. An error in sample estimates which cannot be attributed to sampling fluctuations. Such errors may arise from many different sources such as defects in the frame, faulty demarcation of sample units, defects in the selection of sample units, mistakes in the collection of data due to personal variations or misunderstandings or bias or negligence or dishonesty on the part of the investigator or of the interviewee, mistakes at the stage of the processing of the data, etc. The term 'response error' is sometimes used for mistakes in the collection of data and would not, strictly speaking, cover errors due to non-response. The use of the word 'bias' in the place of error, e.g. 'response bias', is not uncommon. The term 'ascertainment error' is preferable as it would include errors due to non-response and also cases of collection of data by methods other than interviewing e.g. direct physical observation of fields for crop estimates (127).

Population. The complete group of units to which survey results are to apply (134).

Precision of a statistic. It is desirable that a statistic obtained from any single sample from a population is very close to the value of the parameter being estimated. This property of a statistic is referred to as precision, efficiency, or reliability.

Qualitative research. Information obtained through subjective judgments of experts, and through focus groups, in-depth interviews, or case studies

Quantitative research. Information obtained through numeric data such that prevalence and/or magnitude of characteristics under study can be measured (133).

Reliability. The extent to which a survey, if repeated using another (but statistically equivalent) sample and identical questionnaire and procedures, would produce the same results (134).

Risk assessment. Defined as determining the risk associated with a hazard (3).

Salmonellosis. Infestation with bacteria of genus *Salmonella.* Three forms of salmonella infection occur in humans: enteric fever (typhoid fever); septicemia which is usually caused by *Salmonella choleraesuis*; and acute gastroenteritis, which can be caused by a variety of *Salmonella* (130).

Sampling error. The error which arises because the data are collected from a part, rather than the whole, of the population. It is usually measurable from the sample data in the case of probability sampling (134).

Susceptible individuals. Children under the age of five, senior citizens, pregnant women, immunosuppressed individuals (due to cancer, diabetes, liver and/or kidney disease, and/or HIV/AIDS), consumption of antibiotics, excessive iron in blood, possession of certain human antigenic determinants, surgical removal of portions of stomach or intestine, stress, poor personal hygiene (86).

Validity. The degree to which a method of measurement succeeds in measuring what it is intended to measure (134).

Variable. A characteristic that may assume more than one of a set of values to which a numerical measure can be assigned (e.g. income, age, and weight) (134).

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