



REPORT #2

NUTRITION MONITORING IN ONTARIO

A BACKGROUND DOCUMENT

**Prepared for
The Prevention Unit, Division of Preventive Oncology
Cancer Care Ontario**

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November 2001

ACKNOWLEDGEMENTS

I would like to extend my appreciation and thanks to Melody Roberts, Manager and John Garcia, Director of the Prevention Unit, Division of Preventive Oncology, Cancer Care Ontario, for their valuable comments and suggestion on several drafts of this document.

Gratitude is also extended to the following individuals at Cancer Care Ontario for reviewing parts of this document:

Dr. Nancy Kreiger, Director of the Research Unit
Dr. Loraine Marrett, Senior Epidemiologist of the Surveillance Unit and,
Beatrice Boucher, Jennifer Froot and Pierrette Buklis, of the Research, Surveillance and Prevention Units, respectively.

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PREAMBLE

Simply stated, food is essential for life. The fundamental role of nutrition in the maintenance of optimal health is widely accepted in the scientific community and by the general public. The association between diet and disease dates back to 400 B.C. when Hippocrates wrote of the relationship of diet to health. The concept of reducing the risk of disease by diet, however, is relatively new and remains a contentious area of research. The knowledge of the ways by which specific dietary factors affect the risk for disease is incomplete and much remains to be elucidated.

The detection of diseases caused by specific nutrient deficiencies and their subsequent healing by the consumption of foods containing these missing nutrients established the first links between diet and disease. A case in point is the classic study conducted by Lind in 1747, which proved that citrus fruits cure scurvy and inspired the discovery of vitamin C almost two centuries later. Frank vitamin deficiencies and starvation are rare in Western societies today. This is largely a result of improvements in living conditions, an abundant food supply, fortification of foods, better health care, and public education. Protein-energy malnutrition and diseases caused by nutrient deficiencies, such as, beriberi, pellagra, scurvy, rickets, goiter, and xerophthalmia pose a lesser threat in developed countries and, with a few exceptions, have been virtually eliminated in North America. In Canada, nutrient inadequacies such as iron deficiency are still observed in vulnerable groups. Hence, pregnant women, infants, children, the elderly, alcohol and drug abusers, chronically ill and disabled individuals and the homeless are most at risk for nutritional deficiencies and malnutrition.

In Western societies, nutritional deficiencies have been replaced by problems of dietary imbalance and excess, which have contributed to the increased prevalence and burden of chronic diseases. The current public health emphasis on the prevention of major chronic diseases is a direct response to a shift in patterns of morbidity and mortality away from a dominance of acute, infectious diseases to chronic diseases. The major causes of mortality among Canadians are cardiovascular diseases and cancer. The prevalence of two other nutrition-related chronic diseases, namely osteoporosis and type 2 diabetes, is on the rise largely due to an aging population and an increase in the prevalence of obesity, respectively. Scientific evidence linking diet and nutrition to these chronic diseases has advanced and strengthened considerably over the past two decades. Health Canada (1993) estimates the economic burden of unhealthy eating in Canada at \$6.3 billion annually, including direct health care costs of \$1.8 billion.¹ Although it is not possible to quantify most diet-disease relationships at the present time, there is little doubt that diet is implicated in the aetiology of cardiovascular diseases, osteoporosis, type 2 diabetes and some types of cancer. As one of the major modifiable risk factors for chronic disease, nutrition will continue to be at the forefront of public health efforts to improve the health prospects of all Canadians. In fact, the Ontario Ministry of Health and Long-Term Care Mandatory Health Programs and Services Guidelines (1999) outlines specific goals and objectives for the prevention of chronic diseases and for the improvement of the nutritional health of Ontarians.²

BACKGROUND

In Ontario, a number of recent initiatives have focused on strategies to prevent the most prevalent chronic diseases in the province. These include: (1) the Report of the Joint Stroke Strategy Working Group (2000), which outlines a comprehensive strategy for the prevention and control of stroke³; (2) the Report of the Strategic Action Working Group on Osteoporosis entitled "A Framework and Strategy for the Prevention and Management of Osteoporosis" (2000)⁴; (3) the Report of the Chief Medical Officer of Health on diabetes entitled "Diabetes: Strategies for Prevention" (1999)⁵; and, (4) the Report of the Ontario Task Force on the Primary Prevention of Cancer (1995).⁶ Each of these reports identifies nutrition as a key component in the prevention of stroke, osteoporosis, diabetes and cancer, respectively. Fittingly, the Ontario Ministry of Health and Long-Term Care has embarked on a planning exercise to develop a provincial strategy for nutrition, the Ontario Nutrition Strategy.

Cancer Care Ontario has submitted a proposal to the Community Health and Health Promotion Branch of the Ontario Ministry of Health and Long-Term Care to develop a plan for a Nutrition Network for the monitoring, evaluation and intervention development to support the Ontario Nutrition Strategy. The Network

will develop a research agenda in the following four areas: (1) Poor nutrition as a risk factor linked to illness and disease; (2) Intervention development; (3) Monitoring and surveillance; and (4) Evaluative methods. To that end, Cancer Care Ontario has prepared a set of briefs or background documents in these four areas.

This document describes nutrition monitoring and surveillance to support the development of the Ontario Nutrition Strategy in its efforts to prevent chronic diseases and enhance the overall nutritional health of Ontarians.

I. INTRODUCTION

The purpose of this background document is to provide an overview of nutrition surveillance in relation to chronic disease prevention and the improvement of the nutritional health of Ontario residents. Specifically, this document will focus on currently available or soon-to-be available data sources of relevant nutrition-related indicators. A description of the indicators and data sources as well as their strengths and limitations is provided. Gaps in data sources for the development of indicators necessary for monitoring the nutritional health of the population are identified. Finally, a section on future directions addresses some recommendations and next steps for building an effective system.

Neither Canada nor Ontario has a nutrition surveillance system in place at the writing of this paper. There is, however, an interest at the national level to develop a food and nutrition surveillance system for Canada. A 2000 Health Canada report entitled "Food and Nutrition Surveillance in Canada: An Environmental Scan" is an important first step in the planning process for the development of a comprehensive national nutrition surveillance system.¹

II. METHODOLOGY

In preparing this document, a number of recent key provincial strategies with a focus on chronic disease prevention were reviewed. A literature search of scientific publications on surveillance and monitoring in general, and in relation to nutrition in particular, was conducted. Published documents and web sites describing existing and in-development national and provincial surveys and chronic disease registries/databases were reviewed to identify relevant sources of nutrition-related data. Where additional information was required, key individuals and organizations involved in the development or implementation of these surveys were contacted. The selection and description of nutrition-related indicators for inclusion in a nutrition surveillance system draws heavily from previous work in this area at the local, provincial and national levels, namely work done by Toronto Public Health (1998)^{7,8,9}, the Ontario Population Health Indicators Working Group (1998)¹⁰; and the Joint Steering Committee responsible for development of a national nutrition plan for Canada (1996)¹¹, respectively. Finally, the section on Future Directions was developed in consultation with Prevention Unit staff at Cancer Care Ontario.

III. DEFINITION OF TERMS

1. Surveillance and Monitoring

The U.S. Centers for Disease Control and Prevention defines surveillance as "the ongoing, systematic collection, analysis and interpretation of health data essential to the planning, implementation and evaluation of public health practice, closely integrated with the timely dissemination of descriptive information to those who need to know". Surveillance can focus on diseases and/or risk factors as well as the utilization and effects of health services, programs or interventions. A surveillance system includes a functional capacity for data collection, analysis and dissemination linked to health programs and interventions. Spasoff (1999) differentiates between health data, health information and health intelligence, where health data refers to unprocessed numbers of disease or risk factors.¹² When these data are analyzed, they become health

information. When health information is interpreted and its implications identified, it constitutes health intelligence. Therefore, the final link of the surveillance chain is the application of health information to disease prevention and control, and the development of health policy.

The Dictionary of Epidemiology defines monitoring as "(1) the performance and analysis of routine measurements, aimed at detecting changes in the environment or health status of populations and (2) the continuous measurement of the effect of an intervention on the health status of a population or environment".¹³ Despite the differences in the definitions of surveillance and monitoring, these two terms are often used synonymously and interchangeably in practice. To differentiate between these two terms, Spasoff (1999) suggests that it may be helpful to think of monitoring as "looking for something that is expected (whether a desired outcome or a feared adverse effect), and of surveillance as "looking for something unexpected". Others, however, view surveillance as providing the means for monitoring health problems.¹⁴

Objectives of Surveillance^{12,14}

Monitoring trends is the cornerstone objective of most surveillance systems. Therefore, the pivotal role of surveillance is to monitor the occurrence (i.e., incidence) of health problems (diseases and/or risk factors) over time within a specific population. Although evaluation of the effectiveness of public health interventions is complex, trends identified through surveillance can provide an indication of the success of interventions, even though more detailed studies may be required to evaluate programs formally. Surveillance can also provide information on when and where health problems are occurring and who is affected. Therefore, surveillance can be used to describe the demographic characteristics of individuals who are affected by health problems, which in turn allows for the identification of vulnerable groups, i.e., those at highest risk of disease. This information is essential for the design and focus of community health programs as it permits appropriate targeting of interventions. Similarly, by describing where most cases of a disease occur or where disease rates are highest, surveillance provides another means for targeting public health interventions.

Surveillance can also be valuable in health research. By characterizing the basic epidemiology of health problems, according to person, place and time, surveillance data may provide important clues for further investigation of aetiologic hypotheses. Another use of surveillance lies in its ability to provide projections of health problems. Historical trends in disease incidence, combined with other information about the population at risk, can be used to estimate future trends using statistical modeling techniques. This is useful in planning for prevention or slowing the anticipated rise of diseases and risk factors. The ultimate use of surveillance is to influence health policy. As mentioned earlier, timely dissemination of health information to decision makers is critical for action. In an era of evidence-based practice, health data gathered through surveillance, can provide ongoing and timely health information to policy makers for elucidating priorities in research and intervention development.

Components of a Surveillance System

The following steps in planning a surveillance system have been identified¹²:

1. Establish objectives, indicating which diseases or health problems are to be counted.
2. Develop case definitions *or define indicators*.
3. Determine the data sources or data collection methods.
4. Develop the data collection instruments (*if no existing data sources*).
5. Field-test the methods (*if no existing data sources*).
6. Develop and test the analytic approach (*if no existing data sources*).
7. Develop the dissemination mechanism (*e.g., periodic reports, monographs, etc.*)
8. Assure use of the analysis and interpretation.

2. Indicators

It can be argued that no direct measurements of health exist, with the possible exception of self-rated health. An indicator is generally described as a variable used as a proxy for a variable that cannot be measured directly.¹² The Dictionary of Epidemiology defines a health indicator as "a variable, susceptible to direct measurement, that reflects the state of health of persons in a community"¹³.

Nutrition-related Indicators

In 1996, the Joint Steering Committee responsible for development of a national nutrition plan for Canada released a report entitled "Nutrition for Health: An Agenda for Action".¹¹ This report identified thirteen core nutrition-related indicators to be tracked at the national level. These are grouped under the following three headings:

Outcome Indicators: indicators of nutritional status and related health outcomes

- Potential years of life lost due to ischaemic heart disease and stroke
- Prevalence of hypertension
- Incidence of certain site-specific cancers
- Incidence of low birth weight
- Prevalence of overweight and underweight

Determinant Indicators: determinants of nutritional status and related health outcomes.

- Estimated intake of grains, fruits and vegetables
- Estimated intake of fat
- Level of recreational physical activity
- Initiation and duration of breast feeding
- Nutrition awareness / attitudes
- Food bank use
- Cost of a nutritious food basket in relation to income

Process Indicator: tools and supports that are the foundation for actions, which influence nutritional health.

- Existence of a national multisectoral coordinating network.

The key criteria for the selection of the core indicators include a recognition of their importance with regards to nutrition, the availability of data on an ongoing basis, and the feasibility of data collection. These are as follows:

- The indicators will provide useful information for assessment and planning purposes.
- The indicators are well recognized and understood as being related to specific nutrition-related health outcomes and their determinants and therefore, have certain face validity.
- The data needed to calculate the indicators are available and feasible and relatively inexpensive to collect.
- The data are available on an ongoing basis.
- Data are available across regions and/or population strata.
- In general, indicators should be mutually exclusive, i.e., they should not provide duplicate measures.
- Indicators that are deemed to offer significant information potential may be selected even though they are not well known and/or data regarding them are limited.

Two of these, face validity and availability of data on an on-going basis, were key to the selection of indicators by the Joint Steering Committee.

3. Nutritional Health

Nutritional health is influenced by a multitude of interrelated and interdependent factors, none of which singularly contributes to the overall nutritional health of a population. It is thus challenging to capture all dimensions of nutritional health. Nutrition requirements also vary according to the different stages of the life cycle and across gender groups. Characterizing the nutritional health status of a population is, therefore, a complex process. The American Institute of Nutrition defines nutritional state as the "assimilation and utilization of nutrients by the body plus interactions of environmental factors such as those that affect food consumption and food security"¹⁵. Therefore, evaluation of nutritional state requires assessment of food consumption and food insecurity, as well as biochemical, clinical and anthropometric indices of nutritional status.

Nutritional assessment, in turn, is the process used to determine the nutritional health status of individuals or populations. It is defined as the "interpretation of information obtained from dietary, biochemical, anthropometric and clinical studies".¹⁶ Traditional methods used in nutritional assessment thus include dietary methods (e.g., nutrient intakes), laboratory methods (e.g., serum iron), anthropometric methods (e.g., body weight), and clinical methods (e.g., physical examination). Nutritional assessment methods may also extend to the collection of information on variables known to influence the nutritional status of a population, including relevant economic and sociodemographic data, cultural practices, food habits, food beliefs, and food prices.¹⁶

4. Incidence and Prevalence

Incidence rate is defined as the rate at which new cases of a disease occur in a population, i.e., the number of new cases that occur in a defined period of time per population at risk of developing the disease during this period.¹³ Prevalence rate is defined as the number of cases of a disease that are present at, or during, a specified period of time per population at risk of having the disease at, or during, this period of time.¹⁷ Prevalence may be expressed as point prevalence or period prevalence. Point prevalence is the total number of cases of a disease present at a specified moment in time per population at risk of having the disease at this point in time.¹⁷ Period prevalence is the total number of cases of a disease that exist during a specified period of time per population at risk of having the disease or developing the disease during this period of time; thus, period prevalence consists of the point prevalence at the beginning of a specified period of time plus all new cases that occur during that period.¹⁷

5. Potential Years of Life Lost (PYLL)

The PYLL is the ratio for a given period of the total years of life lost before age 75 to the mean population under 75 due to a particular disease or condition. In other words, PYLL is the total number of years of life that were lost before age 75.¹⁰

IV. NUTRITION-RELATED INDICATORS

This section provides an overview of indicators recommended for monitoring the nutritional health of a population and thus, for inclusion in a nutrition surveillance system. A description, rationale for inclusion, limitations, and potential data sources is provided for each indicator. It is noted that the limitations of each indicator largely stem from the derivation of the data source(s). These sources are reviewed in section V.

The selection of indicators described in this paper draws extensively from the works of the Joint Steering Committee (1996)¹¹, the Ontario Population Health Indicators Working Group (1998)¹⁰, Toronto Public Health (1998)^{7,8,9}, Cancer Care Ontario (1999)¹⁸ and the American Institute for Nutrition (1990).¹⁵ In 1996, the Joint Steering Committee responsible for development of a national nutrition plan for Canada released a report entitled "Nutrition for Health: An Agenda for Action", which identified thirteen core nutrition-related indicators to be tracked at the national level (described above)¹¹. The Ontario Population Health Indicators Working Group (1998) defined and operationalized a core set of health indicators, including a number of

nutrition-related indicators, to address objectives outlined in the Ministry of Health and Long-Term Care Mandatory Health Programs and Services Guidelines.¹¹ In 1998, Toronto Public Health in collaboration with the Population Health Branch of the Ontario Ministry of Health and Long-Term Care prepared a working paper on establishing databases for monitoring aspects of the nutritional health of the population at the local and regional levels.^{7,8} An accompanying report on the utilization of nutrition monitoring databases entitled, "Aspects of Nutritional Health in the New City of Toronto, 1998" was produced to illustrate the usefulness of nutrition monitoring databases for describing and tracking the nutritional health of the population.⁹ The Prevention Unit within the Division of Preventive Oncology at Cancer Care Ontario was established in 1999 with the mandate to develop and implement a plan for the primary prevention of cancer for the province of Ontario. To that end, the Prevention Unit developed a Framework for the Primary Prevention of Cancer conceptualized in the form of a program logic model.¹⁸ The program logic model consists of seven components, including a surveillance/monitoring component, which is deemed as an integral part of each component of the model since it provides the tools for tracking prevention efforts and for assessing the success of interventions. Lastly, the American Institute of Nutrition established an ad hoc Expert Panel charged with identifying core indicators to assess the nutritional status of difficult-to-sample populations.¹⁵ The report of this Expert Panel entitled, "Core Indicators of Nutritional State for Difficult-to-Sample Populations", published in 1991, completes the list of documents consulted in developing the list of indicators discussed in this section.¹⁵

In this document, nutrition-related indicators are grouped into two categories: (1) outcome indicators, defined as indicators of health and nutritional status and (2) determinant indicators of health and nutritional status. Health and nutritional status indicators consist of outcome indicators of nutrition and related health conditions. Determinants of health and nutritional status include indicators of personal health practices, individual capacity and coping skills, social and economic environment, physical environment and health services which affect nutritional health. These indicators taken together can provide a picture of the nutritional health of the population.

Outcome Indicators

1. Cardiovascular Diseases

a) **Description:** Incidence of and mortality due to cardiovascular diseases (CVD).

- **Incidence rate:** the rate at which new cases of CVD occur in Ontario, i.e., the number of new cases of CVD that occur in a defined period of time per population at risk of developing CVD during this period.
- **Mortality rate:** the number of deaths due to CVD in a defined period of time per population at risk of dying during this period.
- **PYLL:** potential years of life lost due to CVD in a given year. PYLL, as defined above, is the total number of years of life that were lost before age 75.

These indices can be calculated for all CVD combined as well as broken down by ischaemic heart disease (IHD) and stroke. Each of these measures may be adjusted (or left unadjusted) for age. The process of age-standardization is employed to eliminate the effect of the age structure of the population, thereby permitting comparisons over time or between populations. Therefore, changes or differences in age-standardized rates of CVD incidence and/or mortality are caused by factors other than changes or differences in the age structure of the population. Sex-specific rates can also be reported, especially if there are significant differences in incidence/mortality rates between males and females.

b) **Rationale for Inclusion:** Cardiovascular diseases are the number one cause of death in Canada. The relationship between CVD and diet has been extensively studied, especially in the case of IHD and stroke. The major risk factors for CVD are smoking, hypertension and high blood cholesterol. Two of these, hypertension and high blood cholesterol, have a strong dietary link. Low serum folate, which

contributes to hyperhomocysteinaemia, and high alcohol intake are additional nutrition-related risk factors for CVD. Physical inactivity, obesity and glucose intolerance have also been linked to an increased risk for CVD. These last three risk factors are also directly or indirectly related to diet.

- c) Limitations: Changes in incidence may reflect trends in risk factors or changes in diagnostic or reporting practices. Changes in mortality may reflect trends in risk factors or changes in medical treatments (e.g., new surgical techniques and drugs) or reporting practices. PYLL is an indicator of premature mortality that represents the number of years not lived by an individual from birth to age 75. This indicator places more weight on causes of early death than those causes of death at older ages. The choice of an upper age limit (e.g., 75) can vary according to changes in life expectancy and/or reporting conventions.
- d) Potential Data Sources: Cardiovascular Diseases Surveillance Online, the Berger Monitor and Canadian Health and Stroke Surveillance System. Description and limitation of data sources are found in section V.

2. **Cancer**

- a) Description: Incidence of and mortality due to cancer
 - Incidence rate: the rate at which new cases of cancer occur in Ontario, i.e., the number of new cases of cancer that occur in a defined period of time per population at risk of developing cancer during this period.
 - Mortality rate: the number of deaths resulting from cancer in a defined period of time per population at risk of dying during this period.
 - PYLL: potential years of life lost due to cancer in a given year. PYLL, as defined above, is the total number of years of life that were lost before age 75.

These indices can be calculated for all cancers combined as well as for select site-specific cancers amenable to dietary change. Each of these measures may be adjusted (or left unadjusted) for age. The process of age-standardization is employed to eliminate the effect of the age structure of the population, thereby permitting comparisons over time or between populations. Therefore, changes or differences in age-standardized rates of cancer incidence and/or cancer mortality are caused by factors other than changes or differences in the age structure of the population. Sex-specific rates can also be reported, especially if there are significant differences in incidence/mortality rates between males and females.

- b) Rationale for Inclusion: Cancer is the second leading cause of death among Canadians. Cancer is not a single disease and the causes of most types of cancers are multifactorial. Behavioural, environmental and genetic factors have all been shown to influence the initiation, promotion and/or progression of cancer at different sites. Diet is considered a leading modifiable cause of cancer and it accounts for a large proportion of all fatal cancers. According to Miller (1992), tobacco is responsible for 29% of cancer deaths in Canada, followed by diet, including alcohol (26%) with family history responsible for less than 10% of all cancer deaths.¹⁹ A more recent estimate produced by The Harvard Report on Cancer Prevention (1996) reported adult diet/obesity (30%) and sedentary lifestyle (5%) to account for 35% of all cancer deaths in the U.S., followed by tobacco (30%), with family history accounting for 5% of all cancer deaths.²⁰ The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) published a landmark report in the fall of 1997 entitled "Food, Nutrition and the Prevention of Cancer: a Global Perspective", which provides the most comprehensive review to date of the role of diet and nutrition in the cancer process.²¹ Based on an analysis of more than 4,500 research studies, the WCRF/AICR report summarizes the best currently available advice on actions to take for lowering cancer risk in 14 separate recommendations.
- c) Limitations: Changes in incidence may reflect trends in risk factors or changes in diagnostic or reporting practices. Changes in mortality may reflect trends in risk factors or changes in medical treatments (e.g., new surgical techniques and drugs) or reporting practices. There are also site-specific limitations: for

example, cervical cancer cannot affect women who have had their cervix removed through hysterectomy; however, rates include women who have had hysterectomies in the past because there is no easy way to exclude them from the denominator, particularly at the local level. PYLL is an indicator of premature mortality that represents the number of years not lived by an individual from birth to age 75. This indicator places more weight on causes of early death than those causes of death at older ages. The choice of an upper age limit (e.g., 75) can vary according to changes in life expectancy and/or reporting conventions.

- d) Potential Data Source: Ontario Cancer Registry. Description and limitation of data sources are found in section V.

3. **Type 2 diabetes**

- a) Description: Incidence and/or prevalence of type 2 diabetes. Type 2 diabetes, also referred to as adult-onset diabetes or non-insulin dependent diabetes, occurs when the pancreas produces insulin but the body is unable to use it effectively, or the amount is too small to produce any effect. In contrast, type 1 diabetes is characterized by the body's inability to produce insulin. Whereas type 1 diabetes has an onset in childhood, type 2 diabetes usually occurs in adults over 40 years of age. Approximately 90% of people with diabetes have type 2 diabetes.⁵

- Incidence rate: the rate at which new cases of type 2 diabetes occur in Ontario, i.e., the number of new cases of type 2 diabetes that occur in a defined period of time per population at risk of developing type 2 diabetes during this period.
- Prevalence: the proportion of the Ontario population that has type 2 diabetes at a specific point in time per population at risk of having type 2 diabetes at this point in time (point prevalence). Or, the proportion of the Ontario population that has type 2 diabetes during a specified period of time per population at risk of having type 2 diabetes or developing type 2 diabetes during this period (period prevalence). Note that period prevalence consists of the point prevalence at the beginning of a specified period of time plus all new cases of type 2 diabetes that occur during that period.

Each of these measures may be adjusted (or left unadjusted) for age. The process of age-standardization is employed to eliminate the effect of the age structure of the population, thereby permitting comparisons over time or between populations. Therefore, changes or differences in age-standardized rates of type 2 diabetes incidence are caused by factors other than changes or differences in the age structure of the population. Sex-specific rates can also be reported, especially if there are significant differences in rates between males and females.

Note: mortality due to type 2 diabetes is not selected as an indicator because deaths due to diabetes are notoriously under-reported. More often than not, the immediate cause of death (e.g., myocardial infarction) is reported even though diabetes is the responsible diagnosis for the death.²²

- b) Rationale for Inclusion: Being overweight is the most recognized environmental trigger for type 2 diabetes. Other risk factors, such as physical inactivity and impaired glucose tolerance are intricately tied to body weight and, by extension, nutritional status. Obesity is found among 80% of people with type 2 diabetes.⁵
- c) Limitations: Changes in incidence may reflect trends in risk factors or changes in diagnostic or reporting practices.
- d) Potential Data Source: National Diabetes Surveillance System. Description and limitation of data sources are found in section V.

4. Osteoporosis

- a) Description: Incidence and/or prevalence of osteoporosis; incidence and/or prevalence of fractures (e.g., hip fractures) due to osteoporosis; and, mortality due to osteoporotic fractures. The Working Group on Osteoporosis (2000) defines osteoporosis as a systemic skeletal disease characterized by low bone density and microarchitectural deterioration of bone tissue.⁴ The consequent increase in the bone fragility greatly increases the risk of fractures which represent the major relevant clinical aspects of the disease.
- Incidence rate: the rate at which new cases of osteoporosis occur in Ontario, i.e., the number of new cases of osteoporosis that occur in a defined period of time per population at risk of developing osteoporosis during this period.
 - Prevalence: the proportion of the Ontario population that has osteoporosis at a specific point in time per population at risk of having osteoporosis at this point in time (point prevalence). Or, the proportion of the Ontario population that has osteoporosis during a specified period of time per population at risk of having osteoporosis during this period (period prevalence). Note that period prevalence consists of the point prevalence at the beginning of a specified period of time plus all new cases of osteoporosis that occur during that period.
- b) Rationale for Inclusion:⁴ A healthy diet - adequate in protein, calcium, vitamins A and D, phosphorus, magnesium and minerals throughout life, but especially during adolescence - is essential to a healthy bone mass to prevent the onset of osteoporosis. Similarly, a healthy weight (BMI of at least 20) throughout the life cycle is important to decrease the risk of osteoporosis.
- c) Limitations: Changes in incidence may reflect trends in risk factors or changes in diagnostic or reporting practices. Fractures secondary to osteoporosis may not be accurately coded/captured from hospital separation data.
- d) Potential Data Source: None available at this time for osteoporosis *per se*. However, potential data source for osteoporotic fractures (prevalence and mortality) and osteoporosis diagnosed in a hospital (vs. a clinic) is the Discharge Abstract Database and/or Hospital Morbidity Database managed by the Canadian Institute for Health Information.

5. Body Mass Index (BMI)

- a) Description: Prevalence of overweight and underweight. Calculated as the ratio of one's weight (kg) and the square of his/her height (m²).

The BMI categories, defined by Health and Welfare Canada (1988), are as follows:

- <20.0: indicative of underweight and may be associated with health problems for some people
 - 20.0-25.0: considered a healthy weight range
 - 25.1-27.0: falls in the acceptable range although it may lead to health problems for some people
 - >27.0: indicative of overweight and it is associated with an increasing risk of developing health problems
- Prevalence: generally reported as point prevalence, i.e., the proportion of the Ontario population aged 20-64 that is overweight and underweight at a specific point in time.
- b) Rationale for Inclusion: The BMI is judged the most useful measure of weight status for adults aged 20 to 64 years (excluding athletes and pregnant and breast feeding women). It is also a traditional indicator of nutritional status. Of all the macronutrients, fat intake seems to be of special significance, not only because it is the most energy dense nutrient, but also because fat intake seems to be very poorly regulated. Underweight or overweight is a risk factor for CVD and certain site-specific cancers. A high

BMI is a risk factor for type 2 diabetes and osteoporosis. Being overweight also exacerbates other health conditions, such as hypertension and high blood cholesterol.

- c) Limitations: The BMI is not applicable to adolescents, adults over 65, pregnant or breastfeeding women and athletes. BMI derived from population health survey data is almost always based on self-reported height and weight. It is well established that people tend to underestimate their weight and overestimate their height. Therefore, BMI is generally underestimated. Exact weight may differ from stated weight due to a simple lack of information (e.g., not weighed recently or poorly adjusted scale in the home) or recall and social desirability biases. Studies estimate that obesity would be approximately one and a half times more prevalent if calculations were based on measured data.¹⁰ Note that breast feeding women could not be identified in the Ontario Health Survey and are therefore, included in the indicator derived from this data source.
- d) Potential Data Sources: Ontario Health Survey, National Population Health Survey, CCO Nutrition Survey, Canadian Community Health Survey, Ontario Food Survey and Food Behaviour in Adolescents Survey. Description and limitation of data sources are found in section V.

6. Low Birth Weight

- a) Description: Incidence of low birth weight. Low birth weight (LBW) is defined as birth weight less than 2,500 grams.¹⁰ Number of live births below 2,500 grams relative to all live births in a given year in Ontario.
- Incidence rate: the number of live births in Ontario under 2,500 grams during a specified period of time relative to the number of live births reported during the same time period.

The incidence of LBW should be reported by age of mother since the birth weight is affected by mother's age.

- b) Rationale for Inclusion:⁹ Birth weight is an important indicator of the health status of a population. LBW is thought to be the single most important factor that affects neonatal mortality. It is also a powerful predictor of post-neonatal infant mortality and childhood morbidity. Birth weight is a function of both duration of gestation and intrauterine growth rate. Risk factors for and consequences of LBW caused by intrauterine growth retardation (IUGR) differ from those of LBW caused by prematurity. Nutritional factors are more commonly associated with LBW caused by IUGR. For example, poor maternal nutritional status is one of the major causes of small for gestational age births, but it is not an important determinant of prematurity. Dietary factors associated with LBW include those that influence low maternal pre-pregnancy weight, inadequate gestational weight gain, low caloric intake, and diet of poor nutritional quality during pregnancy. LBW is thus an outcome indicator of maternal nutritional status during pregnancy.
- c) Limitations:¹⁰ From 1993-1995, a truncation error in the birth weights over-estimated the low birth weight rate in Ontario. This error has since been corrected. There is a coding problem with the duration variable for gestational age in the birth data for 1991-1995. The problem is being corrected. Births to women under age 15 are included in the total because the denominator is all live births, not population.
- d) Potential Data Sources: Ontario Live Birth Database and the National Longitudinal Survey of Children and Youth. Description and limitation of data sources are found in the section V.

7. Neural Tube Defects

- a) Description: Incidence of neural tube defects.
- Incidence rate: the number of newborns in Ontario born with a neural tube defect (NTD), such as anencephalus and similar anomalies, spina bifida, or encephalocele, as detected during the first year of life per number of live births and stillbirths during a defined time period.

- b) Rationale for Inclusion: The risk of NTDs, such as spina bifida, is decreased with an increased intake of folate by women one month prior to conception and during the first trimester of pregnancy.¹⁰ Monitoring this birth outcome in Ontario over time would give an indication of the quality of the diet of women who are in their childbearing years. This outcome indicator can be considered a proxy for folate intake in women of childbearing years.
- c) Limitations: The number of fetuses aborted because of a detected neural tube defect is not captured by the Canadian Congenital Anomalies Surveillance System.¹⁰
- d) Potential Data Source: Canadian Congenital Anomalies Surveillance System. Description and limitation of data sources are found in section V.

8. Iron Deficiency Anaemia

- a) Description: Prevalence of iron deficiency anaemia in infants and children. The number of infants and children with iron deficiency anaemia in Ontario in a given year.
- b) Rationale:⁹ Iron deficiency anaemia is suggested for inclusion in the Nutrition Monitoring System as an outcome indicator of infant and child nutritional status. Although iron deficiency anaemia has decreased in Canada over the past 15 years, iron deficiency remains the most significant mineral deficiency among infants and children. It is most common among infants between the ages of 6 and 24 months. Serum iron levels are largely determined by adequate intakes of iron-rich foods and are thus influenced by dietary habits. There is a link between breast feeding and a decreased risk for the development of iron deficiency anaemia in young infants. Exclusive breast feeding during the first 6 months of life is a recommended preventative measure for iron deficiency anaemia.
- c) Limitations: Invasive test. To distinguish between changes resulting from iron deficiency and those arising from infection or inflammation, the test should include measurements of serum ferritin (to detect the first stage of iron deficiency, i.e., depletion of iron storage), transferrin saturation (to detect the second stage of iron deficiency), and the MCV (mean corpuscular volume) index (to detect the third and final stage of iron deficiency characterized by frank microcytic, hypochromic anaemia).¹⁶
- d) Data sources: None available at this time.

Determinant Indicators

1. Fruit and Vegetable Intake

- a) Description: (1) Estimated intake of fruits and vegetables (F+V) and (2) Measured intake of fruits and vegetables.
 - *Estimated intake* of F+V is reported as per capita population mean.
 - *Measured intake* of F+V is reported as number of daily servings for individuals in a given age/sex category.
- b) Rationale for Inclusion: Adequate consumption of fruits and vegetables is protective against CVD and cancer at a variety of sites. A few studies have also suggested that adequate consumption of fruits and vegetables may lower the risk of developing diabetes. The findings of a recent study (2001) point to an inverse association between fruit and vegetable intake and incidence of diabetes, particularly among women, thereby supporting the results of earlier studies.²³ This food group is an important source of a variety of nutrients and non-nutrient compounds involved in health maintenance and disease prevention. These include dietary fibre, antioxidants, phytochemicals, folate, potassium, magnesium and chromium. Magnesium plays an important role in insulin action and the state of hypomagnesaemia is well recognized in individuals with diabetes.²³ It has been shown that hypomagnesaemia may impair insulin

secretion and promote insulin resistance in the diabetic person.²³ A recent study published in the Journal of Nutrition (2000) found that an increased intake of fruits and vegetables (400 grams for 4 weeks) as compared to a lower intake of fruits and vegetables (100 grams for 4 weeks) resulted in significantly higher plasma carotenoids and folate concentrations and lower plasma homocysteine concentrations.²⁴ As mentioned above, hyperhomocysteinaemia, associated with low serum folate, is an independent risk factor for CVD.

The WCRF/AICR report found convincing evidence that an increased intake of vegetables and fruit decreases the risk of cancers of the mouth, pharynx, oesophagus, lung and stomach.²¹ Similarly, the evidence is also convincing for a decrease in risk of colorectal cancer with an increased consumption of vegetables.²¹ Additionally, there is probable evidence that an increased intake of vegetables and fruit decreases the risk of cancers of the larynx, pancreas, breast and bladder.²¹ The evidence that an increased intake of vegetables and fruit decreases the risk of cancers of the ovary, endometrium, cervix and thyroid is categorized as possible.²¹ The relationship between an increased risk of vegetable consumption and a lowered risk of liver, prostate and kidney cancers is also possible.²¹ Please refer to the WCRF/AICR report for definitions of the different levels of evidence (convincing, probable, possible or insufficient).²¹

c) Limitations: applicable to Determinant Indicators 1 through 7.

(1) Estimated intake: Disappearance data is a very gross estimate of what is actually consumed by Canadians because it does not account for many food losses that occur between wholesale and fork level, trimming at retail or during food preparation, cooking losses and plate waste. In addition, beginning in 1990, Statistics Canada has reduced the number of fruit and vegetable products reported due to data unavailability. This may result in an under-counting of consumption for fruits and vegetables. For estimated intake based on Food Expenditure data, it is noted that several factors influence the purchasing habits of consumers.

(2) Measured intake: Dietary intake is very difficult to measure because it is complex and varies greatly on a daily, weekly, and seasonal basis. There are a number of measurement errors and biases that need to be considered and accounted for in the analysis and interpretation of dietary intakes. These vary depending on the type of methodology employed to measure food and nutrient intake (e.g., 24-hour dietary recall, food record methods or food-frequency methods).

d) Potential Data Sources: Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated intake of F+V. The CCO Nutrition Survey, the Food Behaviour in Adolescents Survey, the Canadian Community Health Survey and the Ontario Food Survey for measured intake of F+V. Description and limitation of data sources are found in section V.

2. Grain Product Intake

a) Description: (1) Estimated intake of grain products and (2) Measured intake of grain products.

- *Estimated intake* of grain products is reported as per capita population mean.
- *Measured intake* of grain products is reported as number of daily servings for individuals in a given age/sex category.

b) Rationale for Inclusion:⁹ Grain products are an important source of readily available energy in the form of carbohydrates. They are also good sources of both soluble and insoluble fibre and most B vitamins. While soluble fibre may help to lower blood cholesterol levels and control blood pressure, insoluble fibre helps prevent constipation, diverticulosis, haemorrhoids, and may lower the risk of colorectal cancer.

c) Limitations: see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.

- d) Potential Data Sources: Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated intake of grain products. The Food Behaviour in Adolescents Survey and the Ontario Food Survey for measured intake of grain products. The Canadian Community Health Survey also is a possible data source for measured intake of grain products. Description and limitation of data sources are found in section V.

3. Milk Product Intake

- a) Description: (1) Estimated intake of milk products and (2) Measured intake of milk products.
- *Estimated intake* of milk products is reported as per capita population mean.
 - *Measured intake* of milk products is reported as number of daily servings for individuals in a given age/sex category.
- b) Rationale for Inclusion: Milk products are the best sources of calcium and vitamin D, two nutrients essential for reaching peak bone mass for optimal bone health.
- c) Limitations: see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.
- d) Potential Data Sources: Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated intake of milk products. The Food Behaviour of Adolescents Survey and the Ontario Food Survey for measured intake of milk products. The Canadian Community Health Survey is a possible data source for measured intake of milk products. Description and limitation of data sources are found in section V.

4. Fat Intake - Total and Saturated Fat

- a) Description: (1) Estimated fat intake and (2) Measured fat intake.
- (1) *Estimated fat intake* is reported as per capita population mean.
 - (2) *Measured fat intake* is reported as grams of fat and/or percent of calories from fat for individuals in a given age/sex category.
- b) Rationale for Inclusion: The role of dietary fat in chronic diseases is probably the most researched area in nutrition. The postulated link between dietary fat and obesity, CVD and specific cancers has been investigated for many years. Although researchers still debate the excess role of fat versus that of excess carbohydrate in the aetiology of obesity, the hypothesis connecting the risk of atherosclerosis and IHD with saturated fat and dietary cholesterol has been long established. A diet high in fat has also been linked to an excess risk for certain types of cancers. The WCRF/AICR study found that diets high in total fat possibly increase the risk of cancers of the lung; colon, rectum, breast and prostate.²¹ Diets high in animal/saturated fat possibly increase the risk of lung; colon, rectum, breast, endometrium and prostate cancers.²¹ Diets high in cholesterol possibly increase the risk of lung and pancreatic cancer.²¹ The Nutrition Recommendations for Canadians states that the Canadian diet should include no more than 30% of energy as fat and no more than 10% as saturated fat.²⁵
- c) Limitations: see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.
- c) Potential Data Sources: Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated fat intake. The Canadian Community Health Survey, the Food Behaviour in Adolescents Survey and the Ontario Food Survey for measured fat intake. Description and limitation of data sources are found in section V.

5. **Carbohydrate Intake**

- a) **Description:** (1) Estimated carbohydrate intake and (2) Measured carbohydrate intake.
- *Estimated carbohydrate intake* is reported as per capita population mean.
 - *Measured carbohydrate intake* is reported as grams of carbohydrate and/or percent of calories from carbohydrate for individuals in a given age/sex category.
- b) **Rationale for Inclusion:** Although the negative association of higher intakes of complex carbohydrates with CVD has been documented, it is unclear whether this is due to the higher carbohydrate content or lower fat content of these diets. There is evidence that soluble fibre can reduce blood lipids, including cholesterol. A high fibre intake may also lower the risk of some types of cancers. The Nutrition Recommendations for Canadians states that the Canadian diet should provide 55% of energy as carbohydrate from a variety of sources, with an emphasis on foods rich in complex carbohydrates and fibre.²⁵
- c) **Limitations:** see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.
- d) **Potential Data Sources:** Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated carbohydrate intake. The Food Behaviour in Adolescents Survey and the Ontario Food Survey for measured intake of carbohydrate intake. The Canadian Community Health Survey is a possible data source for measured carbohydrate intake. Description and limitation of data sources are found in section V.

6. **Micronutrient Intakes: calcium, vitamin D and folate**

- a) **Description:** (1) Estimated intakes of calcium, vitamin D and folate and (2) Measured intakes of calcium, vitamin D and folate.
- *Estimated intakes* of calcium, vitamin D and folate are reported as per capita population mean.
 - *Measured intakes* of calcium, vitamin D and folate are reported as grams/micrograms of calcium, vitamin D and folate for individuals in a given age/sex category.
- b) **Rationale for Inclusion:**^{4,9} Adequate intakes of calcium and vitamin D are the single most important dietary contributors to a healthy bone mass, which in turn, decreases the risk for osteoporosis. Adequate folate consumption before conception and during the first trimester of pregnancy is associated with a lower risk of delivering an infant with a neural tube defect. Folate deficiency is also associated with hyperhomocysteinaemia, which is an independent risk factor for CVD.
- c) **Limitations:** see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.
- d) **Potential Data Sources:** Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated intakes of calcium, vitamin D and folate. The Food Behaviour in Adolescents Survey and the Ontario Food Survey for measured intake of calcium, vitamin D and folate. The Canadian Community Health Survey is also a possible data source for measured intakes of calcium, vitamin D and folate. Description and limitation of data sources are found in section V.

7. **Dietary Fibre Intake**

- a) **Description:** (1) Estimated intake of dietary fibre and (2) Measured intake of dietary fibre
- *Estimated intake* of dietary fibre is reported as per capita population mean.

- *Measured intake* of dietary fibre is reported as grams of fibre for individuals in a given age/sex category.
- b) **Rationale for Inclusion:** There is evidence that soluble fibre plays a role in decreasing the risk of CVD by reducing blood lipids, including cholesterol. A high fibre intake may also lower the risk of some types of cancers.
- c) **Limitations:** see limitations for Determinant Indicator 1, Fruit and Vegetable Intake.
- d) **Potential Data Sources:** Food Consumption in Canada Part I and II and the Food Expenditure Survey for estimated intake of fibre. The Food Behaviour in Adolescents Survey and the Ontario Food Survey for measured intake of dietary fibre. The Canadian Community Health Survey also is a possible data source for measured intake of fibre. Description and limitation of data sources are found in section V.

8. **Alcohol Intake**

- a) **Description:** The definition of alcohol use and abuse varies by survey. Therefore, this indicator has not been defined at this time.
- The Population Indicators Working Group in Ontario has defined this indicator as the proportion of current drinkers, aged 20 years of age or older who consume 15 or more alcoholic drinks per week relative to the total population aged 20+ who consumed alcohol in past 12 months (i.e., current drinkers).¹⁰ This definition was chosen to identify groups at high-risk for alcohol-related health problems.
 - The Canadian Community Health Survey includes questions on alcohol use, abuse and dependence in its common content.
- b) **Rationale for Inclusion:** Excessive alcohol intake is associated with an increased risk of CVD and cancer. The WCRF/AICR report found convincing evidence that a high alcohol intake increases the risk for cancers of the mouth, pharynx, larynx, oesophagus and liver, by way of alcoholic liver cirrhosis in that latter case. The evidence is categorized as probable for the relationship between high alcohol intake and colon, rectum and breast cancers, and probable for lung cancer.¹⁴ Excessive alcohol consumption is also associated with compromised nutritional status, such as increasing the risk for B vitamin deficiencies. Heavy drinkers have twice the overall premature death rate of people of the same age and gender in the general population.¹⁰
- c) **Limitations:** If a similar definition to the one described above is adopted, the following limitations should be kept in mind. This indicator is derived from the number of drinks in the past week and does not necessarily reflect what the respondent drinks per week. Additionally, since heavy drinkers are generally more difficult to reach in surveys, the proportion may be underestimated and overall drinking profile skewed. The perception of social approval/disapproval by respondents may affect the responses to survey questions on heavy drinking habits.
- d) **Potential Data Sources:** Ontario Health Survey, National Population Health Survey, the Canadian Community Health Survey, the Food Behaviour in Adolescents Survey and the Ontario Food Survey. Description and limitation of data sources are found in section V.

9. **Physical Activity**

- a) **Description:** The definition of recreational physical activity varies by survey. Therefore, this indicator has not been defined at this time.

- The Ontario Health Survey defined regular physical activity as 12 or more physical activities in the last month (i.e., 3 or more times per week) with each activity lasting more than 15 minutes per session.
 - The CCO Nutrition Survey defined moderate to vigorous physical activity as activity lasting 10 minutes or longer that increases the individual's breathing or makes his/her heartbeat faster.
 - The Canadian Community Health Survey includes questions on physical activities in its common content.
- b) Rationale for Inclusion: Physical activity and nutritional habits are related behaviours. Physical activity is one arm of the energy balance equation; in conjunction with a balanced diet, it enables individuals to achieve and/or maintain a healthy body weight. The role of physical activity in the prevention of disease is now well recognized. Physical activity reduces the risk of premature mortality in general, and of coronary heart disease, hypertension, some cancers and diabetes mellitus, in particular. Studies have shown that vigorous physical activity performed regularly is associated with a lower incidence of IHD.¹⁰ There is evidence that even moderate levels of physical activity will help to reduce the incidence of breast and colon cancers, and perhaps, other cancers as well. Furthermore, physical activity improves mental health and is an important factor for the health of muscles, joints, and bones, and by extension, the prevention of osteoporosis.
- c) Limitations: Physical activity indicators derived from surveys are based on self-reported levels of recreational physical activity. Therefore, consideration should be given to recall and social desirability biases, including the difficulty respondents might have in accurately recalling their activities over the specified time frame. Because the list of activities and the time frame (past month versus past three months) are different in the 1990 and 1996/97 Ontario Health Surveys, comparisons are generally not recommended.¹⁰
- d) Potential Data Sources: Ontario Health Survey, National Population Health Survey, CCO Nutrition Survey, the Physical Activity Monitor, the Food Behaviour in Adolescents Survey, the Ontario Food Survey, and possibly the Canadian Community Health Survey. Description and limitation of data sources are found in section V.

10. Breast Feeding

- a) Description: Initiation and duration of breast feeding.
- *Breast feeding initiation rate* is the percentage of women who started breast feeding their newborn at birth compared to the total number of women with newborns.
 - *Breast feeding duration rate* is the percentage of women who continued breast feeding their newborn for a specified period (usually 4 to 6 months) to the total number of women with newborns.
 - *Prevalence of women breast feeding at 4-6 months postpartum* is the percentage of women who continued breast feeding for 4-6 months among all women who initiated breast feeding (Definition as per Ontario Health Survey).
 - The Canadian Community Health Survey also includes questions on breast feeding in its common content.
- b) Rationale for Inclusion:⁹ Breast feeding is a determinant indicator of infant and child health status. Breast feeding provides optimal nutritional, immunological and emotional benefits for the growth and development of infants. The unique properties of breast milk provide protection against gastrointestinal infections and sudden infant death syndrome during infancy. The Canadian Paediatric Society maintains

that term infants who are exclusively breast fed for the first 6 months of life may not be at risk for iron depletion or for the development of iron deficiency anaemia. During childhood, breastmilk provides protection against lower respiratory infection, otitis media, bacteraemia, meningitis, botulism, urinary tract infection, and necrotising enterocolitis. Studies in the past decade have found significant reductions in childhood cancers, insulin dependent diabetes, allergy, ulcerative colitis, and Crohn's disease in those who were breast fed. Improved cognitive development and fewer learning disabilities have also been associated with breast feeding. Long-term health gains for some breast feeding mothers include protection against breast and ovarian cancers and osteoporosis.

- c) Limitations: If the Ontario Health Survey is used as a data source, note that because of differences in age groups and question, comparison of 1990 and 1996/97 Ontario Health Surveys should be done with caution.
- d) Potential Data Sources: Ontario Health Survey, National Population Health Survey, and the Canadian Community Health Survey. Description and limitation of data sources are found in section V.

11. Food Bank Use

- a) Description: The Canadian Association of Food Banks defines total number of persons served by food banks as the total number of persons who will consume the food and not the total number of clients in attendance at the food bank.
- b) Rationale for Inclusion: Food bank utilization is an indirect indicator of household food insecurity. Food bank use represents inadequate financial resources to buy sufficient food resulting from low income, unemployment, inadequate financial assistance, or other reasons. This limited ability to purchase foods in sufficient quantities and of adequate nutritional quality may lead to poor diets deficient in both energy and essential nutrients. Food insecurity may not only compromise nutritional status, it also imposes emotional stress and social stigma on those affected.
- c) Limitations: This indicator is limited by the myriad of factors influencing food bank utilization. Food bank use is dependent on food availability, food bank hours of operation, types of alternative programs available to address food insecurity, unemployment rate, general welfare assistance rate, and family benefit allowance rate, among other factors. It is noted that food bank use is not an indicator of hunger.
- d) Potential Data Source: Canadian Association of Food Banks. Description and limitation of data sources are found in section V.

12. Cost of a Nutritious Food Basket

- a) Description:
 - Pricing a Nutritious Food Basket provides information on how much it costs to buy a fixed set of nutritious foods. The nutritious food basket is a food costing tool that is a measure of the cost of healthy eating.
 - Health Canada recently revised the NFB as a national template, from which a provincial basket template was developed for local public health units.
- b) Rationale for Inclusion: Cost of a nutritious food basket in relation to income is an indicator of the proportion of total income spent on food and, by extension, the proportion of income remaining to cover other essential living costs, such as rent and clothing. Using this indicator, the affordability of a nutritious food basket can be estimated for families receiving social assistance or earning minimum wage. Therefore, it is another indirect indicator of food insecurity.

- c) Limitations: The nutritious food basket is a very economical basket of foods and costs less than the food costs of average consumers, mainly because expensive food items, such as processed convenience foods, snack foods and foods of little nutritional value, are generally not included in the basket. Food dollars spent away from home are also not considered. Generally speaking, the nutritious food basket tool is based on the assumption that people have the necessary food skills to prepare most meals from scratch. In addition, non-food items that are typically purchased in grocery stores, such as soap, laundry detergent and paper products, are not factored into the cost of the basket. However, such items are basic necessities and contribute significantly to household expenditures.
- d) Potential Data Source: Ontario Boards of Health.

13. Other Indicators of Food Insecurity

- a) Description: Indicators to be defined.

Additional indicators that measure food insecurity (besides food bank use and cost of a nutritious food basket) should be developed and included in the Nutrition Monitoring System. Areas to explore include:

- 1) Income-based measures of poverty, such as the Low-Income Cut-Offs (LICOs) and Low-Income Measures (LIMs) produced by Statistics Canada. LICOs, often referred to as the "poverty line", define low income in relation to average household expenditure patterns and represent dollar values below which households spend 56.2% or more of their gross income on the basic necessities of food, shelter, and clothing.²⁶ LIMs are an estimate of financial hardship and are calculated by making adjustments for family size before family income medians are calculated on both a before-tax and after-tax basis.
 - 2) Income source as an indication of poverty, such as the proportion of households receiving social assistance in the form of welfare, for example. Given that some income support programs in Canada provide only minimal levels of income to recipients, this may provide a good indication of financial hardship.²⁶
 - 3) Indicators of extreme financial hardship, such as homelessness, evictions, arrears, and the termination of household utilities because of unpaid bills.²⁶
- b) Rationale for Inclusion: Canada's Action Plan on Food Security states that food security "exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".²⁶ Simply stated, without food security, one is unable to maintain an adequate nutritional status and, by extension, unable to achieve optimal nutritional status to prevent major chronic diseases.
- c) Potential Data Sources: Statistics Canada, National Population Health Survey, CCO Nutrition Survey, the Ontario Food Survey and the Canadian Community Health Survey. Description and limitation of data sources are found in section V.

14. Knowledge, Attitudes and Beliefs, and Supports and Barriers to Healthy Eating Indicators

- a) Description: Indicators to be defined.

- Indicators that measure Ontarians' knowledge, attitudes and beliefs about healthy eating in general, and the role of nutrition in chronic disease prevention in particular should be developed and included in the Nutrition Monitoring System.
- At this time, there are two data sources that address health and nutrition-related knowledge, attitudes and behaviours (KAB). The definition of indicators that measure KABs must keep in mind the

frequency, availability, timeliness and quality of the data as well as the consistency in the method(s) KABs are measured.

- Questions about supports and barriers to healthy eating are included in the CCO Nutrition Survey.
- b) Rationale for Inclusion: Knowledge, attitudes and beliefs are intermediate steps on the way to behaviour change. Understanding Ontarians' knowledge, attitudes and beliefs about healthy eating, nutrition and chronic disease prevention is important in the design and focus of nutrition interventions.
- c) Potential Data Sources: Tracking Nutrition Trends, The Berger Monitor, CCO Nutrition Survey, the Food Behaviour in Adolescents Survey and the Ontario Food Survey. Description and limitation of data sources are found in section V.

15. Psychosocial Indicators

- a) Description: Indicators to be defined.
- Indicators that measure stages of change.
 - Indicators that measure self-efficacy.
- b) Rationale for Inclusion: Prochaska's stages of change model maintains that changes in health behaviour are not discrete events. Rather, people change as they progress through five iterative stages: precontemplation, contemplation, preparation, action and maintenance. This model has been applied to dietary behaviour change. According to Bandura's social cognitive theory, self-efficacy refers to one's level of confidence to perform behaviour in a variety of situations. Therefore, self-efficacy is also a strong predictor of behaviour.
- c) Potential Data Source: CCO Nutrition Survey, the Canadian Community Health Survey and possibly the Food Behaviour in Adolescents Survey. Description and limitation of data sources are found in section V.

16. Smoking

- a) Description: It is recommended that the definition of this indicator adopt the one used by the Canadian Tobacco Use Monitoring Survey. A recently published paper on assessing the surveillance capability of Canada's national health surveys (2001), identified the Canadian Tobacco Use Monitoring Survey as the only survey capable of generating continuous, uniform time series with monthly intervals.²⁷
- Age- and sex-specific prevalence of smoking in the Ontario population.
- b) Rationale for Inclusion:⁹ Smoking is a major risk factor for CVD and cancer. Although tobacco and nutrition are independent risk factors for chronic disease, they often interact to increase the risk of disease. Furthermore, smoking is linked to food intake and influences nutritional status. Smoking has an adverse effect on antioxidant status independent of dietary intake. Studies have shown an inverse relationship between smoking and serum beta-carotene concentrations and serum ascorbic acid levels. Smoking also lowers serum folate concentrations via its enhancing on erythropoiesis, which in turn increases folate requirements. Folate deficiency and smoking are both associated with high total homocysteine values, an emerging independent risk factor for heart disease. Smokers have significantly lower intakes of beta-carotene and ascorbic acid, resulting from an estimated 60% lower fruit intake than non-smokers.
- c) Potential Data Sources: The Canadian Tobacco Use Monitoring Survey, National Population Health Survey, CCO Nutrition Survey, the Canadian Community Health Survey, the Food Behaviour in Adolescents Survey and the Ontario Food Survey. Description and limitation of data sources are found in section V.

V. DATA SOURCES

The most common sources of data for nutrition-related indicators are population health surveys, chronic disease registries and food sales records. The data sources from which the above-described indicators may be derived are discussed in this section.

1. Food Consumption in Canada Part I and II, Statistics Canada²⁸

- a) Description: Data presented in these publications are compiled from a wide variety of sources, both survey and administrative from within Statistics Canada as well as other provincial and federal government departments, growers' associations and marketing boards. Data are merged by Agriculture & Agri-foods Canada with the Canadian Nutrient File Data. The data are considered of high quality. Data indicate the total amount of basic foods available for consumption by each Canadian annually from retail outlets, food service establishments and in institutions. This is done using a balance sheet approach, that is, determining food supply (production, imports and beginning stocks) and subtracting food use or disposition (exports, ending stocks and, where applicable, seed requirements, manufacturing inputs, livestock feed and waste). To calculate per capita consumption, the result is divided by the Canadian population on June 1.

These publications contain summary information on the Canadian food supply together with general trends in consumption patterns. Various statistical tables containing 15 years of supply-disposition data outline the per capita disappearance of food in the several categories. Part I contains data on dairy products, beverages, eggs, pulses and nuts, sugars and syrups, cereal products, meats and poultry. Part II contains data on citrus fruits, fresh fruits, processed fruits, fresh vegetables, processed vegetables, juices, oils and fats, and fish.

- b) Strengths and Limitations: Ongoing and repeated every year since 1961. Latest year available is 2000. Effective in tracking changes in available food and nutrient supply. Useful in examining general trends in *apparent* consumption patterns over time. However, disappearance data is a very gross estimate of what is actually consumed by Canadians because it does not account for many food losses that occur between wholesale and fork level, trimming at retail or during food preparation, cooking losses and plate waste. In addition, beginning in 1990, Statistics Canada has reduced the number of fruit and vegetable products reported due to data unavailability. This may result in an undercounting of consumption for fruits and vegetables. Regional and local level data may not be available.

2. Family Food Expenditure Survey (FoodEx Survey), Statistics Canada^{7,9,29}

- a) Description: The FoodEx Survey is part of the general Family Expenditure Survey routinely carried out by Statistics Canada. Food data are subsequently processed and analyzed by Agriculture and Agri-food Canada to provide estimated intakes of energy and various nutrients. The survey is conducted in urban and rural areas of all provinces as well as Whitehorse and Yellowknife. The sample is selected from the Labour Force Survey sampling frame. The selection of the sample is comprised of two stages. In stage one, clusters are selected within each city. In stage two, dwellings are selected within the clusters. The sample is drawn for the whole year and then divided into monthly sub-samples to distribute data collection over the entire year.

Food expenditure data are collected in two steps. First, an interviewer asks questions related to food expenditures while away from home the last month as well as information about socio-economic characteristics and general purchasing habits. Next, respondents are asked to maintain a daily record of all food expenditures, excluding those while on a trip overnight or longer, using two one-week diaries. The diaries are used to record the type of packaging (frozen, canned, dried, other), the number of units purchased, the net weight or volume per unit, the total cost of the purchase, and the type of store where the purchase was made (food specialty store, convenience store, supermarket or other). For restaurant purchases, the diaries were used to record the type of meal (breakfast, lunch, dinner, and between-meal food), the number of meals, the total cost, and the type of restaurant (table service, fast food, other). The

questionnaire covers selected socio-economic characteristics (including income), as well as information on the household's purchasing habits and food expenditures while on trips overnight or longer during the previous month.

- b) **Strengths and Limitations:** Ongoing. Family Expenditure Survey is carried out every two years and the FoodEx Survey, every four years. Years available: 1984, 1986, 1990, 1992 & 1996. Data collection for 2001 is underway. The FoodEx Survey is based on food purchase data and thus, reflects the availability of nutrients purchased in each household, rather than estimated individual intake. Although the data are expressed in terms of the per capita purchase, this is derived from the average household purchase divided by the average number of persons per household, rather than the number of persons in each household. Therefore, it actually represents the per capita population mean. Nutrients are expressed as the weight of the food available daily on a per capita basis and not as servings consumed by individuals. This does not allow direct comparisons with recommended daily servings in Canada's Food Guide to Healthy Eating. Although an adjustment factor for waste is applied to allow for losses associated with trimming and cooking, no adjustments are made for table waste or leftovers. This may lead to an overestimation of actual consumption. Results are not generalizable to persons living on Native reserves, families of official representatives of foreign countries living in Canada, members of communal colonies, persons living full-time in institutions and people temporarily living away from their families as these groups are excluded.

3. **Ontario Health Survey (OHS), Ontario Ministry of Health and Long-Term Care**^{7,9,10}

- a) **Description:** The OHS was conducted to provide a "snapshot" of the health of Ontario residents. The 1990 OHS was conducted from January to November 1990 (excluding July). The target population was all Ontario residents of private dwellings. Residents of Native reserves, inmates of institutions, foreign-service personnel, or residents of remote areas were excluded. The OHS used a multistage, stratified, cluster sampling design. Data were collected in two stages. In the first stage, an interviewer administered the questionnaire to a knowledgeable household member. The respondent answered questions on behalf of him/herself and the other members of the household. Once the interview was completed, a copy of a self-administered questionnaire was given to each member of the household, 12 years of age or older. The self-administered questionnaire consisted of the second stage of data collection. The provincial response rate was 87.5% for the interviewer-completed questionnaire and, of those with an interview, 77.2% returned the self-completed questionnaire. All 42 public health units that existed at the time were sampled.

The 1996/97 OHS was conducted from October 1996 to August 1997 in conjunction with the National Population Health Survey (NPHS). The Ontario response rate to the NPHS was 78.8% of households (general survey) with 94.4% of selected individuals subsequently completing the health component. The 1996/97 OHS is comprised of 94.5% of these individuals aged 12 years of age or older who agreed to share their information with the province. The Ontario buy-in was conducted using computer-assisted telephone interviewing with sampling by random digit dialing. All health units were sampled and grouped into 23 health areas. Response rates varied by geographical area. Residents of Native reserves, inmates of institutions, foreign-service personnel, or residents of remote areas were excluded.

- b) **Strengths and Limitations:** The survey design allows results to be generalized to the level of public health units across Ontario. Few OHS questions are answered by proxy. This survey is not ongoing. It was repeated only once in 1996/97 as part of the National Population Health Survey. Results are not generalizable to residents of Native reserves, inmates of institutions, foreign-service personnel, residents of remote areas and children less than 12 years old as these groups were excluded. Because of the complex sampling techniques, both the 1990 OHS and 1996/97 OHS require that sampling weights be used when tabulating data. The 1990 and 1996/97 surveys may not be comparable in some cases because of differences in geographical areas, question wording, and/or skip patterns. Because the 1996/97 OHS was predominantly done by telephone interviewing rather than self-completed as in the 1990 OHS, the non-response percentage is much lower in the 1996/97 OHS. Because an interview is often easier for

people to do than a self-completed questionnaire, the 1996/97 may have more people who are unable to read than the 1990 OHS. Depending upon the question, data may be subject to recall bias, social desirability bias and errors from proxy reporting.

4. National Population Health Survey (NPHS), Statistics Canada^{7,9,30}

- a) Description: The NPHS replaced Canada's Health Promotion Survey, which had two cycles, in 1985 and 1990. The NPHS, first conducted in 1994/95 and repeated in 1996/97, 1998/99 and 2000/01, collects cross-sectional as well as longitudinal data using the Labour Force Survey sampling frame to draw a sample of approximately 22,000 households. The sample is distributed over four quarterly collection periods. In each household, some limited information is collected from all household members and one person, aged 12 years and over, in each household is randomly selected for a more in-depth interview. For cross-sectional purposes, data were collected for a total of 81,000 household residents in all provinces (except people on Native reserves or on Canadian Forces bases) in 1996/97. In 1994/95 the survey interviewed a panel of 17,276 individuals, then returned to interview them a second time in 1996/97. The response rate for these individuals was 96% in 1996/97.

The questionnaires include content related to health status, use of health services, determinants of health, a health index, chronic conditions and activity restrictions. The first three cycles contain data on smoking, alcohol use, physical activity, self-reported height and weight, social support, self-perceived health and food security. Nutrition-related knowledge, attitudes, and beliefs are also sought albeit in an inconsistent manner from cycle to cycle. Socio-demographic information includes age, sex, education, ethnicity, household income and labour force status.

- b) Strengths and Limitations: Ongoing and repeated every two years since 1994/95. Data collection is expected to continue for up to two decades. Optional provincial buy-in content includes diet and nutrition. Nutrition is not part of the core content. However, limited questions on food security are available. Although nutrition-related questions, primarily dealing with knowledge, attitudes and beliefs, are included in the first three cycles, the questions are not consistent from one survey year to the next. No measurement of dietary intake is available. Survey results are generally available 2 years after the completion of the survey. For example, results from the 1998/99 NPHS became available in late 2000.

5. Cancer Care Ontario Nutrition Survey, Cancer Care Ontario³¹

- a) Description: The purpose of this survey is to estimate baseline fruit and vegetable consumption and other relevant data that will serve as a framework for developing and evaluating nutrition-related interventions designed to reduce the risk of cancer in Ontario adults. This survey uses random digit dialing to identify a random sample of Ontario households. Stratified sampling is employed to ensure adequate coverage of each Cancer Care Ontario Region (grouped into six regions). One household member between the ages of 18 and 64 years is surveyed by telephone interview using the Computer Assisted Telephone Interviewing (CATI) system. Questionnaire content includes, fruit and vegetable intake; self-reported weight and height; nutrition-related knowledge, attitudes and beliefs; stages of change and self-efficacy; supports and barriers to healthy eating; food security; self-reported health status; smoking; physical activity; socio-demographic information such as age, sex, income, education, ethnicity and employment status.
- b) Strengths and Limitations: Timely baseline Ontario regional nutrition-related data will be available. Data collection underway since June 2001. Not known if it will be repeated on an ongoing basis. Regions defined according to CCORs and may not be comparable to other Ontario health surveys where regions are defined as health planning regions. Survey results are not generalizable to Ontarians <18 years and >64 years of age.

6. Canadian Community Health Survey (CCHS) and the CCHS Nutrition Survey Statistics Canada^{32, 33}

- a) Description: The purpose of the CCHS is to provide timely cross-sectional estimates of health determinants, health status and health system utilization at national, provincial and sub-provincial levels. Each two-year collection cycle will be comprised of two distinct surveys: a health region-level survey in the first year with a total sample of 130,000 and a provincial-level survey in the second year with a total sample of 30,000. Both computer-assisted personal and telephone interviews are planned. The target population includes household residents in all provinces and territories excluding populations on Indian Reserves, Canadian Forces Bases, and some remote areas. There will be one randomly selected respondent per household. The planned over-sampling of youths will result in a second member of certain households being interviewed. For the first collection cycle only those 12 years of age and over are eligible for selection. However, it is expected that in future cycles child-specific content will be included. Data collection for the first cycle of CCHS began in the fall of 2000 and is expected to be completed by the end of 2000. The tentative date for release of data from this first cycle is spring of 2002. The CCHS is expected to replace the cross-sectional component of NPHS.

Core content relevant to nutrition includes, fruit and vegetable consumption; food security; self-reported height and weight; physical activity; breast feeding; socio-demographic information including age, sex, ethnicity, income, education, labour force status.

The Focus Content Survey in 2004 is planned for nutrition with a tentative date for data collection to begin in January 2004. This nutrition-focus survey proposes to include a range of physical measures, including height, weight and waist circumference, as well as a range of other physical tests and blood work for nutrition-specific biochemical indices.

The objectives of the Nutrition Content Survey³³ are to:

- 1) Estimate the distribution of usual dietary intake in terms of foods, food groups, dietary supplements, nutrients and eating patterns among a representative sample of Canadians at national and provincial levels. Sub populations of particular interest are children, youth, seniors and those living in low-income households.
- 2) Measure selected psycho-social determinants of behaviours in relation to dietary guidelines for chronic disease prevention and nutritional well being.
- 3) Measure the prevalence of household food insecurity among various population groups in Canada.
- 4) Gather some anthropometric measurements for body weight assessment.
- 5) Collect data on selected health conditions and socio-economic and demographic characteristics of respondents.

The sampling plan for the CCHS Nutrition Survey is exploring a primary sample of 30,000 respondents, with a repeated interview for dietary intake for 30% to 40% of this sample for a total of 39,000 to 42,000 dietary interviews. Other sample design issues arise during the data collection phase of the survey. Seasonality will be accounted for by having data collection for a 12-month period, and appropriate sample allocation will be undertaken to gather information for all days of the week.

- b) Strengths and Limitations: Ongoing. Large sample size and availability of provincial and regional estimates. Although the Focus Content Survey in 2004 is planned for nutrition, limited nutrition-related information is part of the core content. Comprehensive nutrition is not part of core content. Funding for the 2004 Focus Content Survey is not secured at this time.

7. **Tracking Nutrition Trends Survey (TNT), National Institute for Nutrition**³⁴

- a) **Description:** The NIN, in partnership with government and industry, commissions TNT, a periodic national cross-sectional survey on the nutrition knowledge, attitudes and behaviours of Canadians. The survey was conducted in 1989, 1994 and 1997. Data are available from all three cycles. The TNT III survey involved interviews with a representative sample of 1,956 Canadians 18 years of age or older in April 1997.
- b) **Strengths and Limitations:** Ongoing and repeated every five years. Provides ongoing information on nutrition and healthy eating knowledge, attitudes and behaviours in Ontario and nationally. No data on dietary intake, nutritional status or health status.

8. **The Canadian Association of Food Banks (CAFB)**^{7,9,35}

- a) **Description:** The CAFB coordinates donations and transportation of food to 615 member food banks, representing 90% of food recipients in all provinces and territories. Each year, since 1997, a survey is sent to its member food banks in January. The survey instrument is a one-page 14-item questionnaire assessing emergency grocery program and meal program use during the month of March. The total number of persons served by food banks is defined as the total number of persons who will consume the food, not the number of clients in attendance at the food bank.
- b) **Strengths and Limitations:** Ongoing since 1997. The results are presented in a report entitled "Hunger Count", which is available for survey years 1997, 1998, 1999 and 2000. Food bank use is problematic for a number of reasons. Although CAFB asked food bank staff to count each person receiving groceries only once regardless of the number of times the client received food during the month, it is likely that some food banks do not have the required tracking systems to enable them to do this. This may lead to double counting. In contrast, the number of people requiring assistance from food banks may also be under-estimated because not all food banks across Canada are members of the CAFB. The nature of data collected and the method of data collection is not uniform across all member agencies. This raises the issue of data quality with respect to accuracy and reliability. Finally, not everyone experiencing food insecurity uses food banks (e.g., accessibility and stigma).

9. **Ontario Cancer Registry (OCR), Cancer Care Ontario**^{7,9,10}

- a) **Description:** The OCR is a computerized database of information on all Ontario residents who have been newly diagnosed with cancer (incidence) or who have died of cancer (mortality). All new cases of cancer are registered, except non-melanoma skin cancer. The OCR utilizes a computerized medical logic ("expert") system that assigns the primary site and histology. The Cancer Act provides a legal mandate for the reporting of cancer, even though it is not a reportable disease in Ontario. The system is passive and relies on predominantly administrative data. The OCR has four major data sources: hospital discharge summaries with cancer diagnoses, pathology reports with any mention of cancer, records from the Regional Cancer Centres or Princess Margaret Hospital, and death certificates with cancer as the underlying cause of death. The OCR has also begun using hospital day surgery reports as well. Since the OCR may receive multiple reports for the same patient, computerized probabilistic record linkage is used to identify duplicates.
- b) **Strengths and Limitations:** The primary data quality issues include consistency in classification and coding, completeness of registration and validity of the data recorded. There are also issues of non-reporting and over-reporting depending on the site. Over-reporting stems mostly from cases that are reported by a hospital separation only, a fraction of which are not confirmed to be cancer. The degree of non-reporting and the extent of over-reporting are available from the Surveillance Unit at Cancer Care Ontario. There is generally a two-year lag period before the data become available. Residence information is less accurate for smaller geographical areas. A validation study done by the OCR suggested that 16% of cancer cases in Ontario have a wrong residence code. Almost all of this miscoding is at the level of town, city or township and with fewer problems at the county level. Rates for urban

areas may be inflated since cases are sometimes attributed to a town or city rather than to the rural area where the person actually lives.

10. Cardiovascular Disease Surveillance Online, Health Canada³⁶

- a) **Description:** Cardiovascular Disease Surveillance Online provides age- and sex-specific mortality data for Canada and provinces.
- b) **Strengths and Limitations:** The data source for mortality is the Vital Statistics Database. In Canadian provinces, the Office of the Registrar General obtains information about mortality from death certificates which are completed by physicians. Causes are those that initiated the sequence of morbid events leading to death. Comorbidity contributes uncertainty to classifying the underlying cause(s) of death. Determining true cause of death may be influenced by the social or legal conditions surrounding the death and by the level of medical investigation. Data analysis should be based on the deceased's geographic place of residence and not where he/she died. Extensive data processing results in data being at least two years old. Variation in data collection procedures over time and/or geography may reduce the validity of time- and/or place-specific comparisons.

11. Canadian Heart and Stroke Surveillance System, Canadian Heart Disease and Surveillance Network³⁷

- a) **Background:** The Canadian Heart Disease and Surveillance Network was formed to develop an expanded system that would include, population health outcomes related to CVD disease (e.g., incidence, prevalence, quality of life and death); risk factors influencing CVD in the population (e.g., physical inactivity, overweight, tobacco smoking); and, intervention for cardiovascular disease that will include prevention (e.g., knowledge of risk factors, smoking cessation), treatment and rehabilitation. The organizations involved are Health Canada; Statistics Canada; the Canadian Institute for Health Information; the Canadian Cardiovascular Society; the Canadian Stroke Society and the Heart and Stroke Foundation of Canada.

The CHSSS is not a database, nor is it a software querying, reporting or analysis tool. It is a working group that utilizes any relevant sources of data or reporting which are currently available. These include the Statistics Canada mortality records, the Canadian Institute of Health Information hospital admissions records, population health surveys and any other large-scale source of heart and stroke related data. The CHSSS is set up to generate products, such as the report entitled "Changing Face of Heart Disease and Stroke in Canada, 2000". Enhancements include any heart and stroke relevant changes, which can be made to existing surveys or other data sources. For instance, a pilot project is currently underway to use administrative data in the Prairie provinces to detect new cases of stroke (and, later, heart disease) for epidemiological purposes. If the pilot is successful, the system will be implemented across Canada and become another of the information sources, which feed into the CHSSS.

- b) **Strengths and Limitations:** Incidence and prevalence data may be available through CHSSS. However, given the nature of the CHSSS, most database-related inquiries are not possible.

12. National Diabetes Surveillance System (NDSS), Health Canada³⁸

- a) **Description:** The NDSS will be used to provide accurate baseline data on rates of new and prevalent cases of diabetes and its serious complications, and to identify high-risk groups/areas. It will also flag indicators and benchmarks of change such as reductions in new cases of diabetes and improvements in quality of care and health outcomes for people with diabetes. The NDSS, which has been in development since 1996 with a broad stakeholder base including governments, non-governmental organizations, national Aboriginal groups, and researchers, will provide a strategic support function for the Canadian Diabetes Strategy.

- b) Strengths and Limitations: The NDSS will develop, facilitate, and coordinate national, provincial, territorial, and Aboriginal diabetes surveillance, beginning with the implementation of a standardized model for core surveillance. This core model will involve the production of a nationally comparative data on diabetes prevalence and incidence, as well as comparisons of mortality, diabetes-associated diseases, and health care utilization rates in the population with diabetes compared to the population without diabetes. Still in the early stages of implementation.

13. Ontario Live Birth Database¹⁰

- a) Description: The Ontario Live Birth database includes records for births to mothers residing in Ontario.
- b) Strengths and Limitations: Because live birth registration is required by law, data are thought to be complete, however the degree of non-reporting is unknown. Although produced on an annual basis, there is generally a two to three year lag period before the database is available. The Office of the Registrar General using the birth registration form completed by parents, collects information on live births. Because the parent registration form is used, data may be subject to some recall bias.

14. National Longitudinal Survey of Children and Youth (NLSCY), Statistics Canada and Human Resources Development Canada³⁹

- a) Description: The NLSCY is designed to follow a representative sample of Canadian children from 0 to 25 years of age, with data collection occurring at two-year intervals. The current sample of NLSCY children is large enough to permit analysis by cohorts, sub-populations and provinces. In 1994, the first year of data collection, the sample included 22,831 children aged 0 to 11. Allows for longitudinal analysis on the prevalence of various biological, social and economic characteristics and risk factors among children and youth, including the environments in which they live, and to support diagnosis of reasons for poor outcomes and predictors for good outcomes. Data on smoking, alcohol and drug use, as well as select health behaviours are collected.
- b) Strengths and Limitations: Ongoing and repeated every two years. Cycles 1 (1994/95), 2 (1996/97) and 3 (1998/99) are completed. Nutrition content is limited.

15. Canadian Tobacco Use Monitoring Survey (CTUMS), Health Canada^{27,40}

- a) Description: The primary objective of CTUMS is to track changes in smoking status and amount smoked, especially for populations most at risk, such as 15-24 year olds. CTUMS conducts monthly computer-assisted telephone interview surveys. The sample design is a special two-phase stratified random sample of telephone numbers. The two-phase design is used to increase representation and capacity for detailed reporting on individuals in the 15-19 and 20-24 age groups. In the first phase, households are selected using random digit dialing (RDD). In the second phase, one or two individuals (or none) are selected, based upon household composition. Oversampling of youth and young adults will result in a sample size of approximately 10,000 per year for the 15-24 age range. In order to ensure that people from all parts of Canada were represented in the sample, each of the 10 provinces was divided into strata or geographic areas. Generally, a Census Metropolitan Area (CMA) stratum and a non-CMA stratum were defined within each province. The exceptions were Prince Edward Island (only one stratum for the entire province), Ontario (a third stratum for Toronto) and Quebec (a third stratum for Montreal). CMAs are areas defined by the census and correspond roughly to cities with populations of 100,000 or more.
- b) Strengths and Limitations: Interim reporting is possible for CTUMS based on survey results for the first and second halves of each calendar year. Analysis of the first wave of surveys, covering February to June 1999, was released in mid-January 2000. Reporting is scheduled for each half calendar year.

16. Canadian Congenital Anomalies Surveillance System (CCASS), Health Canada^{10,41}

- a) Description: The CCASS captures congenital anomalies among stillbirths, live births and hospitalizations in the first year of life using hospitalization data. Data are collected based on location of hospital but are generally analyzed by the residence of the patient. Ontario residents treated outside of the province are excluded. Data by census division are provided to the Ontario Ministry of Health; data by census sub-division are available by contacting the Laboratory Centre for Disease Control directly. The total numbers of live births and stillbirths given by CCASS are different from that of the Ministry of Health. The former captures those in hospital while the latter use Vital Statistics data from the Office of the Registrar General. For consistency within the indicator, the number of live births and stillbirths from CCASS should be used in the denominator.
- b) Strengths and Limitations: Because data are gathered from hospital separations, diagnosis codes may be inaccurate, which may affect the tracking of particular anomalies, such as neural tube defects. The data are not broken down separately for stillbirths and live births except by special request. Since babies with congenital anomalies are often hospitalized more than once in their first year, the CCASS attempts to identify all duplicates using sex, date of birth, province, postal code, geocode, mother's health insurance number (scrambled to protect confidentiality) and medical conditions. Because there are no unique identifiers to ensure positive identification, incomplete records make matching less accurate and result in over-counting the number of cases. As long as the error is kept small, or is equally distributed across the province, this should not bias results. Data are influenced by factors that are unrelated to health status such as availability and accessibility of care, and administrative policies and procedures. This may influence comparisons between areas and over time, particularly for less severe congenital anomalies.

17. The Berger Monitor⁴²

- a) Description: The Berger Monitor is funded by Health Canada and other subscribers and administered by Environics Research Group. Hay Health Care Consulting Group assists in survey topics and question design. The Berger Monitor conducts semi-annual national telephone interviews with a sample of Canadians 15 years and older. Topics include health policy issues, lifestyle and risk factor behaviours, injuries and chronic and acute medical and hospital, pharmacy and medication issues and behaviours, including natural health products and providers, home care and informal care giving, workplace health, illnesses and conditions, and demographic information. Information is collected on the following variables: told by a doctor that you have heart trouble, angina/heart failure; use of health services related to heart trouble, use of natural health products related to heart disease, risk factor data on smoking, knowledge of smoking risks; heart disease related to workplace stress, sexual harassment and violence. The survey consists of a representative sample of the 10 provinces and includes a 2,000 core sample of the 10 provinces, plus 500 additional in Ontario. Additional over-sampling is available as requested by subscribers. The survey is ongoing since winter 1988 and is conducted semi-annually in October and April.
- b) Strengths and Limitations: The Berger Monitor is the largest private database on health issues and behaviours in Canada. Continuing update and tracking of a range of health-related issues and behaviours pertinent to policy and programs of government and public, not-for-profit and private organizations with interests in the health sector. Topics and questions selected in close consultation with subscribers. Strong tracking capability related to disease testing. The answers validated where appropriate with existing data. It is able to respond quickly to emerging issues. In terms of limitation, the typical biases of telephone surveys figure and the sample size does not allow for detailed analyses of small sub groups. Additionally, there is a cost involved for obtaining data.

18. Physical Activity Monitor, Canadian Fitness and Lifestyle Research Institute⁴³

- a) **Description:** The Physical Activity Monitor is part of the Physical Activity Benchmarks Program, which is a joint venture of the Canadian Fitness and Lifestyle Research Institute, Fitness/Active Living Unit of Health Canada, and the Inter-provincial Sport and Recreation Council. It is an annual telephone survey that tracks changes in physical activity patterns, factors influencing participation, and life circumstances in Canada. As such, it tracks outcome indicators of the efforts to increase physical activity among Canadians. Survey partners can purchase customized questions and add sample either nationally or for a particular province or region. The 2000 Physical Activity Monitor is the 7th nation-wide survey on physical activity conducted by the Canadian Fitness and Lifestyle Research Institute - after the 1981 Canada Fitness Survey, the 1988 Campbell Survey on Well-Being in Canada, and the 1995, 1997, 1998, 1999 and 2000 waves of the Physical Activity Monitor. Therefore, to date, five waves of the Physical Activity Monitor have been completed: 1995, 1997, 1998 (focus on communication strategies), 1999 (focus on community sport and recreation), and 2000 (focus on children and school-based programs, results to come). The 1998, 1999 and 2000 waves of the Physical Activity Monitor constitute the first three years of a five-year plan. Future waves will focus on workplace programs (2001) and an assessment of trends to determine progress toward the target of reducing physical inactivity by 10% from 1998 to 2003.

The Physical Activity Monitor survey is a telephone survey conducted by the Institute for Social Research at York University in Toronto using random-digit dialing from telephone exchanges used by households. Data were captured directly during the 25-30 minute interview using the CATI (computer-assisted telephone interview) system. For each selected household, one individual over the age of 18 is selected at random. If that individual is also a parent with children under the age of 18 living at home, he or she answered another physical activity questionnaire for one of the children in the household, also selected at random. The sample size of Physical Activity Monitor surveys conducted to date is approximately 4,000. There are plans to increase this sample size to 4,000 twice a year and include a face-to-face interview component.

- b) **Strengths and Limitations:** Ongoing and repeated every year since 1997. Questions on physical activity are based on the Minnesota Leisure-Time Physical Activity questionnaire. The response rate of the Physical Activity Monitor surveys is around 60% (e.g., 63% in 1997 and 58% in 1998), which is comparable to the 65% generally obtained by telephone surveys. Results of the surveys conducted in 1996, 1997, 1998 and 1999 are available on the Canadian Fitness and Lifestyle Research Institute web site. Although the same question structure was used to determine physical activity levels, the data collection method differed between the seven surveys. Whereas the 1995, 1997, 1998, 1999 and 2000 were telephone interviews, the 1981 and 1988 surveys used self-completed questionnaires. Because of this difference in survey methodology, results from these 7 surveys should be compared with caution.

19. Food Behaviour in Adolescents Survey Health Behaviour and Research Group, University of Waterloo and Dairy Farmers of Ontario⁴⁴

- a) **Description:** the Food Behaviour in Adolescents survey is conducted by researchers at the Health Behaviour Research Group at the University of Waterloo and funded by the Dairy Farmers of Ontario. The purpose of the survey is to examine the food behaviour patterns of Ontario adolescents, especially their consumption of milk and dairy products, fruits and vegetables, and high fat and salty foods. Data collection began in the summer of 2001 and is expected to end in January 2002. Students in grades 6 through 8 from a random selection of schools across Ontario participate in the survey. This is a web-based survey using the 24-hour recall method to capture information on student's eating patterns. Information on nutrition-related knowledge, attitudes and beliefs, smoking, as well as self-reported height and weight will be available. The final report is expected for release in June 2002.
- b) **Strengths and Limitations:** Urban and rural areas in Ontario are represented in the survey. Physical measurements and biochemical indexes are not available due to the web-based nature of the survey.

20. Ontario Food Survey⁴⁵

- Description: the Ontario Food Survey used a stratified multi-stage probability sample of all persons living in Ontario aged 18-74 years from the registered persons database. Individuals living in institutions as well as those on Indian reserves or in a military camp were excluded. A separate sample of women, aged 30-39 years, from low-income enumeration areas was surveyed for a sub-study on food security. Data collection began in the fall of 1997 and completed in the spring of 1998. Trained interviewers conducted face-to-face interviews in the participants' home. Information was obtained via a demographic questionnaire, 24-hour dietary recall (repeated in some individuals), food frequency questionnaire, physical measurements - including height, weight and waist to hip ratio - as well as a unique provincial questionnaire with questions of interest to the investigators (barriers to changing eating habits, physical activity, body weight and food security). Data captured by the 24-hour recall and food frequency questionnaire will be analyzed for nutrients and food groups according to Canada's Food Guide to Healthy Eating. Self-reported information on physical activity, smoking and nutrition-related attitudes and beliefs was also captured. A report on barriers to changing food selection is expected to be published in January 2002. Dietary data is currently being analyzed by Health Canada.
- b) Strengths and Limitations: The survey methodology partially accounted for seasonal variation through collection of data in the fall and spring. A strategy was developed to recruit a sample that was representative of the geographic regions of Ontario, as well as urban and rural areas. Participation rate was quite low-- out of 6, 284 potential subjects identified by the sampling framework, 1,189 individuals took part in the survey (481 male, 708 female) for a 41% response rate. Nutrition-related knowledge and biochemical indices are not available.

VI. DISCUSSION

The cornerstone objective of a nutrition surveillance system is to monitor trends in the nutritional health of the population that will provide relevant and timely information to public health practitioners, program planners and policy makers. At this time, Ontario does not have the necessary data infrastructure - nutrition/health surveys and chronic disease registries/databases - required to develop an effective nutrition surveillance system. On the one hand, data required for the development of a comprehensive set of nutrition-related indicators are lacking. On the other hand, where existing data are available, timeliness and periodicity of the information captured is either lacking or inadequate. Additionally, most nutrition-related indicators are derived from different data sources that employed different methods for collecting data, which occurred at different points in time, making comparisons and linkages between different surveys problematic. Similarly, these shortcomings do not allow for ready pooling of data from these diverse sources. Even within the same data source, the wording or sequence of the questions often changes from one survey cycle to the next that also renders comparisons between survey cycles difficult.

The number of indicators presented in this document is insufficient to adequately characterize the nutritional status of a population. As described above, assessment of nutritional status encompasses dietary methods, laboratory methods, anthropometric methods and clinical methods. With the exception of clinical methods, which consist of physical examination generally conducted when energy and/or nutrient deficiencies are suspected, all other methods of nutritional assessment are necessary to adequately describe the nutritional status of the Ontario population. Dietary methods consist of estimating food and nutrient intakes generally measured by way of a 24-hour recall, food frequency questionnaire, diet history or food records/diaries. There are currently no surveys that are repeated at regular time intervals that can provide this information for Ontario. The only regularly available information on food and nutrient consumption patterns of Ontarians is derived from food disappearance data or food expenditure data. As discussed above, these are but gross estimates of intake that are inadequate for understanding the true nutritional state of the population. Similarly, no ongoing surveys capture physical measures of height, weight, waist and hip circumference, skinfold thickness and other anthropometric indices of nutritional health in a consistent manner. These indicators are important for the calculation of body mass index (BMI) and the waist to hip ratio, both of which are important risk factors for type 2 diabetes, cardiovascular diseases, and some forms of cancer.

The web of causation for chronic disease, even when limited to nutrition-related factors, is complex. A number of biomarkers have been identified as predictors of cardiovascular diseases and cancer, which require further investigation for inclusion in a nutrition monitoring system. Data on biochemical indices of nutritional importance, including blood levels of vitamins (e.g., alpha-tocopherol, beta-carotene) and minerals (e.g., iron) are also lacking at this time. Although there are plans to include both anthropometric measures and blood levels of various nutrients in the Canadian Community Health Survey (CCHS) nutrition focus component scheduled for 2004, these data will be unavailable for many years. More importantly, funding for the 2004 nutrition focus survey of the CCHS is not assured at this time. Information is also lacking on the extent of hunger and food insecurity, including issues of food access, experienced by Ontarians. Indicators that measure the impact and consequences of food insecurity and hunger need to be defined and data sources to capture these data developed. Indicators and data sources on barriers and supports to healthy eating require development as well. Lastly, there is virtually no information on the nutritional status of infants, children or seniors living in Ontario.

Important limitations of currently existing data sources described in this document include, timeliness of data, survey frequency and consistency in methodology in survey cycles, such as how the survey is administered (e.g., telephone vs. face-to-face) and changes in the wording or sequence of the questions.

A recent article by Umphrey et al (2001) evaluated the surveillance capabilities of Canada's national surveys and concluded that only the Canadian Tobacco Use Monitoring Survey had the capability to generate ongoing, uniform time series with monthly intervals.²⁷ The US-based Behavioural Rapid Risk Surveillance System (BRFSS) was used as the comparison. The authors suggest changes to the new Canadian Community Health Survey or instituting a provincial survey based on the BRFSS model in the US. It is recommended that this option be explored for a provincial nutrition survey that could serve as the foundation and provide the data infrastructure for the provincial nutrition surveillance system.

VII. FUTURE DIRECTIONS

This last section outlines a series of suggested next steps, grouped according to short-term, medium-term and long-term objectives, to undertake over the next few months and years to start building a comprehensive and effective nutrition surveillance system for Ontario. It is guided by the concepts outlined in the Primary Prevention Framework developed by CCO as they relate to Surveillance (Appendix A).

1. Short-Term Objectives

a) Establishment of a Nutrition Surveillance System Working Group for Ontario

Establishing a working group that involves stakeholders from a wide range of government, quasi-government private and public health organizations and institutions with an interest in nutrition and/or chronic disease prevention, whether from a programming, health policy or research perspective, is an important and critical first step. This includes involving those organizations and groups that currently manage and/or fund the surveys and databases/registries described in this document as well as those that are involved in nutrition programming and nutrition-related health policy development and analysis.

b) Integration of Ontario Nutrition Strategy

The current analysis is very likely incomplete, and needs to be informed by the specifics of the emerging Ontario Nutrition Strategy. This includes developing a program logic model outlining key inputs (resources), throughputs (activities) and outputs (deliverables), including the capacity building component envisioned for the surveillance system within the strategy. As well, the planning for monitoring the overall objectives of the Ontario Nutrition Strategy need to be incorporated into the Program Logic Model to ensure a continuous feedback mechanism for the Strategy.

c) **Selection of a Core Set of Indicators**

A core set of nutrition-related indicators relevant for chronic disease prevention from those listed in this document should be identified to begin building the system. Most of the indicators reviewed in this paper are available through various data sources identified herein, albeit with some important limitations. Nevertheless, the selection of a set number of key indicators is an important starting point.

2. **Medium-Term Objectives**

a) **Development of Additional Indicators**

This document highlighted important gaps in the number and range of indicators required to adequately describe the nutritional health of the Ontario population in relation to chronic disease prevention. Additional indicators that need to be defined and developed include: (1) indicators of food insecurity and hunger; (2) indicators of nutrition-related knowledge, attitudes and beliefs (KAB); (3) indicators of supports and barriers to healthy eating; (4) psychosocial indicators that measure stages of change and self-efficacy; and, (5) biochemical indices of nutritional importance that have been identified as biomarkers of CVD, cancer and diabetes risk. It is noted that reliable tools for measuring aspects of food insecurity and hunger are available, such as those developed by the U.S. Department of Agriculture. Evaluating and modifying these tools for the Canadian context are worthy steps in defining and developing indicators for measuring food insecurity and hunger in Ontario.

b) **Data Sources for Additional Indicators**

Existing and in-development data sources, including those described in this document, should be evaluated more closely to determine if they are adequate in providing the relevant data necessary for the development of indicators as defined in point 2 a).

3. **Long-Term Objectives**

a) **Development of the Capacity for Nutrition Surveillance in Ontario**

Establishing a comprehensive ongoing nutrition surveillance system for Ontario requires building the capacity of organizations, individuals, as well as intra-organizational systems. This includes examining a number of requirements including human resources, knowledge, technical assistance and support as well as financial resources.¹⁸ For example, survey design, sampling strategy and analysis requires specific technical expertise in nutrition from several fields, including epidemiology, with a focus on chronic disease prevention and population health, as well as behavioural science. More generic expertise is also needed in the area of survey methodology (sampling design and instrument development including reproducibility, calibration and sampling design) as well as biostatistics (analysis). Capturing indicators centrally from already existing data sources and synthesizing the information to be of use for monitoring (including trend analysis) requires support by a junior nutrition researcher or research officer. Underpinning all of the capacity development for nutrition surveillance is the premise of adequate sustained funding. A report outlining the resource requirements, including distinct funding requirements is paramount in the development of ongoing nutrition surveillance for the province.

b) **Development and Implementation of an Ongoing Nutrition Survey for Ontario**

As identified in this document, one of the key limitations for establishing a comprehensive nutrition surveillance system for Ontario at this time, is a lack of periodic surveys that capture all required data elements for the development of a comprehensive set of indicators with timely dissemination of results. In addition to actual (not gross estimates) dietary intakes, data on anthropometric and laboratory indices as well as information on food insecurity/hunger, KAB and psychosocial variables are lacking. A survey that is repeated at regular time intervals using a validated nutritional assessment tool, such as a 24-hour recall or food frequency questionnaire, can provide actual food and nutrient intake information for Ontario. Drawing

on the development experience of implementing continuous surveillance with the Rapid Risk Factor Surveillance Survey initiated within the Durham Health Department and Cancer Care Ontario, and the current Cancer Care Ontario Nutrition Survey is important in planning the overall Surveillance System. Particularly, to develop additional nutrition variables and/or expand the content of the instruments and both should be seen as viable options for consideration.

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