**THE GROWTH AND FEEDING PATTERNS
OF
9 TO 12 MONTH OLD CHINESE CANADIAN INFANTS**

by

CHRISTINA S. SIT

**A thesis submitted in conformity with the requirements
For the degree of Master of Science
Graduate Department of Nutritional Sciences
University of Toronto**

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**Master of Science, 1999
Christina S. Sit
Graduate Department of Nutritional Sciences
University of Toronto**

ABSTRACT

This study, utilizing a cross sectional design, examined the growth and feeding patterns of a sample of Chinese Canadian infants at 9 (n=28), 10 (n=33), 11 (n=35) and 12 (n=34) months of age. These infants achieved heights as described by the National Center for Health Statistics (NCHS) standard. However, they were lower than the NCHS weight and weight for height medians ($p<0.05$). A longer duration of breastfeeding was associated with lighter infants ($p<0.05$). Conversely, longer duration of feeding of formula, other liquids, solid foods in general and specific solid foods (home-prepared carbohydrates, vegetables and fruits) was associated with higher weight and weight for height scores ($p<0.05$). It was concluded that length growth of 9 to 12 month old Chinese Canadian infants achieve NCHS standards and although no explanation for the overall lower body weights of this sample was found, feeding practices contributed to weight variance.

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LIST OF ABBREVIATIONS

Body Mass Index (BMI)

Canadian Paediatric Society (CPS)

Height for Age Z-score (HAZ)

National Center for Health Statistics (NCHS)

National Health and Nutritional Examination Surveys (NHANES)

National Health Examination Surveys (NHES)

U.S. Centers for Disease Control (CDC)

**U.S. Centers for Disease Control Anthropometric Software Package Epi Info 6,
Version 6.02 (Epi6)**

Weight for Age Z-score (WAZ)

Weight for Height Z-score (WHZ)

World Health Organization (WHO)

CHAPTER 1
- INTRODUCTION -

1. Introduction

An infant's failure to achieve the body size represented in international growth standards can be attributed to both environmental factors and genetic makeup. Studies of Asian infants and children report that they do not achieve their potential for growth as measured by international reference standards. However, it is uncertain whether the growth faltering reported in Chinese infants is due to genetic or environmental factors.

The argument that genetic potential accounts for the failure of Asian infants and children to meet international reference standards is based upon studies in Hong Kong, an affluent society with a Chinese majority population. Hong Kong infants start to fall below the standards from four to six months of age (Leung and Davies, 1989). On the assumption that this pattern of growth is genetically determined, and that current international growth standards are inappropriate for the Chinese population, growth curves specific to the Hong Kong population have been developed (Leung, 1989; 1995; Leung and Lui, 1989;1990).

This assumption is not supported by studies of infants born in China's urban centres and of Chinese infants born in western countries. Recent studies have found that infants in certain urban centres of China have also been able to achieve western standards, as measured by the National Center for Health Statistics (NCHS) growth standard. For example, in urban Guangzhou infants were above the NCHS height and weight reference median at four months (He et al., 1996). Similarly, in Chengdu, infants were able to meet NCHS height standards from six months to two years of age (Yang and Leung, 1994).

Chinese infants born in industrialised countries do not show the faltering found in earlier studies in Mainland China or Hong Kong. For example, Chinese infants born in London, although below NCHS standards, were consistently taller and heavier than those children living in Hong Kong (Wheeler and Tan, 1980). A recent study conducted in Toronto on the growth and feeding patterns of four to eight month old Chinese Canadian infants found that they achieved NCHS height standards (Yeung et al., in press). They were able to meet the NCHS weight standards from four to six months and at eight months of age, they were below the standard. Therefore, the objective of this study was to examine the growth and feeding practices of 9 to 12 month old Chinese Canadian infants in Toronto.

CHAPTER 2
- LITERATURE REVIEW -

2. Literature Review

2.1 Introduction

Does growth faltering occur in Chinese infants? If it does, is it due to genetic or environmental factors? Do Chinese infants have the growth potential to meet international standards? The following review of literature examines the issues surrounding these questions. The first section reviews human growth, outlines the pattern of normal growth and addresses the consequences of failing to grow. The next section addresses the measurement of growth and presents arguments on the use of international versus local growth standards. A discussion of the growth of Chinese infants follows. The final section addresses some of the factors involved in the growth of Chinese infants. Issues that will be examined include genetics and growth and the secular change in growth of Chinese infants. There is also a discussion of cultural beliefs related to nutrition, breastfeeding, and solid food introduction.

2.2 Growth

The purpose of growth is to enable a child to reach its full physical and mental potential. Achieved growth is a combination of both genetic and environmental factors. Growth is a continuous process. In studying growth, it is useful to distinguish periods and phases of growth within this continuum. The early phases of a child's life are as follows: prenatal (conception to birth), neonatal (birth to one month), infancy (one month to one year). However, it is important to remember that there is no sharp line that divides the periods. Infancy is the most important stage within the growth continuum. At no other time, including puberty, is the velocity of growth so great (Whitney and Rolfes, 1993). This period is the most critical relative to the lasting effects of serious disease or injury.

Martorell and Habicht (1986) feel that failing to grow during this period cannot be recovered through catch-up growth during more favourable periods. Therefore, failing to grow during this critical period leads to irreparable consequences which last throughout life.

2.2.1 Linear Growth

The first two years of life is when the most dramatic growth spurt occurs (Kaplan, 1987). The length of the normal full term infant is 50.4 cm in males and 49.7 cm in females. During the first year of life, the infant gains 25 to 30 cm. An additional 12 cm is gained in the second year of life. In contrast, during puberty humans grow an average of 9 cm in the year of peak growth (Tanner and Davies, 1985).

2.2.2 Weight at Birth and During Infancy

Immediately after birth, there is a five to ten percent drop in weight due to water loss which is usually regained by the tenth day of life (Zlotkin, 1991). During the first six months of life, weight increases by one to two pounds per month (Kaplan, 1987). By the end of six months, there is usually a doubling of birth weight. After this age, weight gain slows to 100 g per week between six to nine months and 50 g per week between nine to 12 months of age (Zlotkin, 1991).

2.2.3 Growth Failure

Growth failure is defined as deviation from the expected pattern of achieved size (length) for age as observed in an external reference population (Beaton, 1992; Beaton et al., 1990). Growth failure carries severe consequences above and beyond being small. In developing countries, an association between achieved body size and school performance has been observed (McGuire and Austin, 1979). Head circumferences of

malnourished children have been found to be smaller than their nourished counterparts. Malnourished children's performance on intelligence tests are below that of well nourished children. Smaller children also have higher rates of morbidity and mortality (Chen, 1982; Chen et al., 1980; 1981).

However, it is important to realise that the costs of being small may not be the result of smallness itself (Beaton, 1989). Being small does not indicate any functional cost. But the process of becoming small (growth failure) may be an indicator of other environmental problems. Children who experience brain growth retardation in response to nutritional deprivation, are also likely to come from environments that compromise their mental development. Therefore, their functional impairment is a result of the interaction between various environmental constraints, one of which is nutrition. As a result, the permanent effects of nutrition on brain development are difficult to ascertain (Pipes, 1985). What can be said though, is that smallness, due to growth failure can be an effective marker of the environment from which these impairments originate (Beaton, 1992).

2.3 Population Differences in Growth

2.3.1 Environmental Influences

Population differences in growth are the result of a combination of both genetic and environmental factors. Factors influencing infant growth are age specific (Lutter et al., 1990; Martorell, 1989; Martorell and Habicht, 1986). At birth, infant weight and length are determined by maternal factors. During the first four to six months, infant feeding practices, maternal health and ability to take care of the baby are the main influences on growth. From about four to six months through to two years of age, weaning practices and exposure to infectious diseases have a major effect. Other environmental factors

that are significantly associated with growth faltering include a birth order higher than six or seven, lower mean maternal age and weight, children from families in which one or more siblings have died, greater mean number of children less than five years old in the home, birth weight less than 2.4 kg, twin births, death of either parent, broken marriages, socioeconomic status, disease and infections (Autobus, 1971; Morley et al., 1968). Nutrition is among the most important environmental influences on growth. Many of the above factors can be directly or indirectly related to nutrition. Epidemiological data show that the world's population living under low socioeconomic conditions and high rates of parasitic diseases are those that have most of the world's malnutrition.

2.3.2 Genetic Influences on Growth

Genetic factors may predispose an individual or group to have greater sensitivity to some environmental factors that may not affect other children in the same manner (Eveleth, 1986). Birthweight is correlated to race and parental (mainly maternal) characteristics. Ten - 38% of the variation in birthweight can be attributed to heredity (Smith et al., 1976; Zlotkin, 1991). Maternal characteristics that affect birthweight include the constitution of the mother's pelvis, maternal height and maternal nutrition during pregnancy. There is some evidence correlating paternal height to birthweight (Morrison et al., 1991; Wilcox et al., 1995). However, the effect of paternal height is dependent upon maternal height. If the mother is tall, paternal height is able to exert a greater influence. If the mother is short, paternal height has a smaller effect on birthweight. Birth length relates predominantly to maternal factors (Smith et al., 1976).

There is some evidence for a genetic influence on birthweight. Mean birthweight for Caucasians is 3.4 kg with a range of 2.5 to 4.6 kg. Orientals range between 2.9 to 3.2 kg (Magnus et al., 1984). Chinese infants born in the United States were found to be

lighter than Caucasian infants even after socioeconomic background was considered (Yip et al., 1991). However, because dietary intakes were not examined, it is possible that birthweights of the infants were affected by less than optimal but traditional dietary habits of the Chinese mothers. It is also possible that past environmental factors adversely influenced parental size, which in turn constrained infant birthweight.

After birth, individuals start to express their own genetic potential. They grow at a genetically predetermined rate that can be affected by undernutrition, imbalanced nutrient intake or overnutrition. Between birth and two years of age is a critical period of growth. There is a strong correlation ($r=0.8$) between the child's height at two years of age and final adult height.

Most populations have a similar genetic pool with respect to growth. This does not mean that all individuals in a population will be of the same size, but means that the population has a similar mixture of genetic potentials. Thus, although there is individual variation, the population characteristics are similar.

When the environmental constraints of disadvantaged populations are removed, children achieve similar heights and weights as European and North American children. For example, well nourished children from India and the Middle East achieve heights and weights expected of European children (Datta Banik 1982; Eveleth and Tanner, 1976; Vijaya Raghavan et al., 1971).

In contrast, early reports of the body size of Asiatic children showed them to be smaller than Europeans. Socially advantaged children in Tokyo and Hong Kong were below the European averages in height at three or four years (Chang et al., 1965; Tanner et al.,

1982). In Taiwan, they were below the European average at seven years (Eveleth and Tanner, 1976). After one year of age, all are lower in weight. Similarly, Chinese children in Jamaica, Japanese in California and Brazil, and Orientals in San Francisco, California, have been observed to have smaller body size (Ashcroft et al., 1986; Greulich, 1957).

Genetics has been used as the explanation for the smaller body size of Chinese. This assertion is based mainly upon observations made in affluent Hong Kong. Davies and Leung (1985) argue that while environmental influences may explain the growth faltering in children of the 1960's and early 1970's, it cannot explain the current situation as Hong Kong had become an affluent society by the late 1970's. They further commented that the observed differences in anthropometric measures cannot be attributed to inadequate energy intake as Hong Kong children had higher energy intakes than Australian children at fifteen months of age (Hitchcock et al., 1986; Leung and Lui, 1989). As a result, they assert that the smaller size observed in Chinese children is due to genetic limitations.

If the genetic hypothesis is correct, then it must be assumed that Hong Kong infants represent the optimal growth in Chinese infants in a relatively unconstrained environment. If the genetic hypothesis is correct, it can then be reasonably expected that a similar pattern of growth can be expected in other Chinese populations living in unconstrained environments. It will be shown from studies in the west and recent studies of urban Chinese infants, that the genetic hypothesis cannot be verified. It appears that the growth faltering observed in Chinese infants is at least partially associated with environmental issues.

2.4 Assessment of Growth

Growth is assessed by anthropometric techniques. Anthropometry is the science and technique of human body measurements (Bender and Remancus, 1997). To monitor, diagnose or make judgements about growth, whether individual or of the study population, the measurements must be compared to a reference. The results obtained by comparing growth to a reference standard can be used to make judgements about nutritional status. In nutrition surveys there are many benefits to using anthropometric measurements including, a high degree of accuracy, minimal training time for staff and low cost. In addition, the tools are easy to use and transport and can measure both current and past undernutrition. When interpreting the results of anthropometric measurements, age must be taken into account. This is because the causes of growth failure are age specific, and the required interventions often depend on age (Lutter et al., 1990; Martorell, 1989; Martorell and Habicht, 1986).

Four variables are considered in anthropometric assessment (Bender and Remanous, 1997). They are age, weight, length or height and sex. When two of these variables are used together they are called an index. Three indices are commonly used in assessing the nutritional status of children. They are weight for age, length for age and weight for length.

Weight for age is used to determine if a child is overweight or underweight (Bender and Remanous, 1997). Generally when children weigh less than expected for their age, they may be underweight. When they weigh more than expected for their age, they may be overweight. However, it must be remembered that weight for age scores do not take height into account. Children who are taller would be expected to weigh more than other children of the same age and still not be overweight.

Height for age relates a child's height to their age. Interpretation of length varies with the age of the subject (Beaton, 1990). In children under two years of age, a low height for age score may reflect a process of failing to grow. In children older than two years, it may reflect a process of having failed to grow. A child who is not as tall as expected may be stunted. This means that the child may not have grown to his or her full potential. Length for age is considered a measure of the adequacy of past nutrition. A child who is short today may not have been adequately nourished in the past.

Weight for length relates the weight of the individual to his or her height. It helps to identify under or over nutrition regardless of age. Weight for length describes the relative fatness or thinness of the individual in comparison to a standard. It is also a good measure of current nutrition (Beaton, 1990). In the case of a food shortage, low weight for length scores would be expected.

Other concepts that are used in assessing child growth through anthropometric techniques are stunting and wasting. Stunting is the result of a child not growing as well as he or she should have in the past (Bender and Remancus, 1997). It can be caused by chronic undernutrition, that is, not having enough food to encourage growth over a long period of time. A low length for age score may indicate stunting. A child who is stunted may also be underweight. Wasting occurs when a child suffers from acute undernutrition (Bender and Remancus, 1997). A low weight for length might indicate that a child is wasted. A wasted child may also be underweight.

2.5 Reference Standards

The source of the population data used to construct a growth standard is extremely important in order to make accurate diagnoses or judgements. Three criteria must be satisfied in order for anthropometric data to serve as reference data (Waterlow et al., 1977). First, the reference population should be well nourished. Some variability in the degree to which individual requirements are satisfied is acceptable. However, there must not be any significant nutritional deficiencies or excess (Johnston and Ouyang, 1991).

Second, careful sampling procedures must be followed (Waterlow et al., 1977). The sample should be comprised of individuals reflective of the ethnic and socioeconomic levels of the population (Johnston and Ouyang, 1991). Each age/sex group of the sample should contain at least two hundred individuals. This is to ensure that the extreme percentiles, the fifth and the ninety-fifth, can be calculated with confidence. The sample should be cross-sectional and sampling procedures defined and reproducible. Measuring procedures should also be optimal and measurements should include all variables to be used in nutritional evaluation.

Third, the anthropometric data used for reference values should be presented in a usable way (Waterlow et al., 1977). Raw data should be available. The extremes of the distribution must be included in the reference values. The data should be presented using both percentiles and standard distributions, although care must be exercised in skewed distributions. In addition, any techniques used to smooth the data must be described.

2.5.1 International vs. Local Standards

There are several advantages to using a single international reference data set for nutritional evaluation. When assessing a population as a whole, one must use an external reference that is thought to portray unconstrained growth potential (Beaton, 1989; 1992). When comparing between populations, using a single standard is analogous to using a single unit of measurement. For example, when the mean weight of a study population lies two standard deviations below the reference, it means that the mean weight of the study population is smaller than 97.5% of the reference population. In using a single reference standard, the magnitude of the difference between populations becomes immediately apparent. In certain cases, there is also little alternative to using an international reference as many countries are unable to collect and develop a data set that is able to fulfil the criteria set out by Waterlow (1977).

Despite the advantages to using a single international reference and the obstacles to constructing a local reference, the appropriateness of using an international reference in disadvantaged populations has been questioned. It has been suggested that the international standard may be impossible to reach for some populations and using it in such situations unfairly stigmatises those that are disadvantaged. However, it is also recognised that reference data from developing countries cannot be used with confidence due to the high proportion of undernourished individuals that would be included in the sample (Johnson and Ouyang, 1991). Therefore, in countries that are able to derive local data in accordance with Waterlow's guidelines, researchers advocate the use of both international and locally derived references (Johnson and Ouyang, 1991). An international reference population is important in allowing for maximum comparison between populations. Locally derived reference curves may be used for comparison within ethnic groups and countries.

2.5.2 NCHS Reference Curves

In 1978, the World Health Organization, recommended using a single growth reference for assessing individual child growth and for assessing the nutritional status of populations (WHO, 1978). No one single data set was available which fulfilled all the criteria set forth by Waterlow. The set that most closely matched the criteria was the reference developed by The National Center for Health Statistics (NCHS) and Center for Disease Control (CDC) in the United States (National Center for Health Statistics, 1977; Hamill et al., 1979). Since then, this reference, known as the NCHS reference, has been used as the international reference for comparison.

The National Health Examination Surveys (NHES) and National Health and Nutritional Examination Surveys (NHANES) provided the database for the NCHS reference curves (Abraham et al., 1979; Hamill, 1977). The surveys gathered information through direct medical examinations, and clinical tests and measurements. Nutritional status was assessed through anthropometric, dietary, haematological, and biochemical measurements. The sample was taken from the geographically accessible, civilian, non-institutionalised population of the United States. Alaska and Hawaii were included only in the second NHANES survey, conducted between 1976 and 1980. In these surveys, minority groups were sampled at a rate proportional to their density in the population. Therefore, the majority of the participants were of European descent. The major disadvantage of the NCHS data was that it did not include suitable data for children two years and under. Therefore, from birth to age three, the Fels Research Institute's Longitudinal survey of 1929 - 1975 was used to complement the NHES and NHANES data. The sample was composed of 868 white, relatively affluent infants from Southwestern Ohio. There were discrepancies where the two sets of data overlap (Cole,

1985; Dibley et al., 1987). Therefore, when making any judgements about the growth of infants in comparison to the NCHS standard, the sample bias within the standard should be kept in mind.

The validity in using a single reference rests upon the assumption that all populations have a similar genetic growth potential (Habicht et al., 1974). However, even when environmental factors are adequately controlled there are significant, though relatively small differences in stature, and possibly differences in weight between populations (Eveleth, 1986). In these cases, it may be that a locally derived standard is more suitable. For example, it has been suggested that culturally appropriate standards should be used for children of African ancestry (Gam, 1974). Leung et al. (1989; 1995) have developed a reference specific to the Hong Kong population based upon their belief that the differences in size between Hong Kong children and the international population cannot be explained by nutritional factors.

2.6 Growth of Chinese Infants

Despite China's recent economic boom, there is still a high prevalence of malnutrition in China. Among children under five years old, the prevalence of moderate and severe stunting (percentage of children with heights two or three standard deviations below the NCHS reference median) was 35% (Chang et al., 1996; State Statistic Bureau, 1993). The situation is worse in China's poor rural areas where the prevalence of moderate and severe stunting was over 40% (Chang et al., 1994). In addition, the prevalence of such nutritional deficiencies as vitamin D, calcium, iron and zinc is high (Chen et al., 1985; Wong et al., 1986; Yeung, 1988; Zheng, 1985). As a result, due to the environmental constraints in China, in order to determine the genetic growth potential of Chinese infants, it is useful to also examine the growth of Chinese infants world wide. When

Chinese infants born in different locations are studied, it becomes apparent that improved environmental conditions have led to improved growth outcomes for Chinese infants.

2.6.1 Growth of Chinese Infants In China

Growth is considered to mirror conditions in society. Secular changes are seen as indicators of a population's changing nutritional, hygienic and health status. In China, secular changes can be used to measure the impact of economic reforms introduced in 1978 (Shen et al., 1996).

In the last 20 years, the growth and development of Chinese children has greatly improved. Several surveys have documented secular increases in growth in Chinese children. Between 1975 and 1985, there was a general increase in both weight and height of birth to seven year old Chinese children (Zhang et al., 1988). Recent reports show that secular growth in mainland Chinese infants continued into the 1990's (Chang et al., 1996; Shen et al., 1996). Studies also report a decline in the prevalence of malnutrition. Between 1987 and 1991, a substantial improvement in prevalence of underweight children under five occurred. The average decline was 20%. Most of this decline though, was seen in urban children. The national average for stunting in children under five established in 1987 was 32% (de Onis et al., 1993). In a recent study, the urban average was 11.45% (Chang et al., 1996). The recent industrial boom in China has dramatically improved the situation of China's children in urban centres. Recent studies of infants in certain industrial centres of China show that they achieve a pattern of growth that meet NCHS standards.

2.6.2 Growth of Chinese Infants – Urban Centres of China

Chengdu is a city in the Sichuan province where infant growth is able to meet NCHS standards. Yang and Zheng (1989), in a study done between 1987 and 1988 showed that the yearly increments in weight and height of Chengdu infants were similar to those of American infants. Furthermore, when the mean lengths of a recent study were plotted against the NCHS median, it showed that Chengdu infants at from six months to two years of age, were able to meet the standard (Yang and Leung, 1994).

Guangzhou, the capital city of the large southern province of Guangdong is another urban centre where infants compare favourably with NCHS standards. In a cross-sectional study, the mean WAZ, HAZ and WHZ of infants in Guangzhou met the NCHS reference at four months (He et al., 1996).

2.6.3 Growth of Chinese Infants - Hong Kong

The hypothesis that genetics is the major determinant of the smaller size of Chinese infants (birth to two years old) in comparison to Caucasian infants of the same age originated in Hong Kong, an affluent city with a strong western influence. Researchers observed that Hong Kong Chinese infants were smaller than the NCHS reference (Leung and Davies, 1994). From birth, mean length was consistently 0.2 - 0.4 SD below the NCHS reference. The difference from the median was more pronounced in boys than in girls. In the first six months, mean weights were above the NCHS means, but by two years of age were 0.6 SD below (Leung and Davies, 1994). Weight for length scores for both sexes displayed a similar pattern to weight for age scores. The scores started above the median, but after six months they fell below. The researchers felt that the size differences between Hong Kong infants and Caucasian infants could not be

explained by environmental factors. They have provided several arguments in support of this hypothesis.

First, Hong Kong infants were estimated to have an adequate energy intake and a lack of observed nutrient deficiencies (Leung et al., 1988; 1989; Leung and Davies, 1989). Therefore it was felt that nutritional limitations were not the cause of the smaller size of Hong Kong infants.

Second, they suggested that Hong Kong children may have reached their optimum growth potential as no secular increases were observed in two to 18 year old children between 1978 and 1985. Secular trends in growth mirror changing conditions in society. While during this period, no secular increases were observed, there was a tendency for the children to be overweight (Fung et al., 1985; Leung et al., 1987). This indicated that Hong Kong children may have reached optimum nutritional status.

Third, they noted a relationship between the infants' genetic background and growth outcome. Hong Kong parents were both lighter and shorter than Australian parents. Hong Kong infants were both lighter and shorter than Australian infants (Leung and Davies, 1994). A strong correlation was also observed between the height of Hong Kong parents and their offspring (Leung and Lui, 1989). All these factors combined, led to the hypothesis that the smaller size of Chinese infants as compared with Caucasian infants resulted from genetic differences between the populations.

The results of a large scale cross-sectional growth survey conducted in Hong Kong in 1993 contradict this hypothesis (Leung et al., 1996). When the results of the 1993 sample were compared to the 1984 sample and plotted against the NCHS median

values, it was found that growth of Hong Kong infants in 1993 improved from 1984 and measurements were close to the standard (Table 2.1). For example, in the 1984 sample, 12 month old Hong Kong males achieved a length of 74.9 cm. In the 1993 sample, they achieved a length of 75.7 cm, an improvement of 0.8 cm. This represents a significant improvement when the values are compared to the NCHS values. In 1984, Hong Kong infants were only able to achieve the NCHS 33rd percentile. In 1994, the infants were able to achieve the NCHS 44th percentile, an improvement of 11 percentage points. As a result, earlier observations of lack of secular improvements appear to be premature. Further contradicting the genetic hypothesis are studies of Chinese infant growth in urban centres of China and industrialised countries.

Table 2.1 Growth of Hong Kong Infants (1984 and 1993) Compared to the NCHS Reference Median

Age (months)	Length of Hong Kong Males (cm)		Length of NCHS Males (cm)	Length Difference (Hong Kong – NCHS) (cm)	
	1984 ¹	1993 ²		1984 ¹	1993 ²
Birth	--	50.8	50.5	--	+ 0.3
2 months	57.6	58.2	58.1	- 0.5	+ 0.1
4 months	--	63.3	63.7	--	- 0.4
6 month	67.1	67.4	67.8	- 0.7	- 0.4
8 months	--	70.6	71.0	--	- 0.4
10 months	--	73.2	73.6	--	- 0.4
12 months	74.9	75.7	76.1	- 1.2	- 0.4
18 months	--	81.4	82.4	--	- 1.0
24 months	86.3	86.2	86.4	- 0.1	- 0.2

1. Leung and Davies (1994)

2. Leung et al. (1996)

2.6.4 Growth of Chinese Infants – Industrialised Countries

Chinese infants born in industrialised countries also show improved growth. In San Francisco in the 1970's, infants from traditional (adhering to cultural beliefs about feeding practices) Chinese families, had a higher velocity of growth than their American counterparts and Hong Kong Chinese infants for the first four to ten months of age. Following this initial period, there was a deceleration towards the Hong Kong Chinese infant growth curve (Ling et al., 1975). This growth deceleration was dissimilar to both American and Chinese growth patterns but similar to infant growth in underdeveloped countries, indicating that the growth pattern was not likely to have been a genetic effect particular to one race. A decade later, the growth of Chinese infants in London, England was studied (Tan and Wheeler, 1980; Wheeler and Tan, 1983). These families were of higher socioeconomic status than those in the study by Ling et al. (1975) and followed a mixed traditional and western feeding pattern. These children grew at a similar rate to their United Kingdom counterparts for the first two to three years of age and slowed down thereafter. However, they were consistently taller and heavier than those children living in Hong Kong at the time.

The recent growth studies in Hong Kong and China's urban centres refute the genetic hypothesis. Collectively, they indicate that environment and not genetics is the cause for growth faltering seen in Chinese infants. The importance of environment is further emphasised by the differences in growth patterns observed between Chinese infants in industrialised countries and those in Hong Kong and China. Genetics does play a role in growth. However a child's genetically predetermined growth rate can be enhanced or retarded by feeding practices and nutrition. Feeding practices, determined by culture and correct nutrition knowledge, may be a major determinant of infant health even when socioeconomic factors are ruled out.

2.7 Infant Feeding Practices

Care-givers select foods for infants based upon familiarity with foods, knowledge of nutrients and perceptions of satiety, tolerance (digestibility or food allergy), taste (whether the baby will eat the food item), convenience, price, prestige and healthfulness (Lau, 1985). Feeding practices based upon incorrect beliefs or knowledge can create an environment that hinders infant growth despite adequate socioeconomic status.

2.7.1 Cultural Aspects of the Chinese Diet

Cultural beliefs are a set of values inherent in the Chinese population that may affect infant feeding. Within cultures, there are some practices and customs which are beneficial to the health and nutrition of the group, some that are neutral and some which are harmful (Jelliffe, 1968). The Chinese diet is unique and different from the Western diet in many respects. It is deeply rooted in ancient Chinese philosophy, religion and folklore. Traditional preferences and taboos extend particularly to pregnant and post-partum mothers as well as to their young. The Chinese have an unique concept of diet and disease which is sustained even by Chinese outside China (Pearl et al., 1995; Rosenthal and Feldman, 1990; Yeung et al., 1973; Ying 1994). In their new environments, the Chinese adapt their beliefs to new environmental conditions and constraints, one of which is food supply (Holroyd et al., 1995; Hsu-Hage et al., 1995; Lee, 1980; Ludman et al., 1989). Conflicts may arise between traditional health beliefs and the health practices of the new environment, resulting in health effects. Therefore, it is important to first understand the cultural background behind Chinese health practices in order to examine the effects of these beliefs on the health of Chinese Canadians.

In Chinese philosophy, health is a state of bodily equilibrium between the two extremes of hot and cold. When a body falls out of equilibrium and moves towards either of the

extremes, health is impaired. Equilibrium is conceived of as a range of states rather than a fixed point. People are not all born at the same state of equilibrium. At each stage of life, one normally occupies a position somewhere between the extremes of hot and cold.

It is believed that the human body and its organs are subdivided into two categories: Yin (cold) and Yang (hot). These designations are important in determining treatments for a given organ. The balance of Yin and Yang is believed to be necessary for good health and is strongly affected by an individual's state of nourishment. In order to treat disease, it is necessary to determine how the body is unbalanced. Then a food is used, which by its "Yin-ness" or "Yang-ness" equilibrates the imbalance. These foods are called body image foods, foods which are categorised according to the culture's concept of the way the body works. The importance of these classifications lies in the fact that both these foods and illnesses are categorised in this way. Therefore, diet has considerable influence in both health and disease.

2.7.1 Mother/Infant Body Base Dynamics and Traditional Food Concepts

The Chinese culture places great importance on the development of the foetus and mothers follow strict rules on food. The rules exist because it is believed that during pregnancy, women experience changes to their hot/cold status (Tan and Wheeler, 1983). Conception moves the mother from equilibrium into a cold state. Her body base remains cold from the point of conception to the fifth month of gestation. During this time, she is more vulnerable to developing a yang deficiency. As pregnancy progresses, her body migrates into the hot side of the equilibrium. From the sixth to the ninth month of pregnancy, the mother's body base remains hot. At birth, she imparts some of this

hotness to her infant. Therefore at birth, the infant starts life on the hot side of the equilibrium.

Accordingly, foods are consumed at each state to equilibrate the body base (Ling, 1975; Tan and Wheeler, 1983). In early pregnancy, the mother is in a cold state. Therefore substances are taken in order to "fix" the foetus. That is, to secure the infant in the mother's womb in order to prevent miscarriage. From the third to the sixth month of pregnancy, during the transition from cold to hot, more neutral foods are preferred. As the pregnancy progresses, the body moves to the hot state. In the final trimester of pregnancy, hot and catabolic foods are to be avoided. Their intake may lead to an overgrown foetus and thus a difficult labour.

Babies are considered to have a hot body base constitution. In order to neutralise this, babies are given slightly cool to neutral foods (Ling, 1975; Tan and Wheeler). Rice and rice-based products are an integral part of the diet as within the traditional hot/cold classification system, rice is considered to be neutral. Breast milk is traditionally considered neutral. However, its neutrality can be affected by the mother's diet. In contrast, infant formula is considered hot. Its hotness and the infant's hot body base can be neutralised by giving the baby cooling drinks. These preparations are made by boiling water with pearl barley dried chrysanthemum, dried honey suckle flower and sugar cane in combination with Chinese herbs (Lui, 1997). Some mothers consider the womb to have a poisonous quality. Barley water, in addition to its cooling effect, is able to neutralise this poison and is given to some babies.

These traditional tonics may be a practice that hinders the growth of Chinese infants. Guldán (1993) in her study of Chinese infants in Sichuan China, found an association

between poorer growth and tonic consumption. Little is known about the physical effects of these tonics. No clinical trials have been undertaken. It is possible that some of the pharmacological properties of the ingredients, whether singly or as a whole, hinder growth.

2.7.2 Acculturation

Cultural practices, including feeding practices, may change in groups who have emigrated to another country. Acculturation is the term used to describe cultural changes that result from continuous first hand contact between two distinct cultural groups. Two issues determine the mode of acculturation that occurs.

- 1) Is it considered of value to maintain cultural identity and characteristics?
- 2) Is it considered to be of value to create relationships with other groups?

If the answer to the first question is no and to the second yes, then the mode of acculturation is assimilation. The acculturated group relinquishes its own cultural identity and moves into the larger society. If the answer to both questions is yes then the mode of acculturation is integration. The acculturated group maintains some of its cultural integrity in addition to moving into the larger societal framework. If there is no substantial relationship with the larger group, accompanied by maintenance of ethnic identity and traditions, the mode of acculturation is separation. The final mode in which the answer to both questions is no, is marginalisation, in which groups lose both their traditions and the larger society (either by exclusion or withdrawal) (Berry, 1990).

The Chinese Canadian population serves as a good example of integration since Western practices deemed valuable have been adopted while many cultural practices

and philosophies remain intact (Yeung, 1983). Other Chinese populations subjected to Western influences have also acted similarly (Holroyd et al., 1995; Hsu-Hage et al., 1995; Lee, 1980; Ludman et al., 1989). Western influences have changed the feeding patterns of Chinese infants.

2.7.3 Infant Feeding Practices in China

Industrialisation and western influences have changed the feeding patterns of infants in China. Breastfeeding 30 to 40 years ago was universal. However, China is experiencing a rapid decline in the prevalence of breastfeeding. Studies done in the mid 1980's indicate that infant feeding in China is characterised by a low rate of breastfeeding and early solid food introduction (National Coordination Working Group on Breast – Feeding Surveillance, 1987; Shaw, 1984). In certain large urban centres, the rate is much below the national average. In Beijing, a survey done in 1982 revealed that only 22% of the infants in the city and 61.5% in the surrounding areas were breastfed. In contrast, in the 1950's, Beijing had a breastfeeding rate of 81% in the city and 95% in the surrounding areas. Rice soup, fruit juice, cod liver, fish and meat puree are introduced within the first three months of life (Shaw, 1984). From four to six months of age, infants are usually introduced to rice and noodle congee, egg, fish, chopped vegetables and meat. Solid rice, bread, noodles, chopped vegetables and meat are introduced to infants between 9 to 12 months of age.

2.7.4 Infant Feeding Practices in Hong Kong

Infant feeding practices in Hong Kong differ from China. Breastfeeding in Hong Kong has both a much lower incidence and duration than in Mainland China. A study conducted in Shatin, a city within the greater Hong Kong area, found that only 30% of the mothers initiated breastfeeding (Leung et al., 1986). From here, the rate dropped

dramatically. At two months only 8% were still breastfeeding. By four months, the rate dropped to 4% and at six months only 3% were continuing to breastfeed their infants. Solid foods were introduced between four to six months of age (Leung and Davies, 1994). By eight months, the main solids were congee or soft rice together with steamed fish, meat and vegetables.

2.7.5 Infant Feeding Practices of Chinese Canadian Infants

Canadian born Chinese infants have a feeding pattern different from both China and Hong Kong. A recent study in Toronto indicates that the breastfeeding rate among Chinese infants in Toronto is higher than that in China and Hong Kong. In a study by Yeung in 1992, 65.4% of Toronto Chinese mothers surveyed initiated breastfeeding (Yeung, 1993). After initiation though, the incidence of breastfeeding dropped steadily. At the end of the first month, 46.2% continued to breastfeed. By the end of the second, only 36.9% were breastfeeding and by the third 28.5%. At the end of four months, only 24.6% were continuing to breastfeed. Solid foods were not introduced until four months of age in accordance with CPS guidelines (Yeung, 1993). At four months of age, 57.3% were consuming solid foods. The number increased to 88.5% by five months of age and by six months, 100% of the infants were introduced to solid foods. From this sample of infants, there seemed to be a dilution of traditional feeding practices. Only 20% of the infants could be classified as following a traditional feeding pattern. The most common traditional food was glucose tonic, consumed by 17.7% of the infants. Rice congee was the second most common traditional food and was consumed by 6.2%.

2.8 Summary

Past studies indicate that Chinese infants do not achieve their growth potential as measured by the NCHS reference standards. Genetics has been suggested as an explanation for the growth faltering observed (Leung et al., 1989; 1994). However recent studies in industrialised centres of China indicate that some infants demonstrate a growth similar to international reference standards (He et al., 1996; Yang and Leung, 1994)

Environment plays an important role in influencing diet and growth. Chinese infants share a common cultural and genetic heritage. However, due to environmental differences, different growth and feeding patterns emerge.

Canada has a large Chinese subpopulation. Toronto provides a large sample base of first generation Chinese infants where parents are able to make feeding choices based on Western foods and available traditional foods. A better understanding of Chinese Canadian infant feeding patterns is important to public health policies in Canada as it becomes possible to address problems specific to this subpopulation. Whether the growth faltering observed in Chinese infants is due to genetics or environment is important knowledge for physicians and practitioners in Canada as it allows for a correct expectation of health and diagnostic accuracy.

In light of this, a previous study has been conducted on four to six month old Chinese Canadian infants in Toronto. Results indicate that they achieved a size at or above NCHS standards (Yeung, 1993). Weight for age z-scores for four month olds were significantly higher than the fiftieth percentile. Between four to six months, their weight

z-scores decreased down to meet the fiftieth percentile at six months. This trend was observed in both sexes.

In contrast to weight, height for age z-scores remained stable throughout the ages (Yeung, 1993). From four to six months of age, this sample of infants were not significantly different from the NCHS height median. This was also observed in both sexes.

Weight for height scores were also stable, remaining at or slightly above the NCHS fiftieth percentile (Yeung, 1993). The weight for height scores of four month old females were significantly higher than the NCHS median. Four month old males were not significantly different from the median for males. At all other ages, WHZ scores were not significantly different from the median.

Many questions remain unanswered in the previous study. Does the drop in weight continue and then translate into a drop in height? No association was seen between traditional foods such as congee and growth. However, this may be due to the young ages of the infants and traditional foods may play a role when the infant is older. Very little data on Chinese Canadian infants exist beyond six months. Thus, the purpose of this study is to examine the growth and feeding practices of 9 to 12 month old Chinese Canadian infants in Toronto. The data was analysed to determine if growth deviance occurred in this population and if feeding patterns can be associated with growth variance.

CHAPTER 3
- INTRODUCTION TO EXPERIMENTATION -

3. Introduction to Experimentation

3.1 Hypothesis

Infant feeding practices are associated with growth variance between the ages of 9 to 12 months in Chinese Canadian infants.

3.2 Objectives

The overall objective for this study was to obtain data on growth and feeding practices of 9 to 12 month old Chinese Canadian infants in Toronto.

The specific objectives of this project were:

- 1) To provide an anthropometric description (weight and height) for 9 to 12 month old Chinese Canadian infants in Toronto.
- 2) To provide a qualitative description of the feeding patterns of 9 to 12 month old Chinese Canadian infants in Toronto.
- 3) To examine the association between feeding patterns and growth variance of 9 to 12 months old Chinese Canadian infants in Toronto.
- 4) To examine the association between factors such as infant birth weight, infant birth height and parental anthropometrics, education, household income and the achieved size of Chinese Canadian infants in Toronto.

CHAPTER 4
- MATERIALS AND METHODS -

4. Materials and Methods

The study was approved by the Review Committee on the Use of Human Subjects, University of Toronto. The study was a cross sectional examination of the growth and feeding patterns of 9 to 12 month old Chinese Canadian infants in Toronto. Growth was assessed through weight and recumbent height measurements. Feeding patterns were assessed through a questionnaire that recorded diet history and current food frequency consumption.

4.1 Sample

4.1.1 Target Population

The target population was healthy first generation Chinese Canadian infants of 100% Chinese heritage between the ages of 9 to 12 months, from the Metropolitan Toronto area.

Included were 130 male and female infants fulfilling the following criteria:

- Both parents were Chinese
- Full term with gestation age over 36 weeks
- No maternal complications during pregnancy
- No pre-natal complications that could affect growth or development
- Normal delivery without complications that could affect subsequent growth and development
- Birth weight above 2.5 kg

4.1.2 Subject Recruitment

The three paediatric practices that participated in the predecessor to this study (Yeung, 1993), were contacted and were willing to participate in the present study. The three practices that co-operated were in Unionville, Scarborough and North York. In addition, a pre-natal class for Chinese Canadians in North York conducted by York Finch Hospital and the congregation of three Chinese churches (two in Scarborough and one in Toronto) were also contacted and were willing to participate. Every subject was also asked for referrals (see Appendix A for complete addresses of recruitment centres).

One interviewer and one of two assistants conducted all the interviews. Either the interviewer or the assistant made the first contact by the use of a phone list provided by the recruitment centres. An introduction was made and the objectives of the study and the commitment involved (time, type of information needed, and measurements taken) were explained to each potential participant. If verbal consent was obtained, an appointment was scheduled to conduct a home visit. During the visit, the interviewer again explained the objectives of the study, the procedure and the commitment involved. A clinical information form provided written information as to the purpose of the research, the procedure involved, the benefits of the research and the risks and discomforts to the child (see Appendix B and C for copies of the Clinical Information Form). The parents were then asked to sign a consent form allowing the child to participate in the study and acknowledgement that the parent understood the study procedure (see Appendix B and C for copies of the Consent form). If written consent was obtained, the interviewer would administer the questionnaire with the parent(s) and the baby would be weighed and measured. The interviewer and both assistants were trained to ensure standardised and accurate measurement procedures (see Appendix D to F for copies of the questionnaire and for procedures). All interviews were conducted by the author of this thesis.

4.2 Data Collection

4.2.1 Anthropometric Measurement

All body weight measurements were taken using the same scale (Seca Model 289871). The nude body weight was measured 3 times. If a parent objected to the nude weight being taken, the clothing and/or the diaper worn were weighed and subtracted from the total weight,

Recumbent body length was measured 3 times using an infantometer (Frankfort plane, University of Iowa, Iowa, U.S.A.). The interviewer would take the measurements assisted by the assistant.

A source of variation inherent in anthropometric studies is measurement errors. To minimise this source of error, a standardised method of weighing and measuring infants was employed. One scale and one infantometer were used to eliminate the variation involved in using different instruments. Despite these precautions, some error was inevitable. The scale was accurate to 0.05 kg and infantometer to 0.5 cm. The major source of variance in measuring the infants was due to the movement of the infant. The estimated error in this type of measurement by the same person is small, about 0.2 to 0.3 cm for a single height measure (Voss et al., 1990).

4.2.2 Questionnaire

The questionnaire was administered in either English or Chinese (Cantonese or Mandarin), depending upon the parent's preference. The questionnaire was completed in the subject's home and took 30 to 40 minutes to complete (both English and Chinese versions of the questionnaire can be found in Appendix D and E). The interviewer was

able to communicate in English, Cantonese or Mandarin. The interviewer would administer the questionnaire to the parent and either the interviewer or assistant would record the answers.

The questionnaire was divided into three parts and generated two types of data: family background data and dietary data. Part 1 of the questionnaire collected information about the pregnancy, parental age, weight, height, where they emigrated from and length of time that they have been in Canada. Part 2 of the questionnaire collected dietary information and assessed diet history as well as current food frequency consumption. Dietary questions asked included whether a food had ever been fed to the infant, when it was introduced, when it was not fed any more and the frequency it was fed in the last week. Part 2 of the questionnaire also included questions regarding the infant's care and influences on baby's diet. Part 3 of the questionnaire were questions of a more personal nature such as parental education and household income. These were partitioned onto a separate page and given to the parent to complete.

4.3 Statistical Analysis

All data were entered on the U.S. Centers for Disease Control and Prevention (CDC) Anthropometric Software Package Epi Info 6 (Epi6), version 6.04 (Dean, 1994). A questionnaire with entry fields was created using Eped within Epi6 (Appendix G). Checks for errors during data entry were programmed into the questionnaire file using the Check program in Epi6. The data was imported into SAS version 6.12 (SAS Institute, Inc., Carey, NC) for the microcomputer to be analysed. The acceptable level of statistical significance for all tests was $p < 0.05$. Five categories of data were generated: subject profile, growth, feeding patterns, associations of growth and feeding patterns and associations of growth and other factors such as infant birth weight, birth height and

parental anthropometric data. Details of the categories, data generated and statistical tests performed are described below.

4.3.1 Subject Profile

Reports on subject background and profile were generated using the Analysis program within Epi6. The data for these results were derived from Part 1 and Part 3 of the questionnaire which included general information about the baby and the pregnancy, parental and family background (see Appendix D and E).

4.3.2 Growth Data

In order to insure accuracy, weight and recumbent length were each measured three times. An average height and weight was calculated. These anthropometric values were then converted into standard deviation score (Z-scores) by Epi6 using the following formula,

$$\text{z-score} = \frac{(\text{average measured anthropometric value} - \text{median reference value})}{\text{standard deviation of the reference}}$$

The median reference values were derived from the NCHS reference data, as is recommended for international reference use by WHO (WHO, 1979; 1983).

A subject's z-score was calculated using the corresponding age, sex NCHS reference median. For example, the height for age z-score for a female subject ten months of age would be calculated using 71.8 cm as the median reference value. 71.8 cm is the median NCHS height reference value for 10 month old female subjects. Similarly, the

weight for age z-score for a 11 month old male subject would be calculated using 9.9 kg as a reference value.

A z-score transformation of the actual anthropometric values adjusts for the sex and age differences that naturally occur. Males are heavier and taller than females. Younger infants are lighter and shorter than older infants. A z-score transformation adjusts for these differences and allows for comparison between infants for different ages and different sexes.

For each subject, three z-score values were derived: weight, height and weight for height z-scores. These z-score values were then plotted against the NCHS median. Regression analysis was then used to determine the trend lines (lines of best fit). The slopes of the height, weight and weight for height trend lines were tested to determine if they differed from the slope of the NCHS median. The height, weight and weight for height trend lines were also tested for age, sex and age*sex differences.

Mean weight, height and weight for height z-scores at nine, ten, 11 and 12 months were calculated using rounded age. Rounded ages were defined as follows.

Infants between

8.5 months of age – 9.49 months of age = rounded age of 9 months

9.5 months of age – 10.49 months of age = rounded age of 10 months

10.5 months of age – 11.49 months of age = rounded age of 11 months

11.5 months of age – 12.49 months of age = rounded age of 12 months

The mean z-scores for each age was compared across ages using a General Linear Models Procedure (GLM), an Analysis of Variance (ANOVA) for unequal sample sizes. If the infants achieved a similar z-score at each age, indicating that the size of infants in one age group is not bigger or smaller than that of the other age groups, no significant differences would be observed.

The mean height, weight and weight for height z-scores at each age group were compared to the NCHS standard by Student's t-test.

4.3.3 Feeding Practices

Feeding pattern data was obtained from Part 2 of the questionnaire. The patterns of feeding for breast milk, formula, whole cow's milk and two-percent cow's milk were individually described. These were referred to as food items. Because other food items were less frequently fed than the milk items, in order to describe their feeding patterns they were grouped into food categories detailed below.

Mixed Feeding: breast milk and other milks including fortified and unfortified formula and cow's milk.

Other Liquids: liquid items other than milk or water and included sugar tonics, juices and traditional tonics. Sugars and traditional tonics were also analysed as a separate category.

Sugars: traditional sugar tonics found in the diets of Chinese infants and other simple sugar products, including glucose, honey, yellow sugar, rock sugar and sugar cane tonics, candy and soft drinks.

Traditional Tonics: traditional fortifying and cooling drinks found in the Chinese diet. Within the questionnaire, they are referred to as 'bou' and 'cooling'.

Home-Prepared Carbohydrate Foods: rice flour, white root flour, noodles, rice congee, soft rice and rice.

Home-Prepared Meats: egg white, egg yolk, meats such as chicken and beef, fish, liver, intestines and animal blood.

Home-Prepared Vegetables: soybean curd (Tofu) vegetables, legumes and seaweed.

Commercial Baby Food: baby fruit, baby vegetable, baby dessert, baby meat and baby dinner. Within this category baby meat and baby vegetable were also analysed alone.

Fruits: fresh fruits and home-prepared fresh fruit purees.

Solid Foods: infant and adult cereals, home-prepared carbohydrates, meats, vegetables, commercial infant food, fruits, adult soups, breads, cookies, teething biscuits and table foods. Within this category, table foods and snacks were also analysed as subcategories.

Table Foods: foods that have not been specially prepared for infant consumption. They are primarily targeted towards adult consumption.

Snacks: solid foods that are not part of the regular meal. These include bread, cookies, teething biscuits and adult cereals.

From birth to nine, ten, 11 and 12 months, depending upon the age of the infant, descriptions and analysis of feeding practices were based upon diet history and reported feeding practices. Four questions were asked,

- 1) Has your baby ever received (food item)?
- 2) At what age did you start to feed (food item)?
- 3) At what age did you stop to feed (food item)?
- 4) How often did your baby eat (food item) in the last 7 days?
(times per week)

The first question assessed whether the infant had been introduced to the food item. The infant was considered introduced to a food item if it was at any time offered in any quantity to the infant. If the infant had been introduced to the food item, the second question would then be asked to determine the age of introduction to the food item. The age of introduction was the age at which the food item, in any quantity was offered to the infant. The third question was then asked to determine if the infant had ceased to receive the food item and the age at which the infant ceased to receive the food item. The age that an infant ceased to receive was the age at which the food item, in any quantity was not offered to the infant. If the infant was still receiving the food item, the fourth question determined the frequency of consumption in the past week of a food item. This was defined as the number of times that the food item, in any quantity, had been offered to the infant in the past seven days.

The data was compiled using SAS 6.12. General feeding practices were described using the 'Age of Introduction' question on the questionnaire. The graphs for cumulative

age of introduction to a certain food or category of food were also derived from the 'At what age did you start to feed (food item)?' portion of the questionnaire. Current feeding practices are based upon the 'How often did your baby eat (food item) in the last 7 days?' question of the questionnaire. If the frequency of consumption in the past week was greater than '0', then the infant was considered to be currently consuming the food item/category.

4.3.4 Associations of Feeding Practices with Anthropometry

In order to examine the associations between feeding practices and achieved size (weight, height and weight for height), several hypotheses were tested. These were,

- 1) There is a relationship between the introduction at any age of specific food items/categories into the infant diet and achieved size.
- 2) There is a relationship between the current consumption of specific food items/categories and achieved size.
- 3) There is a relationship between the timing of introduction of specific food items/categories into the infant diet and achieved size.

This hypothesis was tested in two parts.

- 3.1) There is a relationship between the age at which specific food items/categories are introduced into the infant diet and achieved size
- 3.2) There was an effect of early vs. later introduction of specific food items/categories on achieved size.
- 4) There is a relationship between the duration of feeding of specific food items/categories and achieved size.
- 5) There is a relationship between the frequency of feeding of specific food items/categories and achieved size.

Hypothesis 1, 2, 3.1, 4 and 5 were tested using a chi – square analysis. Each hypothesis was tested following a similar framework. The variance (spread of the data) surrounding each anthropometric measure (WAZ, HAZ and WHZ) was divided into thirds called tertiles. Those in the first tertile represented those infants with anthropometric measures in the top third of the data and were labelled 'tertile 1'. Infants with anthropometric measures in the middle third of the data represented the second tertile and were labelled 'tertile 2'. Infants with anthropometric measures in the bottom third of the data represented the third tertile and labelled 'tertile 3'. The range of values encompassed by each tertile is described in Table 4.1. Chi – square analysis was used to test for differences in feeding patterns across tertiles.

Table 4.1   **Range of Tertiles**

	Tertile 1	Tertile 2	Tertile 3
HAZ	0.23 – 1.80	-0.19 – 0.22	-2.04 – -0.20
WAZ	-0.21 – 2.30	-0.94 – -0.22	-2.11 – -0.95
WHZ	-0.22 – 1.81	-0.98 – -0.23	- 0.99 – -2.30

4.3.4.1   Relationship Between the Introduction at Any Age of Specific Food Items/Categories Into the Infant Diet and Achieved Size.

A chi – square analysis was used to determine whether some of the variance in the anthropometric data could be explained by the introduction of a food item/category. The anthropometric data was divided into tertiles following the procedure described in 4.3.4. Within each tertile, infants were further divided based on whether or not they were introduced to a food item/category. For example, if the parents answered yes to the question, 'Has your baby ever received (food item)?' was considered to be introduced to

the food item. Chi – square analysis analysed for differences between tertiles with respect to whether the infant had been introduced to the food item/category.

4.3.4.2 Relationship Between Current Consumption of Specific Food Items/Categories and Achieved Size.

A chi – square analysis was used to determine whether some of the variance in the anthropometric data could be explained by a food item's/category's presence in current feeding practices. The anthropometric data was divided into tertiles following the procedure described in 4.3.4. Within each tertile, infants were further divided based upon whether the food item/category was part of the current diet. Current feeding practices were assessed through the use of the 'How often did your baby eat (food item) in the last 7 days?' question. A food item and the corresponding food category was considered to be part of the current diet if a response greater than '0' was entered. Chi –square analysis tested for differences in feeding patterns across tertiles with respect to whether the food item/category was part of the current diet.

4.3.4.3 Relationship Between the Timing of Introduction of Specific Food Items/Categories Into the Infant Diet and Achieved Size.

This question was answered in two parts. The first part tested the effect of the age of introduction and tested the hypothesis that there is a relationship between the age of introduction of specific food item/categories into the infant diet and achieved size. The second part examined the effect of timing of introduction of specific food items/categories by eliminating the effect of those that had not been introduced to the food item/category. It tested the hypothesis that there was an effect of earlier vs. later introduction to a food item/category on achieved size.

4.3.4.3.1 Relationship Between the Age of Introduction To Specific Food Items/Categories Into the Infant Diet and Achieved Size.

A chi – square analysis was used to determine whether some of the variance in the anthropometric data could be explained by whether an infant had been introduced to a food item/category at/by a specific age. The anthropometric data was divided into tertiles following the procedure described in 4.3.1. A separate analysis was performed for each age in the range of ages tested. The range of ages tested was birth to 12 months. The age at which a food item was introduced was assessed by the 'At what age did you first offer (food item)?' question of the questionnaire. The age at which a food category was introduced was determined by examining the age of introduction to a food item of all the food items within the food category. The lowest age of introduction among those food items was used as the age at which the food category was introduced. Within each tertile, infants were further divided based on whether the food item/category was introduced to the diet at/by age the age being tested.

4.3.4.3.2 Effect of Early vs. Later Introduction of Specific Food Items/Categories on Achieved Size.

This analysis examined the effect of early vs. later introduction on achieved size by including only those that had been introduced to the food item/category being examined.

A General Linear Models (GLM) procedure, a one-way ANOVA for unequal group sizes, was used to determine whether earlier introduction to a food item/category had an effect on mean anthropometric data. The range of ages tested in each item or category was obtained by examining the pattern of introduction. For example, the category home-prepared carbohydrates was introduced between three to 12 months of age. Therefore, nine tests were run. The first test was the effect of introducing home-prepared

carbohydrates at less than four months of age (earlier) vs. introduction to home-prepared carbohydrates at or later than four months of age (later). The GLM examined the question in three ways. It first determined if there was an overall effect of earlier vs. later introduction. It then tested if there was an age effect. Lastly, it examined the interaction between earlier vs. later and age.

4.3.4.4 Relationship Between the Duration of Feeding of Specific Food Items/Categories and Achieved Size.

A chi - square analysis was used to determine whether some of the variance surrounding the anthropometric data can be explained by the duration that specific food items/categories were fed. The anthropometric data was divided into tertiles following the procedure described in 4.3.4. Breastfeeding duration was determined by first examining the 'Has your baby ever received breast milk?' question of the questionnaire. If the answer to that question was 'Yes', then the 'At what age did you stop to feed breast milk?' and 'How often did your baby consume breast milk in the last 7 days?' questions of the questionnaire were examined to determine the age of termination of breast milk and current breastfeeding status. As breast milk must be introduced at birth, the age of termination of breast milk was equal to the duration of use of breast milk. If the infant was currently consuming breast milk, then the duration of breastfeeding was equal to the infant's age.

Duration of feeding of a food items a was determined from the 'At what age did you start to feed (food item)?' and 'At what age did you stop to feed (food item)?' questions of the questionnaire. If the food item had been introduced but not terminated, then the duration (in months) that the infant had been introduced to the food item was determined by subtracting from the rounded age of the infant (nine, ten, 11 or 12 months) the age of

introduction to the food item. If the food item had been terminated, then the duration of use of the food item (in months) was determined by subtracting the age of introduction from the age of termination.

The duration of feeding of a food category was determined by examining duration of use of each food item in the category. The longest duration of use among the food items in the food category was used as the duration (in months) that a food category had been used.

Within each tertile, infants were further divided into 'food item/category introduced to the diet for a time period greater than or equal to 'specific length of time being tested' Y/N. Chi – square analysis again tested for differences across tertiles.

4.3.4.5 Relationship Between the Frequency of Feeding of Specific Food Items/Categories and Achieved Size.

A chi – square analysis was used to determine whether some of the variance in the anthropometric data could be explained by the frequency/week that a food item/category was consumed. The anthropometric data was divided into tertiles following the procedure described in 4.3.4. Within each tertile, infants were further divided based on whether or not they were currently consuming the food item/category in the frequency tested. The frequencies tested were, 7 times/week or less and 14 times/week or more. The data for this analysis was derived from the 'How often did the baby eat (food item) in the last 7 days?' question of the questionnaire.

4.3.5 Associations of Factors Other Than Feeding Patterns on Anthropometry

Regression analysis was used to test the hypothesis that other factors, namely infant birth weight, infant birth height and parental anthropometrics had an effect on achieved infant size. A GLM procedure was used to determine the effects of parental education and household income on achieved size.

CHAPTER 5
- RESULTS -

5. Results

5.1 Subject Background

The study population was recruited between June 1996 and April 1997. 63 females and 67 males were recruited. All infants were required to provide a birth weight in order to determine eligibility. However, length at birth information was only available for 99 out of the 130 infants (51 females and 48 males). At birth, males were both significantly ($p<0.01$) taller and heavier than females (Table 5.1).

Tables 5.2 to 5.5 provide information on the baby's parents. All infants had both a mother and a father in the household. For questions of a personal nature, parents were permitted not to answer any questions that they did not feel comfortable answering. Therefore, there were discrepancies between the number of parents and the number of answers.

67.7% of the infants had at least one parent from Hong Kong and on average, had lived in Canada for less than 10 years (Table 5.2). The socioeconomic background of the study families approximated the general Canadian population but had considerably more years in school (Table 5.4 and Table 5.5). According to Statistics Canada (1998), the average family income in 1995 was \$54 583 and the average number of years of education in 1996 was 12.3 years. In this sample, 54.5% of the families had an annual family income greater than \$55 000 and the average number of years in school was 17.5 years for the mothers and 17.4 years for the fathers.

In this sample, the mothers and the doctor were the most influential regarding the decisions made on the infants' diets (Table 5.6). The parents were considered to be

most important in terms of providing care for the infant (Table 5.7). Others, including the grandparents and nannies were only considered somewhat important and for the most part, considered not important.

Table 5.1   **Subject Profile**

	Female (n=63)	Male (n=67)	Total (n=130)
Age (months)			
9	17	11	28
10	14	20	34
11	17	16	33
12	15	20	35
Birth Weight (kg)	3.13±0.32 a [*]	3.35±0.38 b	Average 3.24±0.37 ab
Birth Length (cm)	50.05±1.57 a (n=51)	51.18±1.69 b (n=48)	50.60±1.72 ab (n=99)

Results are means ± SD.

*Means with different letters in the same row denote significant difference from each other (p<0.01).

Table 5.2 Profile of Parental Birthplace and Number of Years in Canada

Birthplace	Mother (n=130)	Father (n=130)
Canada	1.5%	3.1%
China	18.5%	14.6%
Hong Kong	58.5%	67.7%
India	0.8%	0.8%
Macau	4.6%	4.6%
Madagascar	0%	0.8%
Malaysia	3.8%	3.1%
Philippines	2.3%	0%
Singapore	1.5%	0%
Taiwan	3.1%	1.5%
Vietnam	5.4%	3.8%
Average number of years in Canada	8.5±5.9 (n=127)	9.1±6.4 (n=122)

Average numbers of years in Canada are expressed as means ± SD.

Table 5.3 Profile of Parental Anthropometric Data

	Mother	Father
Age (years)	33.5±7.4 (n=122)	35.5±3.9 (n=122)
Height (cm)	156.3±20.1 (n=130)	177.5±134.1 (n=130)
Weight (kg)	53.0±6.8 (n=130)	67.4±8.2 (n=124)

Results are means ± SD.

Table 5.4 Profile of Family Income

Family Income (per annum)	Percentage (n=88)
Lower than \$15 000	2.3%
\$15 000 - \$25 000	3.4%
\$25 000 - \$35 000	12.5%
\$35 000 - \$45 000	13.6%
\$45 000 - \$55 000	13.6%
\$55 000 - \$65 000	15.9%
\$65 000 - \$75 000	17.0%
Greater than \$75 000	21.6%

Table 5.5 Profile of Parental Education

	Mother (n=101)	Father (n=100)
Lower than Grade 6	1.0%	2.0%
Grade 6 (Primary School)	2.0%	1.0%
Grade 9 (Form 3)	2.0%	1.0%
Grade 11 (Form5)	3.0%	7.0%
Grade 12/13 (Matriculation)	20.8%	17.0%
College/University	71.3%	72.0%
Average Years in School	17.5	17.4

Table 5.6 Profile of Influences on Decisions Regarding Infants' Diets

Influence	Most Important	Some Importance	No Importance
Mother	96.2%	3.8%	0%
Father	12.3%	46.9%	40.8%
Maternal Grandmother	14%	20.9%	65.1%
Maternal Grandfather	0.8%	10.8%	88.5%
Paternal Grandmother	6.2%	20.8%	73.1%
Paternal Grandfather	1.5%	8.5%	90.0%
Doctor	43.1%	50%	6.9%
Literature	16.2%	13.1%	70.8%
Friends	0.8%	16.9%	82.3%
Nanny	4.6%	6.9%	88.5%
Other	1.6%	3.1%	95.3%

Table 5.7 Profile of Role of Caregivers

Caregiver	Most Important	Some Importance	No Importance
Mother	96.9%	3.1%	0%
Father	37.7%	55.4%	6.9%
Maternal Grandmother	15.4%	16.9%	67.7%
Maternal Grandfather	3.1%	11.5%	85.4%
Paternal Grandmother	10.0%	13.8%	76.2%
Paternal Grandfather	3.5%	7.7%	89.2%
Infant's Older Siblings	0%	10.0%	90.0%
Daycare	0.8%	2.3%	96.9%
Nanny	22.3%	11.5%	66.2%
Other	0.8%	1.6%	97.7%

5.2 Growth

The mean height and weight values by age are described in Table 5.8. The HAZ, WAZ, and WHZ trend lines were determined by regression analysis. No male and female differences across age were seen, therefore the regression lines for the combined sexes data were used (Figures 5.1-5.3). These regression lines paralleled the NCHS reference median, as the slopes of these regression lines were not significantly different from '0'. Thus age of the infant had no effect on height, weight and weight for height z-scores.

The actual ages of the infants were rounded to the nearest month. A mean HAZ, WAZ and WHZ value was calculated for each rounded age and was compared between ages (Figures 5.4 – 5.6). No differences in mean height and weight z-scores were observed among ages (Figures 5.4 and 5.5). There was an effect however, of rounded age ($p<0.05$) on weight for height scores (Figure 5.6). 11 month old infants had lower WHZ scores than both 10 and 12 month old infants.

The mean z-scores at each month were also compared to the NCHS standard. At no age was HAZ significantly different from the NCHS median (Figure 5.4). Mean WAZ scores at all ages were below the NCHS median (Figure 5.5, $p<0.05$). WHZ scores were significantly lower than the NCHS median at nine, 11 and 12 months of age, but not significantly different at ten months of age (Figure 5.6, $p<0.05$).

Table 5.8 Mean Height and Weight Values By Age

Age (months)	Height (cm)		Weight (kg)	
	Male	Female	Male	Female
9	72.4 ± 1.0*	70.7 ± 1.3	8.47 ± 0.47	8.16 ± 0.59
10	73.3 ± 1.4	71.9 ± 2.4	9.18 ± 0.93	8.63 ± 1.05
11	74.6 ± 1.8	72.8 ± 1.4	9.11 ± 0.65	8.38 ± 0.67
12	76.2 ± 1.6	74.3 ± 2.4	9.83 ± 0.70	9.11 ± 1.26

* Results expressed as means ± standard deviation

Figure 5.1 Regression of anthropometry height for age z-score (HAZ), combined sexes

Figure 5.2 Regression of anthropometry weight for age z-score (WAZ), combined sexes.

Figure 5.3 Regression of anthropometry weight for height z-score (WHZ), combined sexes.

Figure 5.4 Mean height for age z-scores (HAZ), compared to NCHS standard (combined sexes). Results are expressed as mean $\pm$ standard deviation.

Figure 5.5 Mean weight for age z-scores (WAZ) compared to NCHS standard (combined sexes). Results are expressed as mean $\pm$ standard deviation. * significantly lower than NCHS reference median ($p < 0.05$).

Figure 5.6. Mean weight for height z-score (WHZ) compared to NCHS standard (combined sexes).

Results are expressed as mean $\pm$ standard deviation.

- * significantly lower than NCHS reference median ($p < 0.05$).
- letters denote significance between ages ($p < 0.05$).

5.3 Feeding Practices

5.3.1 Overview

Based upon the reported introduction of foods from birth to 12 months of age, four stages in feeding practices can be described (Table 5.9). Prior to four months of age, infants were receiving primarily milk which was introduced at birth. Infant cereal was reported to have been introduced primarily between four to six months of age. Fruits, adult cereals, vegetables and home-prepared carbohydrate were introduced between six to eight months of age. Meats were introduced into the infants' diets primarily from six months of age. Table foods were introduced to infants' diets mainly after eight months of age.

Table 5.9 Cumulative Age of Introduction to Food Item/Category

Percentage Introduced (%)			Age (months)												
	Y	N	0	1	2	3	4	5	6	7	8	9	10	11	12
Breast Milk*	78.5	21.5	78.5	60.0	53.8	42.3	28.3	21.5	17.7	14.6	11.5	11.5	10.8	7.4	5.7
Mixed Feeding*	75.5	24.5	10.8	20.0	27.7	7.7	3.8	2.3	1.5	3.1	3.1	6.2	5.9	4.6	2.9
Formula	96.7	3.3	32.8	49.8	54.4	66.0	75.3	80.7	84.5	89.1	92.9	95.2	—	96.7	—
Whole Cow's Milk	10.7	89.3	—	—	—	—	—	—	—	—	—	1.5	3.0	9.2	10.7
2% milk	1.5	98.5	—	—	—	—	—	—	—	—	—	0.8	—	—	1.5
Other Liquids	85.4	14.6	9.2	16.9	20.7	26.8	36.1	43.0	60.7	66.9	77.7	81.6	85.4	—	—
Traditional Tonics	28.5	71.5	3.1	3.9	7.0	11.6	13.9	14.7	23.2	27.1	—	—	28.5	—	—
Sugar Tonics	36.2	63.8	6.2	13.1	14.6	18.4	23.1	26.1	30.7	31.5	33.1	34.5	35.3	36.1	—
Solid Foods	100.0	0.0	0.8	—	—	8.4	78.5	89.2	99.2	100	—	—	—	—	—
Commercial Infant Food	86.9	13.1	—	—	—	2.3	40.0	63.0	83.0	83.8	86.9	—	—	—	—
Commercial Infant Cereal	98.5	1.5	0.8	—	—	5.4	63.8	80.8	96.9	98.5	—	—	—	—	—
Commercial Infant Vegetable	80.0	20.0	—	—	—	—	34.6	51.6	73.9	75.4	76.2	79.3	80.0	—	—
Commercial Infant Fruit	78.5	21.5	—	—	—	1.5	25.3	49.1	68.3	70.6	74.5	78.5	—	—	—
Commercial Infant Meat	68.5	31.5	—	—	—	—	5.4	9.2	45.4	52.3	63.1	66.2	67.7	68.5	—
Home-Prepared Carbohydrate	94.6	5.4	—	—	—	0.8	6.2	13.9	46.1	66.9	80.7	90.0	93.1	93.8	94.6
Home-Prepared Vegetables	94.6	5.4	—	—	—	—	6.2	15.4	45.4	60.7	80.7	90	93.1	94.6	—
Fruits	97.7	2.3	—	—	—	0.8	6.2	13.9	33.2	57.0	82.4	91.5	96.1	96.9	97.7
Home-Prepared Meats	92.3	7.7	—	—	—	—	3.8	9.2	39.2	53.0	72.1	86.0	91.4	—	92.3
Snacks	90.0	10.0	—	—	—	—	0.8	7.7	22.3	44.6	69.2	83.8	90.0	—	—
Table Foods	46.9	53.1	—	—	—	—	0.8	3.2	4.7	8.5	20.8	32.3	38.5	45.4	46.9

*percentage of breastfed and mixed fed infants

Table 5.10   **Current Feeding Patterns**

Percentage Currently Feeding...	Age (months)			
	9 n=28	10 n=34	11 n=33	12 n=35
Breast Milk	14.3	11.8	9.1	5.7
Formula	92.9	97.1	93.9	88.6
Whole Cow's Milk	0	2.9	3.9	5.4
2% milk	0	0	0	5.7
Other Liquids	78.6	70.6	66.7	88.6
Traditional Tonics	21.4	23.5	9.1	17.1
Sugar Tonics	14.3	17.7	18.2	11.4
Solid Foods	100	100	100	100
Commercial Infant Foods	71.4	64.7	48.5	51.4
Home-Prepared Carbohydrate	82.1	94.1	97.0	94.3
Home-Prepared Vegetables	78.6	85.3	90.9	94.3
Fruits	92.9	88.2	100	100
Home-Prepared Meats	78.6	91.2	97.0	100
Snacks	92.9	91.2	78.8	88.6
Table Foods	28.6	44.1	24.2	26.9

5.3.2 Breastfeeding

Of the 130 mothers surveyed, 78.5% reported initiating breastfeeding (Table 5.9). Of the 28 mothers that did not breastfeed, insufficient milk and inconvenience were the premier reasons cited (Table 5.11).

Table 5.11 Reasons for not Breastfeeding

Reasons	Percentage (n=28)
Caesarian	7.1
Mother Taking Medication	3.6
Misinformed	3.6
Family Objected	3.6
Too Difficult	14.3
Insufficient Milk	28.6
Inconvenient	39.3

From birth, the percentage of mothers breastfeeding decreased steadily. 42.3% of the mothers reported that they were breastfeeding at three months and only 17.7% reported so at six months. By nine months of age only 11.5% of mothers reported that they were still breastfeeding.

At the time of the study, 10% of the infants were receiving breast milk. Specifically, 14.3% of nine month old infants were receiving breast milk (Table 5.10). 11.8% of the

ten month olds, 9.1% of the 11 month olds, and 5.7% of the 12 month olds respectively, were reportedly currently receiving breast milk.

5.3.3 Exclusively Breastfeeding

At birth, 67.7% of the infants were reported to be exclusively breastfed. The percentage of those that were exclusively breastfed declined steadily from birth to 34.7% by three months, 16.2% by six months and by nine months, only 5.3% of the infants were exclusively breastfed. Only one infant at one year of age was reportedly still exclusively breastfed.

5.3.4 Mixed Feeding

From birth to six months, mixed feeding patterns were similar to breastfeeding patterns. At birth 10.8% of the 130 subjects were following a mixed milk feeding pattern (breast milk in addition to commercial formula). From here, the numbers declined and by three months, 7.7% were reported to be mixed feeding and by six months only 1.5% were reported to be mixed feeding. After nine months, the number of those that were following a mixed milk feeding regime had increased to 6.2%. From ten months on, the percentage of those mixed feeding again decreased, and at 12 months only 2.9% were mixed feeding. Changes in mixed feeding patterns were dependent upon changes in both breastfeeding and exclusive breastfeeding patterns. The general decline in infants that followed a mixed milk feeding regime was due to the decline in breastfeeding rates.

5.3.5 Formula Feeding

In contrast to breastfeeding, formula feeding increased steadily from birth. At birth, three months and six months of age 32.8%, 66.0% and 84.5% respectively, of the infants were

reported to be consuming formula (Table 5.9). At the time of the study, 96.7 of the infants had been reportedly introduced to formula.

In response to the questions on current feeding practices, it was found that 93.1% of the infants were currently consuming formula. Specifically, 92.9%, 97.1%, 93.9% and 88.6% of the nine, ten, 11 and 12 month olds respectively, were reportedly consuming formula (Table 5.10).

5.3.6 Cow's Milk

The types of cow's milk consumed by the infants in the study were homogenised (whole cow's milk) and 2% partially skimmed milk (2% milk).

From birth to eight months, neither whole cow's milk nor 2% milk were introduced (Table 5.9). At nine months 1.5% of the infants were introduced to whole cow's milk and 0.8% of the infants reportedly started consuming 2% milk. At the time of the study, only 10.7% of the infants were introduced to whole cow's milk and 1.5% introduced to 2% milk.

When the current diets were examined, it was found that 10.0% of the 130 infants were consuming whole cow's milk. Specifically, 0%, 2.9%, 3.9% and 5.4% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming whole cow's milk (Table 5.10). The percentage of those currently consuming 2% milk was lower. 1.5% of the infants included 2% milk into their current diet. Specifically, none of the nine, ten and 11 month old infants and 5.7% of the 12 month old infants were reportedly consuming 2% milk.

5.3.7 Other Liquids

The food category 'other liquids' was defined as liquid items other than milk or water and included sugar tonics, juices and traditional tonics. The proportion of infants introduced to other liquids in addition to breast milk and water increased steadily from birth (Table 5.9). At birth, three and six months of age 9.2%, 26.8% and 60.7% respectively, of the infants were reportedly introduced to other liquids. At the time of the study, 85.4% were reportedly introduced to other liquids.

When the current feeding practices were examined, 76.2% of the infants included other liquids. Specifically, 78.6%, 70.6%, 66.7% and 88.6% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming other liquids (Table 5.10).

5.3.8 Traditional Tonics

Traditional tonics referred to traditional fortifying and cooling drinks found in the Chinese diet. The majority of the infants were not introduced to traditional tonics (Table 5.9). At birth and by three months 3.1% and 11.6% of the infants were reportedly introduced to traditional tonics. At the time of the study, only 28.5% of the infants had been introduced to traditional tonics.

In the current diets, 17.7% of the infants were consuming traditional tonics. Specifically, 21.4%, 23.5%, 9.1% and 17.1% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming traditional tonics (Table 5.10).

5.3.9 Sugar Tonics

The majority of the infants were not introduced to sugar tonics. At birth and by six months of age, only 6.2% and 30.7% of the infants were reportedly introduced to sugar

tonics (Table 5.9). At the time of the study, only 36.2% had been introduced to sugar tonics.

When the current infant diets were examined, 15.4% of the infants included sugar tonics. Specifically 14.3%, 17.7%, 18.2% and 11.4% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming sugar tonics (Table 5.10).

5.3.10 Solid Foods

Solid food introduction followed a similar pattern to home-prepared carbohydrate introduction and was primarily introduced from four months of age. At birth, only one mother added solid foods (commercial infant cereal) into the infant's diet (Table 5.9). At three and four months of age, 8.5% and 78.6% of the infants were reportedly introduced to solid foods. By 6.5 months, 100% of the infants were reportedly introduced to solid foods. Solid foods were included into every infant's current diet (Table 5.10).

The first solid food choice for the majority of infants was infant cereal, which was the choice of 80.8% of the infants (Table 5.12). The second choice of solid food introduction was commercial infant food, which was the choice of 38.5% of the infants. The percentages did not add to 100% as more than one solid food could have been introduced at the same time.

Table 5.12 First Solid Foods Introduced to Chinese Canadian Infants

Food	Percent Introduced
Commercial Infant Cereal	80.8
Cheese	40.8
Commercial Baby Food	38.5
Commercial Baby Fruit	6.9
Vegetables	6.2
Home-Prepared Carbohydrates	4.6
Table Foods	1.5
Bread	0.8

5.3.11 Commercial Infant Foods

Commercial infant foods first appeared in the infant diets at three months of age (Table 5.9). At three months, 2.3% of the infants were reportedly introduced to commercial infant food. The number of infants introduced to commercial infant food increased steadily and at the time of the study, 86.9% of the infants had been introduced to commercial infant foods. Commercial infant foods were introduced in two stages. Between four to six months of age, commercial infant cereal, commercial infant vegetables and commercial infant fruits were introduced. Between six to eight months of age, infants were introduced to commercial infant meats.

When the current infant diets were examined, 58.5% of the infants were currently consuming commercial infant foods. Specifically, 71.4%, 64.7%, 48.5% and 51.4% of

the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming commercial infant foods (Table 5.10).

5.3.12 Home-Prepared Carbohydrates

From birth to three months, none of the infants were reported to be receiving home-prepared carbohydrates (Table 5.9). By three, six and nine months of age, home-prepared carbohydrates were introduced to 0.8%, 46.2% and 90.1% respectively, of the infants. At the time of the study, 94.6% of the infants had been reportedly introduced to home-prepared carbohydrates.

In the current diets, 93.1% of the infants included home-prepared carbohydrates. Specifically, 82.1%, 94.1%, 97.0% and 94.3% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming home-prepared carbohydrates (Table 5.10).

5.3.13 Home-Prepared Vegetables

Home-prepared vegetables were primarily introduced from four months of age (Table 5.9). By seven months of age, 60.7% of the infants were reportedly introduced to vegetables. At the time of the study, 94.6% of the infants were introduced to vegetables.

In the current diets, home-prepared vegetables were reportedly consumed by 87.7% of the infants. Specifically, 78.6%, 85.3%, 90.9% and 94.3% of the nine, ten, 11 and 12 month old infants respectively, were currently consuming vegetables at the time of the study (Table 5.10).

5.3.14 Fruits

Infants were introduced to fruits primarily after four months of age (Table 5.9). At three and six months of age, 0.8% and 33.2% of the infants were introduced to fruits. At the time of the study, 97.7% of the infants were reportedly introduced to fruits.

In the current diets, 95.4% of the infants included fruits. Specifically, 92.9%, 88.2% of nine and ten month old infants respectively, and 100% of the 11 and 12 month old infants were reportedly currently consuming fruits (Table 5.10).

5.3.15 Home-Prepared Meats

Based on the food history questionnaire, from birth to four months of age, none of the infants had been introduced to home prepared meats (Table 5.9). Meats were primarily introduced to infants from six months of age. At seven and nine months of age, 53.0% and 86.0% of the infants were reportedly introduced to meats. At the time of the study, 92.3% of the infants had been introduced to meats.

In their current diets, 92.3% of the infants were consuming home-prepared meats. Specifically, 78.6%, 91.2%, 97.0% and 100% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming meats (Table 5.10).

5.3.16 Snacks

Snack introduction was delayed until the infants were four months old (Table 5.9). At four and seven months of age, 0.8% and 44.6% of the infants were reportedly introduced to snacks. At the time of the study 90% of the infants had been introduced to snacks.

In the current diets, 87.7% of the infants included snacks. Specifically, 92.9%, 91.2%, 78.8% and 88.6% of the nine, ten, 11 and 12 month old infants respectively, were reportedly currently consuming snacks (Table 5.10).

5.3.17 Table Foods

From birth to four months of age, none of the infants were reportedly introduced to table foods (Table 5.9). Starting from four months, table foods were slowly introduced into the diet but were primarily introduced into the diet from nine months of age. By nine months, 32.2% were reportedly introduced to table foods.

At the time of the study, 46.9% of the infants had been introduced to table foods. 36.9% of the subjects included table foods into their current diet. Specifically, 28.6% of the nine month olds, 44.1% of the ten month olds, 24.2% of the 11 month olds and 26.9% of the 12 month olds were currently consuming table foods (Table 5.10).

5.4 Associations of Feeding Practices on Anthropometry

5.4.1 Relationship Between the Introduction at Any Age of Specific Food Items/Categories into the Infant Diet and Achieved Size

This section summarises the results from the chi-square analysis that tested the hypothesis that there was a relationship between the introduction of specific food items/categories into the infant diet and achieved size. There was little relationship between the introduction of a food item/category and achieved size, when time of introduction was not considered (Table 5.13). The only specific food category to associate its introduction with a measure of body size was the introduction of table foods (Table 5.14). However, no clear interpretation of the statistical result can be made.

The introduction of table foods into the diet had a statistically significant but unclear effect on achieved HAZ scores (Table 5.14, $p < 0.05$, $\chi^2 = 9.02$). Table 5.14 can be read as follows. The total observed frequency row shows the number of infants in each tertile. 45 infants had heights that represented the tallest third of the distribution. 42 infants represented the middle third and 43 infants represented the shortest third of the distribution. At the time of the study 62 infants were introduced to table foods and 68 were not introduced to table foods as shown by the total observed frequency column. The observed frequency row shows the number of infants in each tertile in the context of whether they had been introduced to table foods. Among those introduced to table foods, 18 infants had HAZ scores that fell into the first tertile, 28 infants had heights that fell into the second tertile and 16 infants had heights that fell into the third tertile. Among those not introduced to table foods, 27 infants had HAZ scores that fell into the first tertile, 14 infants had heights that fell into the second tertile and 27 infants had heights that fell into the third tertile.

The row percentage for each cell was calculated by the following formula:

$$\frac{\text{Observed frequency for a cell}}{\text{Total observed frequency for the row that the cell is a part of}} \times 100$$

The chi-square value for each cell represents the contribution that each cell makes to the total chi-square value of the analysis. If no relationship existed between the consumption of table foods and height, the expected row percentage for each cell would be close to 33.3% for each tertile. The total chi-square value in addition to the p-value, determines whether the deviations seen from 33.3% and thus the trends observed are significant. If the chi-square analysis is significant, the pattern of distribution between

the tertiles is significant. The cells that deviate the most from the expected percentage contributes the most to the significant chi-square value, as can be seen from the individual cell chi-square values. However, it is important to remember that it is the trend as a whole that is significant.

The lambda value shows the amount of error in HAZ that can be reduced by taking the introduction of table foods in account.

As seen by both the p-value and chi-square total in Table 5.14, there was a relationship between the introduction of table foods into the diet and achieved HAZ scores. Those that were introduced to table foods were more likely to have heights that fell into the second tertile as opposed to the first or third tertiles. Those that were not introduced to table foods tended to have HAZ scores that fell into either the first or third tertiles and not the second. A λ value of 0.12 indicates that by taking the introduction of table foods into account, the error in HAZ can be reduced by 12%.

Table 5.13 Relationship Between The Introduction of Specific Food Items/Categories and Achieved Size

	HAZ	WAZ	WHZ
Breastfeeding	NS	NS	NS
Formula	NS	NS	NS
Other Liquids	NS	NS	NS
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	NS	NS
Solid Foods	NS	NS	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	NS	NS
Commercial Infant Meat	NS	NS	NS
Home Prepared Carbohydrates	NS	NS	NS
Home Prepared Vegetables	NS	NS	NS
Fruits	NS	NS	NS
Home Prepared Meats	NS	NS	NS
Snacks	NS	NS	NS
Table Foods	(+/-)* p<0.05	NS	NS

*sign (+/-) indicates effect of introducing food item/category into the infant diet on anthropometric index.

NS = not significant

Table 5.14 Relationship Between Table Food Introduction and HAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	18 (29.0) [0.56]	28 (45.2) [3.17]	16 (25.8) [0.99]	62
No	27 (39.7) [0.51]	14 (20.6) [2.89]	27 (39.7) [0.90]	68
Total Observed Frequency (n)	45	42	43	130

p < 0.05

 χ^2 Total = 9.02 $\lambda = 0.12$

5.4.2 Relationship Between Current Consumption of Specific Food Items/Categories and Achieved Size

This section summarises the results from the chi-square analysis that tested the hypothesis that there was a relationship between currently consuming specific food items/categories and achieved size.

There was a relationship between current consumption of table foods and HAZ scores and currently consumption of commercial infant vegetables and WAZ scores (Table 5.15). Current table food consumption had a statistically significant but unclear effect on HAZ scores. A larger proportion of those infants currently consuming table foods had HAZ scores in the second tertile than those that were not (Table 5.16, $p < 0.05$, $\chi^2 = 9.10$). A larger proportion of those that were currently consuming commercial infant vegetables had WAZ scores in the second and third tertile (Table 5.17, $p < 0.05$, $\chi^2 = 7.18$).

Table 5.15 Relationship Between Current Consumption of Specific Food Items/Categories and Achieved Size

	HAZ	WAZ	WHZ
Breastfeeding	NS	NS	NS
Formula	NS	NS	NS
Other Liquids	NS	NS	NS
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	NS	NS
Solid Foods	NS	NS	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	(-)* p<0.05	NS
Commercial Infant Meat	NS	NS	NS
Home-Prepared Carbohydrates	NS	NS	NS
Home-Prepared Vegetables	NS	NS	NS
Fruits	NS	NS	NS
Home-Prepared Meats	NS	NS	NS
Snacks	NS	NS	NS
Table Foods	(+/-)* p<0.05	NS	NS

* sign (+/-) indicates effect of food item/category in current diet on anthropometric index.

NS = not significant

Table 5.16 Relationship Between Current Consumption of Table Foods and HAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	11 (22.9) [1.90]	23 (47.9) [3.62]	14 (29.2) [0.22]	48
No	34 (41.5) [1.11]	19 (23.2) [2.12]	29 (35.4) [0.13]	82
Total Observed Frequency (n)	45	42	43	130

 $p < 0.05$ χ^2 Total = 9.10 $\lambda = 0.14$ **Table 5.17** Relationship Between Current Consumption of Commercial Infant Vegetables and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	10 (21.3) [2.64]	20 (42.6) [1.80]	17 (36.2) [0.14]	47
No	36 (43.4) [1.50]	21 (25.3) [1.02]	26 (31.4) [0.08]	83
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ χ^2 Total = 7.18 $\lambda = 0.12$

5.4.3 Relationship Between the Timing of Introduction of Specific Food Items/Categories into the Infant Diet and Achieved Size

5.4.3.1 Relationship Between the Age of Introduction of Specific Food Items/Categories into the Infant Diet and Achieved Size

This section summarises the results from the chi-square analysis that tested the hypothesis that there was a relationship between the age of introduction to specific food items/categories into the infant diet and achieved size.

The time at which specific food items/categories were introduced into the diet was associated with achieved size (Table 5.18). There was a positive relationship between introducing solid foods at/by four months and HAZ scores. Introducing solid foods at/by four months, specifically, introducing commercial infant meat at/by six and seven months of age and home-prepared carbohydrates at/by six and eight months of age was related to higher WAZ scores. Introducing other liquids at/by nine months of age, commercial infant meat at/by six months of age and introducing home-prepared carbohydrates at/by six, seven, and eight months of age was also related to higher WHZ scores.

The time of introduction of solid foods was associated with HAZ scores (Table 5.19, $p < 0.05$, $\chi^2 = 8.45$). A larger proportion of those infants that were introduced to solid foods at/by four months of age had HAZ scores in the first and second tertile than those that were not.

A λ value of 0.12 indicates that by considering the age of introduction to solid foods, the error in HAZ can be reduced by 12%.

There was a relationship between the age at which solid foods, commercial infant meat and home-prepared carbohydrates were introduced and WAZ scores. A larger proportion of those infants that were introduced to solid foods at/by four months had WAZ scores in the first tertile than those that were not (Table 5.20, $p<0.05$, $\chi^2=7.09$). The timing of introduction of specific solid food items/categories was also associated with WAZ scores. Infants introduced to commercial infant meat at/by six and seven months of age (Table 5.21 and Table 5.22, $p<0.05$, $\chi^2=10.19$ and 7.03) and infants introduced to home-prepared carbohydrates at/by six and eight months of age (Table 5.23 and Table 5.24, $p<0.05$, $\chi^2=7.30$, 8.34) were more likely than those that were not, to have WAZ scores in the first and second tertiles.

WHZ scores were associated with the age of introduction to other liquids, commercial infant meat and home-prepared carbohydrates. A larger proportion of those infants that were not introduced to other liquids at/by nine months of age had WHZ scores in the third tertile (Table 5.25, $p<0.05$, $\chi^2=7.72$). Infants that were introduced to commercial infant meat at/by six months (Table 5.26, $p<0.05$, $\chi^2=6.05$) of age and infants that were introduced to home-prepared carbohydrates at/by six, seven and eight months of age (Table 5.27 - Table 5.29, $p<0.01$, $\chi^2=11.87$, 10.97 and 21.27) were more likely than those that were not, to have WHZ scores in the first tertile.

Table 5.18 Relationship Between the Age of Introduction to Specific Food Items/Categories and Achieved Size

	HAZ	WAZ	WHZ
Formula	NS	NS	NS
Other Liquids	NS	NS	9 months (+), $p < 0.05$
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	NS	NS
Solid Foods	4 months (+), $p < 0.05$	4 months (+), $p < 0.05$	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	NS	NS
Commercial Infant Meat	NS	6 months (+), $p < 0.01$ 7 months (+), $p < 0.05$	6 months (+), $p < 0.05$
Home-Prepared Carbohydrates	NS	6 months (+)*, $p < 0.05$ 8 months (+), $p < 0.05$	6 months (+), $p < 0.01$ 7 months (+), $p < 0.01$ 8 months (+), $p < 0.01$
Home-Prepared Vegetables	NS	NS	NS
Fruits	NS	NS	NS
Home-Prepared Meats	NS	NS	NS
Snacks	NS	NS	NS
Table Foods	NS	NS	NS

* sign (+/-) indicates effect of introducing food item category into the infant diet at/by the mentioned age on anthropometric index.
NS = not significant

Table 5.19 Relationship Between the Introduction of Solid Foods At/By 4 Months of Age and HAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	40 (39.2) [1.50]	34 (33.3) [0.03]	28 (27.4) [0.98]	102
No	5 (17.9) [2.27]	8 (28.6) [0.12]	15 (53.6) [3.55]	28
Total Observed Frequency (n)	45	42	43	130

$p < 0.05$
 $\chi^2 = 8.45$
 $\lambda = 0.12$

Table 5.20 Relationship Between the Introduction of Solid Foods At/By 4 Months and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	42 (41.2) [0.98]	30 (29.4) [0.14]	30 (29.4) [0.41]	102
No	4 (14.3) [3.52]	11 (39.3) [0.53]	13 (46.4) [1.51]	28
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$
 $\chi^2 = 7.09$
 $\lambda = 0.11$

Table 5.21 Relationship Between the Introduction of Commercial Infant Meat At/By 6 Months of Age and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	25 (42.4) [0.81]	23 (39.0) [1.04]	11 (18.6) [3.71]	59
No	21 (29.6) [0.68]	18 (25.4) [0.86]	32 (45.1) [3.09]	71
Total Observed Frequency (n)	46	41	44	130

$p < 0.01$

$\chi^2 = 10.19$

$\lambda = 0.13$

Table 5.22 Relationship Between the Introduction of Commercial Infant Meat At/ By 7 Months of Age and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	25 (36.8) [0.04]	27 (39.7) [1.44]	16 (23.5) [1.87]	68
No	21 (33.9) [0.04]	14 (22.6) [1.58]	27 (43.6) [2.06]	62
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 7.03$

$\lambda = 0.10$

Table 5.23 Relationship Between the Introduction of Home Prepared Carbohydrates At/By 6 Months of Age and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	28 (46.7) [2.16]	18 (30.0) [0.05]	14 (23.3) [1.72]	60
No	18 (25.7) [1.85]	23 (32.9) [0.04]	29 (41.4) [1.48]	70
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 7.30$

$\lambda = 0.13$

Table 5.24 Relationship Between the Introduction of Home Prepared Carbohydrates At/By 8 Months of Age and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	42 (40.0) [0.63]	34 (32.3) [0.02]	29 (27.6) [0.96]	105
No	4 (16.0) [2.66]	7 (28.0) [0.10]	14 (56.0) [3.97]	25
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 8.34$

$\lambda = 0.12$

Table 5.25 Relationship Between the Introduction of Other Liquids At/By 9 Months and WHZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	36 (34.0) [0]	40 (37.8) [0.70]	30 (28.3) [0.73]	106
No	8 (37.5) [0]	3 (18.8) [3.07]	13 (54.2) [3.22]	24
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

χ^2 Total = 7.72

$\lambda = 0.11$

Table 5.26 Relationship Between the Introduction of Commercial Infant Meat At/By 6 Months of Age and WHZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	24 (40.7) [0.81]	22 (37.3) [0.31]	13 (22.0) [2.18]	59
No	20 (28.2) [0.68]	21 (29.6) [0.26]	30 (42.2) [1.81]	71
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 6.05$

$\lambda = 0.12$

Table 5.27 Relationship Between the Introduction of Home Prepared Carbohydrates At/By 6 Months and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	27 (45.0) [2.21]	22 (36.7) [0.23]	11 (18.3) [3.96]	60
No	17 (24.3) [1.89]	21 (30.0) [0.20]	32 (45.7) [3.38]	70
Total Observed Frequency (n)	44	43	43	130

$p < 0.01$

$\chi^2 = 11.87$

$\lambda = 0.17$

Table 5.28 Relationship Between the Introduction of Home Prepared Carbohydrates At/By 7 Months of Age and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	32 (36.8) [0.22]	34 (39.1) [0.95]	21 (24.1) [2.10]	87
No	12 (27.9) [1.52]	9 (20.9) [1.92]	22 (51.2) [4.26]	43
Total Observed Frequency (n)	44	43	43	130

$p < 0.01$

$\chi^2 = 10.97$

$\lambda = 0.14$

Table 5.29 Relationship Between the Introduction of Home Prepared Carbohydrates At/By 8 Months of Age and WHZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
Yes	41 (39.0) [0.84]	39 (37.1) [0.52]	25 (23.8) [2.73]	105
No	3 (12.0) [3.53]	4 (16.0) [2.20]	18 (72.0) [11.45]	25
Total Observed Frequency (n)	44	43	43	130

$$p < 0.01$$

$$\chi^2 = 21.27$$

$$\lambda = 0.17$$

5.4.3.2 Effect of Early vs. Later Introduction of Specific Food Items/Categories on Achieved Size

This section summarises the results from the GLM analysis that tested the hypothesis that early versus later introduction to specific food items/categories had an effect on achieved size. Only those introduced to the food item/category being considered was included in the analysis.

Early introduction to other liquids, home-prepared carbohydrates, home-prepared meats and sugar tonics was associated with an increased size (Table 5.30). Introduction to other liquids at an earlier age was associated with taller infants. Earlier introduction to other liquids, sugar tonics, and home-prepared carbohydrates was associated with both

heavier babies and babies that were heavier for their achieved weight. Earlier introduction to home-prepared meats was also associated with higher WHZ scores.

Infants introduced to other liquids at/by three months of age had higher HAZ scores than those not introduced to other liquids after three months of age (Table 5.31, $p < 0.05$).

Early introduction to other liquids, sugar tonics and home-prepared carbohydrates was associated with higher WAZ scores (Table 5.32 - Table 5.36, $p < 0.05$). Those that were introduced to other liquids and sugar tonics at/by three (other liquids only) and four months of age had higher WAZ scores than those that were not (Table 5.32 - Table 5.34, $p < 0.05$). Infants introduced to sugar tonics at/by two months of age had higher WAZ scores than those that were introduced to sugar tonics at four months of age or after (Table 5.35, $p < 0.05$). Of those that were introduced to other liquids, a difference in WAZ was observed between ages. Eleven month olds had lower WAZ scores than both ten and 12 month olds but were not different from nine month olds (Table 5.32 and Table 5.33, $p < 0.01$).

There was also an interaction between early introduction to other liquids and the age of the infant (Table 5.32, $p < 0.01$). Twelve month olds introduced to other liquids before three months of age were heavier than nine, ten and 11 month olds that were also introduced to other liquids before three months of age. They were also heavier than all those that were not introduced to other liquids at/after three months of age. Twelve month olds introduced to other liquids at/after three months of age were heavier than 11 month olds introduced to other liquids at/after three months of age but were lighter than ten month olds introduced to other liquids before three months of age.

Early introduction to home-prepared carbohydrates was associated with higher WAZ scores (Table 5.36, $p<0.01$). Those that were introduced to home-prepared carbohydrates at/before six months of age had higher WAZ scores than those introduced to home-prepared carbohydrates at/after eight months of age. An interaction between the timing of introduction to home-prepared carbohydrates and age was also observed (Table 5.36, $p<0.05$). Ten month old infants that were introduced to home-prepared carbohydrates and at/before six months had higher WAZ scores than those that had been introduced to home-prepared carbohydrates at/after eight months of age regardless of age. Both ten and 12 month old infants that were introduced to home-prepared carbohydrates at/before six months of age had higher WAZ scores than 11 month old infants that were introduced to home-prepared carbohydrates at/before six months of age. Twelve month old infants introduced to home-prepared carbohydrates at/before six months of age were also heavier than ten, 11 and 12 month old infants that were introduced to home-prepared carbohydrates at/after eight months of age.

Early introduction to other liquids, home-prepared carbohydrates and home-prepared meats was associated with higher WHZ scores (Table 5.37 - Table 5.39, $p<0.05$). Infants introduced to other liquids before three months of age had higher WHZ scores than those introduced to other liquids at/after three months of age (Table 5.37, $p<0.01$). Among those introduced to other liquids, a difference in WAZ was observed between ages. Eleven month olds had lower WAZ scores than both ten and 12 month olds but were not different from nine month olds. An interaction between early introduction to other liquids and the age of the infant was also observed (Table 5.37, $p<0.05$). Twelve month olds that were introduced to other liquids before three months had higher WHZ scores than those that were introduced to other liquids at/after three months of age. They also had higher WHZ scores than infants at all other ages regardless of when they

were introduced to other liquids. Eleven month olds that were introduced to other liquids at/after three months had lower WHZ scores than those that had been introduced to other liquids before three months. In addition, they also had lower WHZ scores as compared to both ten month old infants that had been introduced to other liquids before three months and 12 month old infants that were introduced to other liquids at/after three months of age.

Among the solid foods, early introduction home-prepared carbohydrates and home-prepared meats associated with higher WHZ scores. Infants that were introduced to home-prepared carbohydrates and infants introduced to home-prepared meats at/before six months of age had higher WHZ scores than those that were introduced to these items at/after eight months of age (Table 5.38 and Table 5.39, $p < 0.05$). Among those introduced to home-prepared meats a difference in WHZ was also observed between ages (Table 5.39, $p < 0.05$). Ten month olds had higher WHZ scores than both nine and 11 month olds. Among those introduced to home-prepared meats, a difference in WHZ was also observed between ages (Table 5.39, $p < 0.05$). ten month olds had higher WHZ scores than both nine and 11 month olds.

Table 5.30 Effect of Early vs Late Introduction to Specific Food Items/Categories on Achieved Size

	HAZ	WAZ	WHZ
Breastfeeding	NS	NS	NS
Formula	NS	NS	NS
Other Liquids	< 3 months (+)*, ≥ 3 months (-) p<0.05	< 3 months (+), ≥ 3 months (-) p<0.01 < 4 months (+), ≥ 4 months (-) p<0.05	< 3 months (+), ≥ 3 months (-) p<0.01
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	< 4 months (+), ≥ 4 months (-) p<0.05 ≤ 2 months (+), ≥ 4 months (-) p<0.05	NS
Solid Foods	NS	NS	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	NS	NS
Commercial Infant Meat	NS	NS	NS
Home-Prepared Carbohydrates	NS	≤ 6 months (+), ≥ 8 months (-) p<0.01	≤ 6 months (+), ≥ 8 months (-) p<0.05
Home-Prepared Vegetables	NS	NS	NS
Fruits	NS	NS	NS
Home-Prepared Meats	NS	NS	≤ 6 months (+), ≥ 8 months (-) p<0.05
Snacks	NS	NS	NS
Table Foods	NS	NS	NS

*sign (+/-) indicates effect of timing of introduction to food item category on anthropometric index.

NS = not significant

Table 5.31 Effect of Other Liquid Introduction Before 3 Months Of Age or At/After 3 Months of Age on HAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
<3 (n = 30)	1	0.18 a*	4.84
≥3 (n = 81)		-0.06 b	

*Means with different letters are significantly different from each other (p<0.05).

Table 5.32 Effect of Other Liquid Introduction Before 3 Months of Age or At/After 3 Months of Age on WAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
<3 (n = 30)	1	-0.17 a*	12.62
≥3 (n = 81)		-0.60 b	
Infant's Age (months)	3		6.07
9 (n = 23)		-0.59 ab*	
10 (n = 28)		-0.36 a	
11 (n = 27)		-0.79 b	
12 (n = 33)		-0.28 a	
Interaction Between Age of Introduction and Infant's age (months)	3		3.72
≥3, 9 (n = 15)		-0.55 ac*	
≥3, 10 (n = 18)		-0.51 ac	
≥3, 11 (n = 19)		-0.93 a	
≥3, 12 (n = 29)		-0.48 c	
<3, 9 (n = 8)		-0.67 ac	
<3, 10 (n = 10)		-0.08 a	
<3, 11 (n = 8)		-0.44 ac	
<3, 12 (n = 4)		1.13 b	

*Means with different letters are significantly different from each other (p<0.01).

Table 5.33 Effect of Other Liquid Introduction Before 4 Months of Age or At/After 4 Months of Age on WAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
<4 (n = 36)	11	-0.32 a*	4.56
≥4 (n = 75)		-0.57 b	
Infant's Age (months)	3		4.73
9 (n = 23)		-0.59 ab**	
10 (n = 28)		-0.36 a	
11 (n = 27)		-0.79 b	
12 (n = 33)		-0.28 a	

* Means with different letters are significantly different from each other (p<0.05).

** Means with different letters are significantly different from each other (p<0.01).

Table 5.34 Effect of Sugar Tonic Introduction Before 4 Months of Age or At/After 4 Months of Age on WAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
<4 (n = 24)	1	-0.25 a*	5.62
≥4 (n = 23)		-0.80 b	

*Means with different letters are significantly different from each other (p<0.05).

Table 5.35 Effect of Sugar Tonic Introduction At/Before 2 Months of Age or At/After 4 Months of Age on WAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
≤2 (n = 19)	1	-0.32 a*	4.61
≥4 (n = 23)		-0.80 b	

*Means with different letters are significantly different from each other (p<0.05).

Table 5.36 Effect of Home-Prepared Carbohydrates Introduction At/Before 6 Months of Age or At/After 8 Months of Age on WAZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
≤6 (n = 61)	1	-0.28 a**	7.19
≥8 (n = 33)		-0.77 b	
Interaction Between Age of Introduction and Infant's Age (months)	3		2.90
≥8, 9 (n = 8)		-0.60 ac*	
≥8, 10 (n = 6)		-0.93 a	
≥8, 11 (n = 12)		-0.70 a	
≥8, 12 (n = 7)		-0.97 a	
≤6, 9 (n = 10)		-0.57 ac	
≤6, 10 (n = 19)		0.15 b	
≤6, 11 (n = 15)		-0.80 a	
≤6, 12 (n = 17)		-0.04 bc	

* Means with different letters are significantly different from each other ($p < 0.05$).

** Means with different letters are significantly different from each other ($p < 0.01$).

Table 5.37 Effect of Other Liquid Introduction Before 3 Months of Age or At/After 3 Months of Age on WHZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
<3 (n = 30)	1	-0.27 a**	8.27
≥3 (n = 81)		-0.60 b	
Infant's Age (months)	3		6.12
9 (n = 23)		-0.67 ab**	
10 (n = 28)		-0.33 a	
11 (n = 27)		-0.82 b	
12 (n = 33)		-0.29 a	
Interaction Between Age of Introduction and Infant's Age (months)	3		3.26
≥3, 9 (n = 15)		-0.64 ac*	
≥3, 10 (n = 18)		-0.40 a	
≥3, 11 (n = 19)		-0.93 c	
≥3, 12 (n = 29)		-0.48 a	
<3, 9 (n = 8)		-0.74 ac	
<3, 10 (n = 10)		-0.20 a	
<3, 11 (n = 8)		-0.53 ac	
<3, 12 (n = 4)		1.02 b	

* Means with different letters are significantly different from each other (p<0.05).

** Means with different letters are significantly different from each other (p<0.01).

Table 5.38 Effect of Home Prepared Carbohydrate Introduction At/Before 6 Months of Age or At/After 8 Months of Age on WHZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
≤6 (n = 61)	1.	-0.26 a*	5.25
≥8 (n = 33)		-0.75 b	

*Means with different letters are significantly different from each other ($p < 0.05$).

Table 5.39 Effect of Meat Introduction on At/Before 6 Months of Age or At/After 8 Months of Age on WHZ

Age of Introduction (months)	Degrees Of Freedom	Mean	F Value
≤6 (n = 64)	1	-0.32 a*	3.91
≥8 (n = 42)		-0.69 b	
Infant's Age (months)	3		2.97
9 (n = 22)		-0.70 b*	
10 (n = 29)		-0.12 a	
11 (n = 27)		-0.78 b	
12 (n = 28)		-0.36 ab	

*Means with different letters are significantly different from each other ($p < 0.05$).

5.4.4 Relationship Between the Duration of Feeding of Specific Food Items/Categories and Achieved Size

This section summarises the results of the chi-square analysis that tested the hypothesis that there is a relationship between the duration of feeding specific food items/categories and achieved size.

The duration of feeding of specific food items/categories had an effect on size (Table 5.40). Breastfeeding duration was related to achieved WAZ. A higher proportion of infants that were breastfed for at least three, four, five, seven and eight months had WAZ scores in the third tertile compared to those that were not (Table 5.41 - Table 5.45, $p < 0.05$, $\chi^2 = 6.10, 8.23, 6.63, 7.91$ and 6.75). When the WAZ scores of those that were breastfed were compared to those that were primarily formula fed (breastfed for two months or less), it was found that those that were breastfed for at least four, five, six, seven and eight months were more likely to have WAZ scores in the third tertile (Table 5.46 - Table 5.50, $p < 0.05$, $\chi^2 = 7.36, 8.19, 7.28, 10.33$ and 8.83).

There was a relationship between the duration of formula feeding and achieved size. Those that were introduced to commercial infant formula for six months or more had a higher proportion of infants that had WAZ scores in the first tertile as compared to those that were introduced to formula for less than six months (Table 5.51, $p < 0.05$, $\chi^2 = 6.00$).

There was also a relationship between the duration of feeding of solid foods in general and specific solid food items/categories (home-prepared carbohydrates, home-prepared vegetables, and fruits) and WAZ scores (Table 5.52 - Table 5.60). A greater proportion of infants that were introduced to solid foods for at least six and eight months were in the first tertile as opposed to those that were not (Table 5.52 and Table 5.53 $p < 0.05$, $\chi^2 = 9.07$ and 5.91). Similarly, those that were fed home-prepared carbohydrates for at least three and four months, home-prepared vegetables for at least three, four and six months and fruits for at least five and six months were more likely than those that were not, to have WAZ scores in the first tertile (Table 5.54 - Table 5.60, $p < 0.05$, $\chi^2 = 6.90, 6.38, 6.64, 8.46, 7.08, 9.08$ and 6.75).

There was a relationship between the duration of feeding of formula, other liquids and home-prepared carbohydrates and WHZ scores (Table 5.61 - Table 5.68). Those that were fed formula for at least six and seven months and those that were fed other liquids for at least two and three months had a greater proportion of infants with WHZ scores in the first tertile as opposed to those that were not (Table 5.61 - Table 5.64, $p < 0.05$, $\chi^2 = 8.53, 5.25, 8.89$ and 6.13). The duration of solid food feeding as a category did not associate with WHZ scores. However, feeding home-prepared carbohydrates for two, three, four and five months resulted in a higher proportion of infants with WHZ scores in the first tertile (Table 5.65 - Table 5.68, $p < 0.05$, $\chi^2 = 6.60, 9.80, 8.80$, and 7.03).

Table 5.40 Relationship Between the Duration of Feeding of Specific Food Items/Categories and Achieved Size

	HAZ	WAZ	WHZ
Breastfeeding	NS	≥ 3 months (-), $p < 0.05$ ≥ 4 months (-), $p < 0.05$ ≥ 5 months (-), $p < 0.05$ ≥ 7 months (-), $p < 0.05$ ≥ 8 months (-), $p < 0.05$	NS
Formula	NS	≥ 6 months (+), $p < 0.05$	≥ 6 months (+), $p < 0.05$ ≥ 7 months (+), $p < 0.05$
Other Liquids	NS	NS	≥ 2 months (+), $p < 0.05$ ≥ 3 months (+), $p < 0.05$
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	NS	NS
Solid Foods	NS	≥ 6 months (+), $p < 0.05$ ≥ 8 months (+), $p < 0.05$	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	NS	NS
Commercial Infant Meat	NS	NS	NS
Home-Prepared Carbohydrates	NS	≥ 3 months (+), $p < 0.05$ ≥ 4 months (+), $p < 0.05$	≥ 2 months (+), $p < 0.05$ ≥ 3 months (+), $p < 0.01$ ≥ 4 months (+), $p < 0.05$ ≥ 5 months (+), $p < 0.05$
Home-Prepared Vegetables	NS	≥ 3 months (+), $p < 0.05$ ≥ 4 months (+), $p < 0.05$ ≥ 6 months (+), $p < 0.05$	NS
Fruits	NS	≥ 5 months (+), $p < 0.05$ ≥ 6 months (+), $p < 0.05$	NS
Home-Prepared Meats	NS	NS	NS
Snacks	NS	NS	NS
Table Foods	NS	NS	NS

* sign (+/-) indicates the effect that the duration of feeding of specific food item/category had on the anthropometric index.

NS = not significant

Table 5.41 Relationship Between Breastfeeding for at Least 3 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [1.57]	19 (31.7) [0]	14 (23.3) [1.72]	60
≥ 3	19 (27.1) [1.34]	22 (31.4) [0]	29 (41.4) [1.47]	70
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 6.10$ $\lambda = 0.12$ **Table 5.42 Relationship Between Breastfeeding for at Least 4 Months and WAZ**

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 3	34 (44.7) [1.88]	23 (30.3) 0.04	19 (25.0) 1.50	76
≥ 4	12 (22.2) [2.64]	18 (33.3) [0.06]	24 (44.4) [2.11]	54
Total Observed Frequency (n)	46	46	38	130

 $p < 0.05$ $\chi^2 = 8.23$ $\lambda = 0.14$

Table 5.43 Relationship Between Breastfeeding for at Least 5 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 4	39 (41.5) [0.99]	29 (30.8) [0.01]	26 (27.7) [0.83]	94
≥ 5	7 (19.4) [2.59]	12 (33.3) [0.04]	17 (47.2) [2.17]	36
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 6.63$ $\lambda = 0.12$ **Table 5.44 Relationship Between Breastfeeding for at Least 7 Months and WAZ**

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 6	43 (40.2) [0.70]	34 (31.8) [0]	30 (28.0) [0.15]	107
≥ 7	3 (13.0) [3.24]	7 (30.4) [0]	13 (56.5) [3.82]	23
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 7.91$ $\lambda = 0.12$

Table 5.45 Relationship Between Breastfeeding for at Least 8 Months and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 7	43 (38.7) [0.35]	36 (32.4) [0.03]	32 (28.8) [0.61]	111
≥ 8	3 (15.8) [2.06]	5 (26.3) [0.16]	11 (57.9) [3.54]	19
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 6.75$ $\lambda = 0.12$ **Table 5.46 Relationship Between Breastfeeding for at Least 4 Months Vs. Formula Feeding and WAZ**

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [1.81]	19 (31.7) [0]	14 (23.3) [1.71]	60
≥ 4	13 (23.6) [1.96]	18 (32.7) [0]	24 (43.6) [1.87]	55
Total Observed Frequency (n)	40	37	38	115

 $p < 0.05$ $\chi^2 = 7.36$ $\lambda = 0.15$

Table 5.47 Relationship Between Breastfeeding for at Least 5 Months vs. Formula Feeding and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [1.69]	19 (31.7) [0.03]	14 (23.3) [1.40]	60
≥ 5	7 (18.9) [2.75]	13 (35.1) [0.05]	29 (46.0) [2.27]	37
Total Observed Frequency (n)	34	32	31	97

$p < 0.05$

$\chi^2 = 8.19$

$\lambda = 0.16$

Table 5.48 Relationship Between Breastfeeding for at Least 6 Months vs. Formula Feeding and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [1.23]	19 (31.7) [0.03]	14 (23.3) [1.06]	60
≥ 6	5 (17.9) [2.64]	10 (35.7) [0.07]	13 (46.4) [2.26]	28
Total Observed Frequency (n)	32	29	27	88

$p < 0.05$

$\chi^2 = 7.28$

$\lambda = 0.14$

Table 5.49 Relationship Between Breastfeeding for at Least 7 Months vs. Formula Feeding and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [1.30]	19 (31.7) [0]	14 (23.3) [1.56]	60
≥ 7	3 (13.0) [3.39]	7 (30.4) [0.01]	13 (56.5) [4.07]	23
Total Observed Frequency (n)	30	26	27	83

$p < 0.01$

$\chi^2 = 10.34$

$\lambda = 0.19$

Table 5.50 Relationship Between Breastfeeding for at Least 8 Months vs. Formula Feeding and WAZ

Observed Frequency (n) (Row %) [χ^2]	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	27 (45.0) [0.78]	19 (31.7) [0.03]	14 (23.3) [1.31]	60
≥ 8	3 (15.8) [2.47]	5 (26.3) [0.10]	11 (57.89) [4.14]	19
Total Observed Frequency (n)	30	24	25	79

$p < 0.05$

$\chi^2 = 8.83$

$\lambda = 0.16$

Table 5.51 Relationship Between Formula Introduction for at Least 6 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 5	5 (16.7) [2.97]	11 (36.7) [0.25]	14 (46.7) [1.68]	30
≥ 6	41 (41.0) [0.89]	30 (30.0) [0.07]	29 (29.0) [0.14]	30
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 6.00$

$\lambda = 0.11$

Table 5.52 Relationship Between Solid Food Introduction for at Least 6 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 5	7 (19.4) [2.59]	18 (50.0) [3.90]	11 (30.6) [0.07]	36
≥ 6	39 (41.5) [0.99]	23 (24.5) [1.49]	32 (34.0) [0.03]	94
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 9.07$

$\lambda = 0.13$

Table 5.53 Relationship Between Solid Food Introduction for at Least 8 Months and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 7	27 (29.0) [1.06]	33 (35.5) [0.46]	33 (35.5) [0.16]	93
≥ 8	19 (51.4) [2.67]	8 (21.6) [1.15]	10 (27.0) [0.41]	37
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 5.91$

$\lambda = 0.07$

Table 5.54 Relationship Between Home-Prepared Carbohydrate Introduction for at Least 3 Months and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	6 (18.2) [2.76]	11 (33.3) [0.03]	16 (48.5) [2.36]	33
≥ 3	40 (41.2) [0.94]	30 (30.9) [0.01]	27 (27.8) [0.80]	97
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 6.90$

$\lambda = 0.12$

Table 5.55 Relationship Between Home-Prepared Carbohydrate Introduction for at Least 4 Months and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 3	13 (23.2) [2.35]	21 (37.5) [0.63]	22 (39.3) [0.65]	47
≥ 4	33 (44.6) [1.78]	20 (27.0) [0.48]	21 (28.4) [0.49]	83
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 6.38$

$\lambda = 0.11$

Table 5.56 Relationship Between Home-Prepared Vegetables Introduction for at Least 3 Months and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	9 (23.7) [1.47]	18 (47.4) [3.03]	11 (29.0) [0.20]	38
≥ 3	37 (40.2) [0.61]	23 (25.0) [1.25]	32 (34.8) [0.08]	92
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 6.64$

$\lambda = 0.11$

Table 5.57 Relationship Between Home-Prepared Vegetables Introduction for at Least 4 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 3	13 (22.8) [2.55]	24 (42.1) [2.22]	20 (35.1) [0.07]	57
≥ 4	33 (45.2) [1.99]	17 (23.3) [1.57]	23 (31.5) [0.06]	73
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 8.46$

$\lambda = 0.13$

Table 5.58 Relationship Between Home-Prepared Vegetables Introduction for at Least 6 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 5	31 (30.1) [0.81]	37 (35.9) [0.63]	35 (33.0) [0.03]	103
≥ 6	15 (55.6) [3.11]	4 (14.8) [2.40]	8 (29.6) [0.10]	27
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 7.08$

$\lambda = 0.07$

Table 5.59 Relationship Between Fruit Introduction for at Least 5 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 4	28 (30.8) [0.55]	36 (39.6) [1.86]	27 (29.7) [0.32]	91
≥ 5	18 (46.2) [1.28]	5 (12.8) [4.33]	16 (41.0) [0.74]	39
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 9.08$ $\lambda = 0.10$ **Table 5.60** Relationship Between Fruit Introduction for at Least 6 Months and WAZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 5	35 (32.7) [0.22]	39 (36.4) [0.82]	33 (30.8) [0.16]	107
≥ 6	11 (47.8) [1.00]	2 (8.7) [3.80]	10 (43.5) [0.75]	23
Total Observed Frequency (n)	46	41	43	130

 $p < 0.05$ $\chi^2 = 6.75$ $\lambda = 0.05$

Table 5.61 Relationship Between Formula Introduction for at Least 6 Months and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 5	5 (16.7) [2.61]	9 (30.0) [0.09]	16 (53.3) [3.78]	30
≥ 6	39 (39.0) [0.68]	34 (34.0) [0.03]	27 (27.0) [1.37]	30
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 8.53$

$\lambda = 0.13$

Table 5.62 Relationship Between Formula Introduction for at Least 7 Months and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 6	8 (21.1) [1.84]	12 (31.6) [0.03]	18 (47.4) [1.64]	38
≥ 7	36 (39.2) [0.76]	31 (33.7) [0.01]	25 (27.2) [0.97]	92
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 5.25$

$\lambda = 0.12$

Table 5.63 Relationship Between Other Liquid Introduction for at Least 2 Months and WHZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 1	11 (39.3) [0.24]	3 (10.7) [4.32]	14 (50.0) [2.43]	28
≥ 2	33 (32.4) [0.07]	40 (39.2) [1.16]	29 (28.4) [0.67]	102
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 8.89$

$\lambda = 0.12$

Table 5.64 Relationship Between Other Liquid Introduction for at Least 3 Months and WHZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	11 (33.3) [0]	6 (18.2) [2.22]	16 (48.5) [2.36]	33
≥ 3	33 (34.0) [0]	37 (38.1) [0.75]	27 (27.8) [0.80]	97
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 6.13$

$\lambda = 0.10$

Table 5.65 Relationship Between Home-Prepared Carbohydrate Introduction for at Least 2 Months and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 1	3 (15.8) [1.83]	5 (26.3) [0.26]	11 (57.9) [3.55]	19
≥ 2	41 (36.9) [0.31]	38 (34.2) [0.04]	32 (28.8) [0.61]	111
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 6.60$

$\lambda = 0.09$

Table 5.66 Relationship Between Home-Prepared Carbohydrate Introduction for at Least 3 Months and WHZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 2	6 (18.2) [2.39]	9 (27.3) [0.34]	18 (54.6) [4.59]	33
≥ 3	38 (39.2) [0.81]	34 (35.0) [0.11]	25 (25.8) [1.56]	97
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 9.80$

$\lambda = 0.14$

Table 5.67 Relationship Between of Home-Prepared Carbohydrate Introduction for at Least 4 Months and WHZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 3	13 (23.2) [1.87]	17 (30.4) [0.12]	26 (46.4) [3.02]	56
≥ 4	31 (41.9) [1.41]	26 (35.1) [0.09]	17 (23.0) [2.29]	74
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 8.80$

$\lambda = 0.15$

Table 5.68 Relationship Between Home Prepared-Carbohydrate Introduction for at Least 5 Months and WHZ

Observed Frequency (n) (Row %) χ^2	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 4	21 (27.6) [0.87]	23 (30.3) [0.18]	32 (42.1) [1.87]	76
≥ 5	23 (42.6) [1.22]	20 (37.0) [0.26]	11 (20.4) [2.63]	54
Total Observed Frequency (n)	44	43	43	130

$p < 0.05$

$\chi^2 = 7.03$

$\lambda = 0.13$

5.4.5 Relationship Between the Frequency of Feeding of Specific Food Items/Categories and Achieved Size

This section summarises the results of the chi-square analysis that tested the hypothesis that there is a relationship between the frequency of feeding specific food items/categories and achieved size.

The frequency that specific food items/categories were consumed had an effect on achieved size for only two food items/categories (Table 5.69). Those that were consuming home-prepared carbohydrates and vegetables 14 times or more in a week were more likely than those that were consuming these items less than 14 times per week to achieve WAZ scores in the first tertile (Table 5.69 and Table 5.71, $p < 0.05$, $\chi^2 = 6.17, 8.52$).

Table 5.69 Relationship Between the Frequency of Feeding of Specific Food Items/Categories and Achieved Size

	HAZ	WAZ	WHZ
Breastfeeding	NS	NS	NS
Formula	NS	NS	NS
Other Liquids	NS	NS	NS
Traditional Tonics	NS	NS	NS
Sugar Tonics	NS	NS	NS
Solid Foods	NS	NS	NS
Commercial Infant Cereal	NS	NS	NS
Commercial Infant Vegetable	NS	NS	NS
Commercial Infant Meat	NS	NS	NS
Home-Prepared Carbohydrates	NS	≥ 14 times/week (+)*, p<0.05	NS
Home-Prepared Vegetables	NS	≥ 14 times/week (+), p<0.05	NS
Fruits	NS	NS	NS
Home-Prepared Meats	NS	NS	NS
Snacks	NS	NS	NS
Table Foods	NS	NS	NS

* sign (+/-) indicates effect of frequency of food item/category on anthropometric index.

NS = not significant

Table 5.70 Relationship Between Consuming Home-Prepared Carbohydrates at Least 14 Times a Week and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 14	10 (21.7) [2.42]	19 (41.3) [1.39]	17 (35.0) [0.21]	46
≥ 14	36 (42.9) [1.33]	22 (26.2) [0.76]	26 (31.0) [0.06]	84
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 6.17$

$\lambda = 0.11$

Table 5.71 Relationship Between Consuming Home-Prepared Vegetables at Least 14 Times a Week and WAZ

Observed Frequency (n) (Row %) $[\chi^2]$	Tertile 1	Tertile 2	Tertile 3	Total Observed Frequency (n)
≤ 14	17 (25.4) [1.90]	28 (41.8) [2.23]	22 (32.8) [0]	67
≥ 14	29 (46.0) [2.02]	13 (20.6) [2.37]	21 (33.3) [0]	63
Total Observed Frequency (n)	46	41	43	130

$p < 0.05$

$\chi^2 = 8.52$

$\lambda = 0.13$

5.4.6 Effect of Infant Birthweight, Infant Birth Height and Parental Anthropometric Data on Achieved Size

This section summarises the results of the regression analysis on the hypothesis that infant birth weight, infant birth height and parental anthropometric data had an effect on achieved size.

A small positive correlation was found between maternal height and achieved HAZ score (Table 5.72, $p < 0.05$). A small negative correlation was found between paternal age and achieved HAZ (Table 5.72, $p < 0.05$).

No other associations between infant birth weight, infant birth height, parental anthropometric data, parental education and family income on achieved size were observed.

Table 5.72 Relationship Between Infant Birth Weight, Infant Birth Height
Parental Anthropometric Data, Parental Education, Income and Achieved
Size

	HAZ	WAZ	WHZ
Infant Birth Height	NS	NS	NS
Infant Birth Weight	NS	NS	NS
Maternal Height	$r = 0.29$ $r^2 = 0.08$ $p < 0.01$	NS	NS
Paternal Height	NS	NS	NS
Maternal Weight	NS	NS	NS
Paternal Weight	NS	NS	NS
Maternal Age	NS	NS	NS
Paternal Age	$r = -0.18$ $r^2 = 0.03$ $p < 0.05$	NS	NS
Maternal Education	NS	NS	NS
Paternal Education	NS	NS	NS
Family Income	NS	NS	NS

NS = not significant

CHAPTER 6
- DISCUSSION -

6. Discussion

The data support the hypothesis that infant feeding practices are associated with growth variance and show that length but not body weight of these infants achieved the NCHS standard. The overall objective of obtaining data on growth and feeding practices of 9 to 12 month old Chinese Canadian infants was achieved.

6.1 Growth

The first objective of this study was to obtain data on the growth (recumbent length and weight) for 9 to 12 month old Chinese Canadian infants in Toronto (Section 5.2). This sample of 9 to 12 month old Chinese Canadians in Toronto was able to meet the NCHS reference median in terms of length (Figure 5.2). However, at all ages, they were lower than the NCHS weight and weight for height (except ten months) reference median (Figures 5.5 and 5.6). This suggests that Chinese infants, at birth have the genetic potential to achieve lengths similar to Western children in advantaged situations, until at least 12 months of age.

Data from the current study confirm and extend from a study on four to eight month old Chinese Canadian infants in Toronto (Yeung et al., in press). First, the length data are consistent with the results of the Yeung study. In that study, at four months of age HAZ scores were significantly higher than the NCHS reference median, while at five, six and eight months they were not different (Figure 6.1). In the present study, at no age were the HAZ scores significantly different from the NCHS reference median.

Second, the weight data obtained extend from those obtained in the previous study (Yeung et al., in press; Figure 6.2). In that study, at four and five months of age, WAZ

scores were above the NCHS reference median. However, by six months of age the WAZ scores were not significantly different from the NCHS reference median and by eight months, they had fallen below. In the present study of 9 to 12 month old Chinese Canadian infants, at all ages, this sample of infants had lower weights than the NCHS median but did not continue the downward trend in WAZ scores seen in the four to eight month old infants.

Third, the weight for height results seen in the current study were also consistent with those observed previously (Yeung et al., in press; Figure 6.3). In the Yeung study, WHZ scores were higher than the NCHS weight for height reference median at four months and at five, six and eight months of age, the WHZ scores were not significantly different from the reference median. The decline in WAZ scores coupled with stable HAZ scores suggested that the infants might be getting thinner in comparison to the NCHS reference median. The Yeung study (in press) was unable to confirm that hypothesis as WHZ scores in that sample were not significantly lower than the NCHS reference median. The results of the present study can confirm that the infants were thinner than the NCHS reference median. In the present study, at all ages (except ten months), the WHZ scores were all significantly lower than the NCHS reference median (Figure 6.3).

Figure 6.1 Observed height for age z-scores (HAZ) of 4 to 12 month old Chinese Canadian infants (combined sexes).

Results expressed as mean $\pm$ standard deviation.

* significantly higher than NCHS reference median ($p < 0.05$)

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

Figure 6.2 Observed weight for age z-scores (WAZ) of 4 to 12 month old Chinese Canadian infants (combined sexes).

Results are expressed as mean $\pm$ standard deviation

• significantly higher than NCHS reference median ($p < 0.05$)

** significantly lower than NCHS reference median ($p < 0.05$)

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

Figure 6.3 Observed weight for height z-scores (WHZ) of 4 to 12 month old Chinese Canadian infants (combined sexes).

Results are expressed as mean $\pm$ standard deviation

* significantly higher than NCHS reference median ($p < 0.05$)

** significantly lower than NCHS reference median ($p < 0.05$)

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

6.2 Feeding Practices

The second objective of this study was to provide a qualitative description of the feeding patterns of 9 to 12 month old Chinese Canadian infants in Toronto (Section 5.3). Chinese Canadian parents did not adhere to CPS guidelines with respect to breastfeeding. However, the timing of solid food introduction to the infants was in accordance with practices recommended by Canadian professionals. Through their infant feeding patterns, it can be seen that the Chinese Canadian parents in this sample are incorporating aspects of their Canadian environment and Chinese heritage into their infant feeding choices.

The CPS recommends breastfeeding for at least the first six months of life (CPS, 1979). In this group of Chinese Canadian infants, 78.5% of mothers initiated breastfeeding. The breastfeeding rate dropped rapidly from birth (Table 5.9). By three months of age, only 42.3% of the study population were breastfeeding and by six months, only 17.7% of the infants were breastfed. A study of infant feeding practices in North York, Toronto found that 86.9%% of mothers initiated breastfeeding and by six months 44.1% were still breastfeeding (City of North York, 1994). Therefore, in comparison to their Caucasian counterparts in Toronto, this sample of infants had lower breastfeeding initiation and continuance rates.

However, in comparison to Chinese in Hong Kong and a previous sample of Chinese Canadian infants in Toronto, this group of Chinese Canadian infants had higher breastfeeding initiation and continuance rates. In Hong Kong, only 30% of the mothers initiated breastfeeding and by four months, only 4% of the infants were still being breastfed (Leung and Lui, 1990). In the Yeung (1993) study of Chinese Canadian

infants, 65.4% of the mothers started breastfeeding and by the fourth month, only 24.6% of the infants continued to do so. Table 6.1 compares the breastfeeding rates of Chinese Canadian infants between the previous study (Yeung, 1993) and the present study. The breastfeeding initiation and continuance rates in this study improved from those shown in previous studies, but remained lower than their Caucasian counterparts.

Table 6.1   Breastfeeding Rates of Chinese Canadian Infants (1993 and 1998)

Age (months)	1993 (%)	1998 (%)
0	65.4	78.5
1	52.8	60.0
2	36.9	53.8
3	28.5	42.3
4	24.6	28.3

The differences in breastfeeding rates may be related to both culture and environment. Chinese women are traditionally very modest. In Hong Kong, Chinese customs and beliefs prevail. Hong Kong is also a fast-paced Asian economic centre where mothers are anxious to return to work. In contrast, Chinese Canadian mothers live in a less pressurised environment, with long maternity leaves, and more acceptance of breastfeeding. A study by Leung and Lui (1990) revealed that embarrassment and inconvenience were the most cited reasons for not breastfeeding in Hong Kong. Other reasons included insufficient milk, the need to return to work, sucking problems, poor infant weight and breast and nipple problems. In this study inconvenience and insufficient milk were the most cited reasons for not breastfeeding (Table 5.8). Embarrassment was not a factor.

The belief that they had insufficient milk was a deterrent to breastfeeding in both Hong Kong and Canada. This belief also deterred breastfeeding in China (Guldan, 1995). To address this concern, Wang et al. (1987) studied both the volume and composition of breast milk secreted by Chinese mothers in Beijing and found the quality and quantity similar to that of developed countries. Therefore, it appears that the general concern among Chinese mothers of insufficient milk is unfounded.

The timing of solid food introduction in this sample of Chinese Canadian infants was in accordance with practices recommended by Canadian professionals. The CPS states that solids may be introduced at six months but not before three or four months. Before four months, only 0.8% infants in this sample had been introduced to solid foods. Solid foods were introduced to the majority of the infants at four months of age and by six months of age, 99.4% of the infants in this sample had been introduced to solid foods (Table 5.9).

The solid food choices of this group of Chinese Canadian parents showed both western and eastern influences. The first solid food introduced to the majority (80.8%) of the infants was commercial infant cereals (Table 5.12). Most infants (86.9%) were also introduced to commercial infant foods. The diets of these infants did not include only western foods. An Asian influence was also evident in the diets of these infants. Sugar tonics such as glucose were introduced to 15.4% of infants at the time of the study. 23.1% of the infants were introduced to traditional Chinese fortifying and/or cooling tonics. Home-prepared carbohydrates, which included such traditional infant staples as congee and soft rice were introduced to 90% of the infants by nine months of age. As a result, the diets of the infants in this sample could not be classified as either traditional

Chinese or Western. Elements of both cultures influenced the feeding pattern of this sample of infants.

Similarities were seen in the timing of solid food introduction and choices of solid foods between this sample and Hong Kong (Leung 1989; Leung and Lui, 1990). Hong Kong parents, similar to Chinese Canadian parents, delayed solid food introduction until four months of age. Infant cereal was the most prevalent solid food to be first introduced in both Hong Kong and Canada (Leung, 1989; Leung and Lui, 1990). Home-prepared carbohydrate was introduced to both sets of infants and the timing of introduction was similar. In Hong Kong, infants were introduced to home prepared carbohydrates between five to eight months of age (Leung and Lui, 1990). In this sample, home-prepared carbohydrate was introduced mainly between six to nine months of age (Table 5.9). The infant feeding choices and patterns of Chinese parents in Hong Kong and Canada were similar but there were also differences. The traditional tonics that were prevalent in Hong Kong (Sung et al., 1988) were not prevalent in the present sample. Only 28.5% of the present sample of Chinese Canadian infants had been introduced to traditional tonics (Table 5.9).

The similarities in infant feeding practices between Chinese parents in Hong Kong and Canada may be due to the fact that the majority of the families surveyed emigrated from Hong Kong. 67.7% of the infants had at least one parent from Hong Kong (Table 5.2). The differences in feeding patterns between Hong Kong Chinese infants and Toronto Chinese Canadian infants may be attributed to acculturation.

Chinese mothers in Toronto have established a feeding pattern unique to Chinese Canadians in Toronto. Due to the large Chinese Canadian population in Canada and

here in Toronto, this feeding pattern has some public health implications. Physicians need to be aware that traditional foods play a role in the diets of Chinese Canadians and therefore need to understand the nature and nutritional value of these foods. They should also be aware that Chinese Canadian mothers in Toronto have a low, though improving, rate of breastfeeding and should strive to understand and address the causes as well as the misunderstandings in order to effectively educate and encourage them to breastfeed.

6.3 Effects of Feeding Practices on Anthropometry

The objective of this section of the study was to examine the association between feeding patterns and growth variance for 9 to 12 month old Chinese Canadian infants in Toronto. Results of this section of the study were able to confirm the hypothesis that there was a relationship between feeding patterns and growth variance. Infant feeding practices were associated with growth variance between the ages of 9 to 12 months in Chinese Canadian infants (Section 5.4). The heavier and heavier for their achieved height infants were characterised by earlier introduction of other liquids, home-prepared carbohydrates, commercial baby meats, solid foods and sugars. Longer feeding of formula, other liquids, home-prepared carbohydrates, vegetables, fruits and solid foods was associated with higher weight and weight for height scores. Currently consuming commercial infant vegetables and consuming home-prepared carbohydrates and vegetables at least 14 times/week was associated with heavier infants.

Chinese infants in Canada are in an unique situation. This group of Chinese infants is relatively free of environmental and economic constraints (no associations were found between household income and achieved size). As a result, the interaction between the effects of the feeding patterns of Chinese infants on their achieved size can be more

effectively studied. The associations between growth and feeding patterns among this group of Chinese Canadian infants were similar to findings among infants in industrialised countries and unlike those found in China.

The associations of breastfeeding with lower weight measures observed in this study are consistent with the findings of numerous other studies. Reduced growth velocity (both height and weight) has been reported for primarily and exclusively breastfed infants as compared to the NCHS reference median between the ages of three to 12 months (Chandra, 1981; Dewey et al., 1989, 1995; Duncan et al., 1984; Hitchcock et al., 1985; Pomerance, 1987). In this sample lower WAZ scores were associated with breastfeeding for three to eight months (Section 5.4.4).

In this study, it appeared that the lower weight scores of breastfed infants did not have any adverse effects on their achieved height. The infants weighed less, but were just as tall as formula fed infants. The lower weight gain of breastfed infants in comparison to formula fed infants has not been associated with any deleterious consequences (Dewey et al., 1991). No evidence was found that would indicate a functional advantage to the more rapid growth of formula fed infants (Heinig et al., 1993a).

There has been some suggestion that breastfed infants are capable of self regulating their total energy intake when complementary foods are introduced to adjust for the added energy (Cohen et al., 1994; Heinig et al., 1993a, 1993b). In contrast, formula fed infants may be less able to. This may be a factor in explaining the associations seen in this study between solid foods and heavier infants in this predominantly formula fed group.

The associations of earlier solid food introduction with heavier infants are also consistent with findings from other studies (Forsyth et al., 1993; Kramer et al., 1985). The results of the present study also indicated that the timing of introduction to solid foods influenced achieved weight (Section 5.4.3). Solid food introduction at or by four months of age was associated with heavier babies. In addition, introducing solid foods for six and eight or more months was also associated with heavier babies. That means that among those introduced to solid foods for at least six months, infants that were nine months old at the time of the study, started solid foods no later than three months of age. Infants that were ten, 11 and 12 months of age started solid foods no later than four, five and six months of age in order to have been introduced to solid foods for at least six months. Similarly, in order to be introduced to solid foods for at least eight months, the nine month old infants within that category started solid foods no later than one month of age, the ten month olds no later than two months of age, the 11 month olds no later than three and 12 month olds no later than four months of age. However, based on information relating to the age of introduction of solid foods, solid foods were only introduced to 0.8% of the infants before three months of age and 13.8% of the infants before four months of age. It was not until four months of age that the majority of the infants in this study were introduced to solid foods. Therefore, collectively, these results suggest that introducing solid foods between four to six months leads to higher WAZ scores and thus heavier babies at 9 to 12 months of age.

The associations between feeding patterns and achieved size in this sample of Chinese infants in Canada were unlike those observed in China. Whereas in this sample, breastfeeding was associated with lower weight for age scores, in China longer duration of breastfeeding and exclusive breastfeeding are associated with positive deviance in growth (Gulden et al., 1993). The reason for this difference may be due to

environmental conditions. In China, infant formula is expensive and if available may be prepared excessively diluted. In such situations, breastfed infants would grow better than those not breastfed.

Associations between home-prepared carbohydrate including congee and anthropometric indices in this sample, also differ from China. In the Guldán study (1993) congee was associated with lower anthropometric measures. In this study, earlier home-prepared carbohydrate introduction and duration of home-prepared carbohydrate consumption was associated with higher weight and weight for height measures. The opposing findings between China and Canada may be due to the quality of the congee. How the congee was prepared and what ingredients were added to the congee was not measured in this study. However, there is some suggestion that the foods surrounding the congee also play an important role as baby meat, meats and the frequency of vegetable consumption were associated with higher weights.

The associations between feeding practices and growth variance cannot fully explain why the mean WAZ and WHZ scores fell below the reference median. Accounting for the associations between feeding practices and achieved size only reduced the error in WAZ and WHZ scores by 10-14% (as indicated by the λ values).

In the absence of other influences, genetics may be offered as an explanation for the lower weight scores. When the growth of our sample of Chinese Canadian infants and those from the Yeung (in press) sample were plotted against the growth of Hong Kong infants, the curves were very similar (Figures 6.4 – 6.9). In terms of height, both Hong Kong and Toronto infants closely follow the NCHS reference median (Figures 6.4 and 6.5). From four to six months, Toronto infants appear to be slightly taller. The pattern of

achieved size in terms of weight is identical between the two samples (Figures 6.6 and 6.7). Chinese infants in both Toronto and Hong Kong are able to meet the NCHS reference median from four to six months of age. After six months of age, they fall below the NCHS reference median. From 9 to 12 months of age, the pattern of growth between Chinese infants in Toronto and Hong Kong remains similar. It may be that while Chinese infants are able genetically to achieve heights similar to Caucasian infants, they are genetically predisposed to achieving lower weights. There is some epidemiological evidence to suggest that Asians, including Chinese, have lower body mass index scores than Europeans (Harland et al., 1997; Wang et al., 1994, 1996).

Figure 6.4 Comparison of mean height for age z-scores (HAZ) among Toronto, Hong Kong and NCHS (males).

Results are expressed as mean $\pm$ standard deviation.

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996a)

Figure 6.5 Comparison of mean height for age z-scores (HAZ) among Toronto, Hong Kong and NCHS (females).

Results are expressed as mean $\pm$ standard deviation.

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996a)

Figure 6.6 Comparison of mean weight for age z-scores (WAZ) among Toronto, Hong Kong and NCHS (males).

Results are expressed as mean $\pm$ standard deviation.

* significantly higher than NCHS reference median ($p < 0.05$).

** significantly lower than NCHS reference median ($p < 0.01$).

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996b)

Figure 6.7 Comparison of mean weight for age z-scores (WAZ) among Toronto, Hong Kong and NCHS (females).

Results are expressed as mean $\pm$ standard deviation.

* significantly higher than NCHS reference median ($p < 0.05$).

** significantly lower than NCHS reference median ($p < 0.05$).

*** significantly lower than NCHS reference median ($p < 0.01$)

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996b)

Figure 6.8 Comparison of mean weight for height z-scores (WHZ) among Toronto, Hong Kong and NCHS (males).

Results are expressed as mean $\pm$ standard deviation.

* significantly lower than NCHS reference median ($p < 0.05$).

** significantly lower than NCHS reference median ($p < 0.01$).

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996b)

Figure 6.9 Comparison of mean weight for height z-scores (WHZ) among Toronto, Hong Kong and NCHS (females).

Results are expressed as mean $\pm$ standard deviation.

* significantly higher than NCHS reference median ($p < 0.05$).

** significantly lower than NCHS reference median ($p < 0.05$).

*** significantly lower than NCHS reference median ($p < 0.01$).

¹ Results from 4 to 8 months of age are derived from Yeung et al. (in press)

² Leung et al. (1996b)

This study was designed to measure growth and qualitatively assess feeding patterns. It was unable to measure the impact of all influences on growth. It is possible that factors beyond the scope of this study influenced the growth of these infants.

The size measurements in this study were compared to the NCHS reference median. Those curves were based upon data from the Fels longitudinal study (Hamill et al., 1979). It is possible that due to environmental changes and changes in feeding practices, that sample no longer reflects the achieved weight of today's infants. A new reference standard being constructed based upon data obtained from the National Health and Nutrition Examination Survey (NHANES III) may be more appropriate for this sample of infants.

It is important to emphasise that being lighter than the NCHS reference median even as a population may not be a problem. This sample of infants, although statistically significantly below the reference median, in terms of actual mass they were only on average $0.52 \text{ kg} \pm 0.22 \text{ SD}$ below the NCHS reference median. This lower weight did not translate to a drop in height. Infants that are lighter than the reference do not necessarily suffer any physiological or functional disadvantages.

Within the sample there were biases that may have influenced growth. 72% of the infants had at least one parent who had completed university (Table 5.5). Commercial infant formula had been introduced to 74.6% of the infants by 4 months of age (Table 5.9). The majority of the infants (85.4%) were introduced to solid foods between 4 to 6 months of age. 67.7% of the infants had at least one parent from Hong Kong, which contributes to the similarities in feeding practices seen between this sample and Hong Kong infants (Table 5.2). In addition, this sample was not a random sample. All the

subjects were recruited at centres with a high density of Chinese ethnicity in order to facilitate recruitment. Thus this sample may not have been representative of the Chinese Canadian infant population.

As shown by the inclusion of traditional foods in the infant diets, Chinese Canadian mothers retained aspects of their cultural background. It is likely that they also retained some traditional child care attitudes, beliefs and practices. These factors may also have influenced growth.

Rice based foods appear consistently in the Chinese diet. Their predominance is one factor that distinguishes the Chinese diet from a Western diet. Their prevalence makes it difficult to assess their effects on growth. Ideally, the growth of Chinese infants not consuming home-prepared carbohydrates could be compared to the growth of Chinese infants consuming home-prepared carbohydrates. However, this is difficult to accomplish as shown by the present study, as home-prepared carbohydrates had been introduced almost universally (94.6%) (Table 5.9). This study was able to associate earlier introduction of home-prepared carbohydrates, longer duration of feeding of home-prepared carbohydrates and higher frequency of home-prepared carbohydrates consumption with heavier babies (Section 5.4.3 – 5.4.5).

Empirically, there appears to be a relationship between the introduction of home-prepared carbohydrates and weight. This can be seen when the results of the Yeung (in press) data on four to eight month old Chinese Canadian infants with the results of the present study are combined. WAZ scores start to drop after five months of age (Table 6.2). By eight to nine months of age, the WAZ scores seem to have stabilised. No significant differences in WAZ scores were observed between 9 to 12 months of age.

The drop in WAZ scores appear to coincide with the pattern of introduction to home prepared carbohydrates. Home-prepared carbohydrates were introduced starting from five months, just when WAZ scores were starting to fall. By nine months of age when WAZ scores seem to stabilise, almost the entire sample of infants had been introduced to home-prepared carbohydrates. Other complementary foods, (other liquids and other solid foods) also associated with weight. However, the pattern of introduction of these items did not coincide as well as home-prepared carbohydrate introduction to the changes in weight. With the exception of solid foods in general, these items were also not introduced to this sample of infants to the same extent as home-prepared carbohydrates. Further study is needed to examine this association.

This study was designed to qualitatively assess 'what' was being fed to these infants. It could not measure the 'when', 'how' or 'how much' was being fed. This study was a cross-sectional study, which allowed for relatively quick and easy data collection. This study was able to determine when the infants were introduced to solid foods and if they were still currently consuming solid foods. As infants were only sampled once, this study was unable to determine the pattern of solid food consumption between the time of introduction and the time of the study. This study could not determine if there had been a period where solid foods had been terminated and then reintroduced. It was also unable to determine how the solid food was introduced. This study was able to identify general feeding patterns, but was unable to assess the quality of the diet. A study that quantitatively measured food intake would be useful to more completely understand the feeding practices of Chinese infants.

Despite the sample bias and limitations in the study design, some comment can be made about the genetic growth potential of Chinese infants. The results of the present

study show that Chinese infants at birth have the genetic potential to achieve heights similar to those of Caucasian infants at 12 months of age. While there may be a genetic component, limiting weight growth of Chinese infants, this study was able to demonstrate that the diet, even in economically advantaged situations, affected achieved weight. There is a large component in the Chinese Canadian diet that differs from that of European infants. Home-prepared carbohydrates, a traditional staple, still play a large role in the diets of Chinese infants. Further research is needed in this area. In addition, no differences may be observed when the weights of these infants are compared against the new reference medians. Therefore, any statements regarding differences in genetic determination of body weight for height between Chinese and Caucasian infants are premature.

CHAPTER 7
- FUTURE RESEARCH -

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7. Future Research

Based on the results of the survey, a number of suggestions can be made for future research.

- 1. The growth (both weight and height) of this sample of infants should be compared to the new NCHS growth charts that are being constructed.**
- 2. Mothers in the Chinese Canadian population were less likely to initiate and sustain breastfeeding. The cultural aspects of breastfeeding among the Chinese Canadian population should be investigated in order to construct culturally appropriate strategies to promote breastfeeding in this population.**
- 3. This study was able to associate earlier introduction of home-prepared carbohydrates, longer duration of feeding of home-prepared carbohydrates and higher frequency of consumption of home-prepared carbohydrates with heavier babies. However, it was unable to associate home-prepared carbohydrate introduction in general with achieved size as 95.4% of the infants had been introduced to home-prepared carbohydrates. There were not enough infants not introduced to home-prepared carbohydrates with which to make comparisons. If a group of Chinese Canadian infants in the same age range as the present sample, that were not introduced to home-prepared carbohydrates were recruited, the effects of introducing home-prepared carbohydrates in general could be examined.**

4. Feeding patterns in this study were associated with growth variance. However, due to the qualitative nature of this study, this study was unable to determine the effects of quantity and quality of the diet on growth. A quantitative study would help answer those questions.

CHAPTER 8
- SUMMARY -

8. Summary

- 1. This sample of 9 to 12 month old Chinese Canadians in Toronto were able to meet the NCHS reference median in terms of height. However, at all ages, they were lower than the NCHS weight and weight for height (except 10 months) reference median.**
- 2. The feeding patterns of 9 to 12 month old Chinese Canadian infants in Toronto represented a mix of eastern and western foods. They did not adhere to CPS guidelines with respect to breastfeeding. However, the timing of solid food introduction in this sample of Chinese Canadian infants was in accordance with practices recommended by Canadian professionals. Their solid food choices incorporated aspects of their Asian background and Canadian environment.**
- 3. Infant feeding practices were associated with growth variance between the ages of 9 to 12 months in Chinese Canadian infants. The associations observed were primarily between feeding practices, weight and weight for height. The heavier and heavier for their achieved height infants were characterised by earlier introduction of other liquids, home-prepared carbohydrates, commercial baby meats, solid foods and sugars. Longer duration of feeding of formula, other liquids, home-prepared carbohydrates, vegetables, fruits and solid foods was associated with higher weight and weight for height scores. Currently consuming commercial infant vegetables and consuming home-prepared carbohydrate and vegetables at least 14 times/week was associated with heavier infants.**

CHAPTER 9
- CONCLUSIONS -

9. Conclusions

- 1. Feeding practices of Chinese Canadian infants are associated with growth variance. Breastfed infants were lighter and infants introduced to complementary foods earlier and for a longer duration were heavier.**
- 2. Feeding patterns of Chinese Canadian infants encompassed aspects of their cultural heritage and their present environment.**
- 3. Chinese Canadian infants in Toronto have the potential at birth to achieve growth patterns in terms of height reflected by the NCHS reference median from 9 to 12 months of age. In terms of weight and weight for height, they were lower than the NCHS reference median at all ages.**
- 4. Based on the available evidence and the questions that remain unanswered, it would be premature to attribute the lower weight scores of Chinese infants to genetic factors, as feeding patterns have a significant effect on weight. More research is needed.**

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APPENDIX A
- RECRUITMENT CENTRES -

**Dr. Cinda Lee
3420 Finch Avenue
Suite 408
Scarborough, Ontario
M1W 2R6
(416) 491-3331**

**Dr. John Lee
75 The Donway West
Suite 906
Don Mills, Ontario
M3C 2E9
(416) 445-4611**

**Dr. Richard Wong and Dr. Ho Yin Lai
4581 HIGHWAY 7 East,
Suite 109
Unionville, Ontario
L3R 1M6
(416) 940-0112**

**York – Finch Hospital Prenatal Class
Administrator: May Wong
2111 Finch Ave West
(416) 744-2500**

**Chinese Grace Baptist Church
20 Claremont St.
Toronto, Ontario**

**Grace Chinese Gospel Church of North York
201 Tempo Ave.
North York, Ontario
M2H 2R9**

**Milliken Chinese Community Church
390 Bamburgh Circle
Scarborough, Ontario**

APPENDIX B
- CLINICAL INFORMATION FORM
AND CONSENT FORM -
(English Version)

CLINICAL INFORMATION FORM

Title of Research Project:

The Growth and Feeding Patterns of Chinese Canadian Infants

Investigators:

Christina Sit, B.Sc.

G. Harvey Anderson,

Professor of Nutritional Sciences and Physiology

Patient Identification:

NAME OF INFANT:

DATE OF BIRTH:

Purpose of Research:

The overall objective of this study is to examine some of the factors influencing the nutritional status of Chinese Canadian infants between the ages of four months to one year. This will include information about growth and feeding habits of these infants.

Procedure:

Your child's length and weight will be measured. your child's medical records will be used to gather further information about his/her growth and health and you will be asked to fill out a questionnaire which will provide information about the infant's feeding habits as well as some family background. No names will be used in any reports from this study and all information will remain confidential.

Benefits:

Although there is no direct benefit to your child, the information obtained in this study may be important in understanding the nutritional status of Chinese Canadian infants. Proper nutrition, among other things, is very important in affecting growth. Not only is this information important in helping to ensure proper growth and development of Chinese Canadian children but may also help improve health services in China and lead to further important studies on the proper growth and development of Chinese children.

Risk/Discomforts/Alternatives:

There is no risk to your child and we only ask for about twenty minutes of your time to fill out the questionnaire.

CONSENT FORM

Title of Research Project:

The Growth and Feeding Patterns of Chinese Canadian Infants

Investigators:

Christina Sit, B.Sc.

G. Harvey Anderson,

Professor of Nutritional Sciences and Physiology

I acknowledge that the research procedures described on the attached form and of which I have a copy, have been explained to me and that any questions that I have asked have been answered to my satisfaction. I also understand the benefits of joining the research study. The possible risk and discomforts have been explained to me. I know that I may ask now, or in the future, any questions I have about the study or research procedures. I have been assured that records relating to me/my child and my/his/her care will be kept confidential and that no information will be released or printed that would disclose personal identity without my permission.

I understand that I am free to withdraw my child from the study at any time. I further understand that if my child does not participate in the study, or if there is withdrawal from it at any time, the quality of medical care for my child will not be affected.

I hereby consent for my child _____ to participate.

_____
Name of Guardian

The person who may
be contacted about
the research is:
Christina Sit

_____
Signature and Relationship,
e.g. Parent

Who may be reached at
telephone #:
978-0402 or 978-3700

_____
Name of Baby, and Age

_____
Witness

_____
Date

APPENDIX C
- CLINICAL INFORMATION FORM
AND CONSENT FORM -
(Chinese Version)

CLINICAL INFORMATION FORM

研究計劃明稱:

加籍中國嬰孩的成長及進食方式.

研究人員:

Christina Sit

G. Harvey Anderson 營養學及人體學教授

參與者身份:

嬰孩名字:

出生日期:

研究目的:

這次研究的總體目標是要考驗出什麼因素會影響到年齡介乎四個月至一歲的加籍中國嬰孩的營養狀況. 這會包括嬰孩的成長及進食習慣的資料.

程序:

你的嬰孩的體高及體重會被量度. 其健康紀錄會被用作關於他/她們的成長及健康情況資料. 你會被要求填寫一份有關你嬰孩的飲食習慣及家庭背景的問卷. 所有名字都不會公開於這些研究的任何報告內. 一切你提供的資料亦會是絕對保密.

利益:

雖然參與這次研究對你的嬰孩沒有直接益處, 但這些從研究中搜集的資料對了解加籍中國嬰孩的營養狀況很重要. 適當營養對成長是很重要的. 你提供的資料不但可使加籍中國嬰孩能有良好的成長及對發展有幫助, 它亦能改進中國的健康服務及進一步作中國嬰孩良好成長的研究很是重要.

可能引起的危險/不適/或其他:

這次研究對你嬰孩是沒有任何危險性的. 我們只需要你抽出二十分鐘的時間來填寫一份問卷.

同意書

我認同附表上及我所收到的副本上所述的研究程序已向我解釋清楚，而我所發問的問題亦得到滿意答覆。我更明白參與這次研究的好處及危險性或不適之處亦被解釋清楚。我知道我現在可以及將來也可以詢問關於這次研究工作上的任何問題。

我被保證關於我和我嬰孩及我和他/她的保健資料紀錄會絕對保密。未經我批准，我個人身份資料絕不能公開和刊登。

我明白我的嬰孩可以在任何時候退出這次的研究工作。我更明白如我的嬰孩不參與這次研究，或在任何時間退出，絕不會影響到我嬰孩的醫療保健性質。

我同意我的嬰孩 _____ 參與。

_____
監護人姓名

_____
簽名(與嬰孩的關係)
例：家長

有關於這次研究工作的任何事項，
可聯絡 Christina Sit.
電話 # (416) 978-0402 或
(416) 978-3700

_____
嬰孩姓名及年齡

_____
見證人

_____
日期

APPENDIX D
- QUESTIONNAIRE -
(English Version)

QUESTIONNAIRE

SUBJECT CODE _____

PART I

Date of visit: _____ / _____ / _____
(day) (month) (year)

Your baby's name: _____

Sex: 1. male   2. female

Date of birth: _____ / _____ / _____
(day) (month) (year)

Age: _____ weeks

Address: _____

Telephone: _____

About the pregnancy and your baby:

Before your baby was born, what did the doctor say was your baby's due date?

_____/_____/_____
(day) (month) (year)

How long did the mother remain in the hospital when the baby was born? If more than three days, why? _____

After birth, did the baby have any post-natal complications?

After leaving the hospital, has the baby been hospitalized again? If yes, why?

Is this baby a singleton or twin? _____
Is this your first, second, third, etc. child? _____

What was the birth date of your last child? _____

Baby's birth weight: ____ lbs. ____ oz. or ____ kg

Baby's height (length) at birth: ____ inch or ____ cm

About the baby's parents:

Are both the baby's parents Chinese? _____

Father

Mother

Name: _____

Age: _____ Years

Height: ____ ft. ____ inch or ____ cm

Weight: ____ lbs. or ____ kg

Weight of mother just before baby was born: ____ lbs. or ____ kg

Weight before mother was pregnant: ____ lbs. or ____ kg

Birth place _____

Where in China did the father's family originate from?

_____

How long has the baby's father been living in Canada? _____

Where in China did the mother's family originate from?

_____

How long has the baby's mother been living in Canada? _____

Part II

Date: _____

(1) Please answer the following questions about your baby's diet.

Milk

What was the very first milk feed received? _____

If not breast fed, why not? _____

	Has your baby ever received? (Yes or No)	At what age did you start to feed... (months)	At what age did you stop to feed... (months)	How often did your baby eat in the last 7 days? (times per week)
<u>Milk</u>				
Breast milk		NA		
Formula (commercial) fortified				
unfortified				
Cow's Milk homogenized				
2%				
Cow's Milk (powdered)				
Evaporated Milk				
Sweet Condensed Milk				
Other: (please specify)				

	Has your baby ever received? (Yes or No)	At what age did you start to feed... (months)	At what age did you stop to feed... (months)	How often did your baby eat in the last 7 days? (times per week)
<u>Cereal</u>				
Baby Cereal (commercial)				
Rice Flour (porridge)				
White Root Flour (Taro)				
Noodles				
Rice Congee				
Soft Rice				
Other: (please specify)				
<u>Meat</u>				
Egg Yolk				
Egg White				
Fish				
Meat (home prepared)				
Pork Liver				
Intestines				
Animal's Blood				
Other: (please specify)				

	Has Your Baby Ever Received? (Yes Or No)	At What Age Did You Start To Feed... (Months)	At What Age Did You Stop To Feed... (Months)	How Often Did Your Baby Eat In The Last 7 Days? (Times Per Week)
<u>Vegetables And Legumes</u>				
Soy Bean Milk				
Soy Bean Curd				
Vegetables (home prepared)				
Legume				
Seaweed				
Other: (specify)				
<u>Sugar</u>				
Glucose Drink (tonic)				
Honey Drink				
Yellow Sugar				
Rock Sugar				
Sugar Cane				
Candy				
Others: (please specify)				

	Has your baby ever received? (Yes or No)	At what age did you start to feed... (months)	At what age did you stop to feed... (months)	How often did your baby eat in the last 7 days? (times per week)
<u>Fruits</u>				
Apple				
Orange				
Banana				
Grapes				
Juice: (please specify)				
Others: (please specify)				
<u>Commercial Baby Foods</u>				
Baby Fruit				
Baby Vegetable				
Baby Dessert				
Baby Meat				
Baby Dinner				
Teething Biscuits				
Other: (please specify)				

	Has your baby ever received? (Yes or No)	At what age did you start to feed... (months)	At what age did you stop to feed... (months)	How often did your baby eat in the last 7 days? (times per week)
<u>Other Items</u>				
Water				
Soup (please specify)				
Herbal "Bo" (please specify)				
Herbal "Cooling" (please specify)				
Vitamins (please specify)				
Minerals (please specify)				
Table Foods				
Have you given your baby anything that we have not asked?				

- (2) Has baby's appetite been normal over the last 7 days? ____
 If no has it been better or worse? _____

For questions (3) and (4), please write a 1, 2 or 3 beside each of the people listed below.

1 = most important   2 = some importance   3 = no importance

- (3) Who has had some influence in making decisions about what the baby eats or drinks, since birth?

__ mother	__ father
__ maternal grandmother	__ maternal grandfather
__ paternal grandmother	__ paternal grandfather
__ doctor	__ other (specify) _____

(4) Who has had a role in taking care of your child?

☐ mother	☐ father
☐ maternal grandmother	☐ maternal grandfather
☐ paternal grandmother	☐ paternal grandfather
☐ child care centre	☐ other (specify) _____
☐ babysitter	

(5) Can we contact you again in three to six months to ask you these questions again?

_____

(6) Please do not answer the next two questions. This section to be filled out by the investigator:

Baby's present weight:

_____ kg

Baby's present height:

_____ cm

SUBJECT CODE _____

PART III

These additional questions are of a more personal nature and are intended to give us a better understanding of the composition of the population we are studying.

(7) What is the highest level of education completed by the baby's father?

Less than Grade 6 (Less than Primary School)	_____
Grade 6 (Primary School)	_____
Grade 9 (Form 3)	_____
Grade 11 (Form 5)	_____
Grade 12/13 (Matriculation - Form 7)	_____
College/University	_____

(8) What is the highest level of education completed by the baby's mother?

Less than Grade 6 (Less than Primary School)	_____
Grade 6 (Primary School)	_____
Grade 9 (Form 3)	_____
Grade 11 (Form 5)	_____
Grade 12/13 (Matriculation - Form 7)	_____
College/University	_____

(9) How many people are supported by your household income, including yourself? _____

(10) What range best describes your household income?

< \$15 000	_____
\$15 000 - \$25 000	_____
\$25 000 - \$35 000	_____
\$35 000 - \$45 000	_____
\$45 000 - \$55 000	_____
\$55 000 - \$65 000	_____
\$65 000 - \$75 000	_____
> \$75 000	_____
No response	_____

APPENDIX E
- QUESTIONNAIRE -
(Chinese Version)

問卷

第一部份

探訪日期：_____ 年 _____ 月 _____ 日

嬰兒姓名：_____ 性別：1. _____ 男 2. _____ 女

出生日期：_____ 年 _____ 月 _____ 日

年齡：_____ 星期

地址：_____

電話：(_____) _____

嬰兒和懷孕期的資料

在嬰兒誕生之前，根據醫生的判斷，嬰兒的預期是 _____ 年 _____ 月 _____ 日

嬰兒誕生之後，母親留在醫院有多久？如果是多過三天，為甚麼？

_____

嬰兒在出院後，有沒有再回到醫院接受治療，如果有，為甚麼？

_____

嬰兒是單胞胎或雙胞胎？ _____

嬰兒是你的第幾個孩子？ _____

嬰兒和你對上的孩子相距的年齡是： _____

嬰兒出生時的體重： _____ 磅 _____ 安士 或 _____ 公斤

身高： _____ 吋 或 _____ 厘米

嬰兒父母親的資料

嬰兒的父母是否都是中國人? _____

	父親	母親
姓名:	_____	_____
年齡:	_____	_____
身高:	_____ 呎 _____ 吋 或 _____ 厘米	_____ 呎 _____ 吋 或 _____ 厘米
體重:	_____ 磅 或 _____ 公斤	_____ 磅 或 _____ 公斤
出生地點:	_____	_____
籍貫:	_____	_____

嬰兒剛要出生之前，母親的體重是 _____ 磅 或 _____ 公斤

母親在懷孕之前的體重是 _____ 磅 或 _____ 公斤

嬰孩的父親在加拿大定居有多久? _____ 年 _____ 月

嬰孩的母親在加拿大定居有多久? _____ 年 _____ 月

第二部份

日期: _____

(1) 請回答下列有關嬰兒膳食的問題

嬰兒在剛出生時所進飲的是什麼奶? _____

_____

如果不是母乳，為什麼? _____

_____

奶類	有否進食 有/否	第一次進食 時有多大	最後一次進 食有多大	在過去七天內曾經進 食的次數(以星期計算)
母乳(人奶)				
嬰兒奶粉(含鐵質)				
(不含鐵質)				
鮮牛奶				
普通奶粉				
淡奶				
煉奶				
其他(請說明)				
穀麥類				
嬰兒麥粉				
米粉(糊仔)				
淮山粉				
麵				
粥				
稀飯				
其他(請說明)				
肉類				
蛋黃				
蛋白				
魚				
肉(自己煮)				
豬肝				
腸翼				
豬紅 或 雞紅				
其他(請說明)				

蔬菜 and 豆類	有否進食 有/否	第一次進食 時有多大	最後一次進 食有多大	在過去七天內曾經進 食的次數(以星期計算)
豆漿				
豆腐				
蔬菜(自己煮燉)				
豆類				
海藻				
其他(請說明)				
糖類				
葡萄糖水				
蜜糖水				
黃糖				
冰糖				
蔗糖				
糖果				
其他(請說明)				
水果				
蘋果				
橙				
香蕉				
葡萄(提子)				
果汁(請說明)				
其他(請說明)				

樽裝嬰兒食品	有否進食 有/否	第一次進食 時有多大	最後一次進 食有多大	在過去七天內曾經進 食的次數(以星期計算)
嬰兒水果				
嬰兒蔬菜				
嬰兒甜品				
嬰兒肉類				
嬰兒晚餐				
嬰兒餅乾				
其他(請說明)				
其他項目				
水				
湯(請說明)				
補湯(請說明)				
中國涼茶(請說明)				
肥仔水				
維他命(請說明)				
礦物質(請說明)				
其他(請說明)				

你有否讓嬰兒進食其他食物。 如果有，請說明。

- (2) 在過去七天內，嬰兒的胃口是否正常？ 如果不正常，
現在的胃口是好些或有轉壞的情形？

在下列問題 (3) 和問題 (4)，請選用： (1 - 非常重要，2 - 頗重要 或 3 - 不重要) 來作答。

(3) 在嬰兒出生後，誰人最有影響力來決定嬰兒的飲食。

_____ 母親	_____ 父親
_____ 外祖母	_____ 外祖父
_____ 祖母	_____ 祖父
_____ 醫生	_____ 其他(請說明)

(4) 誰人負責照顧嬰兒。

_____ 母親	_____ 父親
_____ 外祖母	_____ 外祖父
_____ 祖母	_____ 祖父
_____ 托兒中心	_____ 其他(請說明)
_____ 保姆	

(5) 我們可否在三至六個月之內，再請你回答同樣的問卷？ _____

(6) 請勿回答下列問題，這部份是由調查員填寫。

嬰兒現在的體重 _____ 公斤

嬰兒現在的身高 _____ 厘米

第三部份

此部份能讓研究員對嬰兒家庭中的成員作更詳盡了解。

嬰兒父親的教育程度：   1 小學六年級以下
                                     2 小學六年級
                                     3 中學二年級
                                     4 中學畢業
                                     5 大專畢業

嬰兒母親的教育程度：   1 小學六年級以下
                                     2 小學六年級
                                     3 中學二年級
                                     4 中學畢業
                                     5 大專畢業

包括你自己在內，家庭的總收入要維持多少人的生活費？ _____

請選擇最接近的數字。

< \$15,000
\$15,000 - 25,000
\$25,000 - 35,000
\$35,000 - 45,000
\$45,000 - 55,000
\$55,000 - 65,000
\$65,000 - 75,000
> \$75,000
沒有意見。

APPENDIX F
- PROCEDURES FOR ANTHROPOMETRICS -

PURPOSE: To obtain accurate, measurements of infant weight and height at ages 9, 10, 11 and 12 months of age. Each anthropometric measurement is done 3 times during the visit.

Weight

- Zero scale
- Calibrate against the 5 lb weight
- Undress infant
- Place on scale, weigh
- Remove infant from scale
- Allow scale to zero before taking next measurement

Height

- Place the plane on a hard flat surface
- Lay the infant on the plane with the head at the top
- The infant should be lying flat and centred on the board
- Have a second person cup the infant's head and position the infant's head against the top of the plane
- Infant should be facing straight up with head flat against the headboard
- Hold the plane footpiece in one hand while placing the other hand on the infant's left shin or knee
- Press down on infant's left leg to straighten while moving the footpiece into position against the infant's feet
- Ensure infant is in position, take measurement

(Reference: How to weigh and measure children: assessing the nutritional status of young children in household surveys. United Nations Dept. of Technical Co-operation for Development and Statistical Office. New York, 1985)

APPENDIX G

- QUESTIONNAIRE WITH EPI6 ENTRY FIELDS -

The Growth and Feeding Patterns of
9 - 12 Month Old Chinese Canadian Infants

QUESTIONNAIRE

Date of {visit} <dd/mm/yy>

{Last Name} _____
{Birthday} <dd/mm/yy>

{First Name} _____
{Age} ##.## {Sex} _

ABOUT THE PREGNANCY AND THE BABY:

Baby's {Expected} Due Date: <dd/mm/yy>
{Gestation}, {Expected - Birthday}: ##

How long did the mother remain in the hospital when the baby was born?
{momhos}: ##

If {longer} than three days, why? _____

After leaving the hospital, has the baby been hospitalized again? {rehos} <Y>
If yes, why? {whyrehos}:
_____

Is the baby a {singleton} or twin? <y>
Is this your first, second, third, etc. child? {childnum} ##
How old the baby's closest in age {sibling}? ##

Baby's {birth weight}:   Kilos   ##.##
                                                 LBS   ##
                                                 OZ   ##
Baby's {height} at {birth}:   cm   ##.##
                                                 In   ##.##

ABOUT THE BABY'S PARENTS:

FATHER:
{DAge}:   ##
{DHeight}:   cm   ###.##
                                                 Ft   ##
                                                 Inch   ##
{DWeight}:   Kilos   ##.##
                                                 Pounds   ###

Birth Place {DBPlace}: _____
How long has the baby's father been living in Canada? {DadCan} ## years
Where in China did the father's family originate from {DChina}? _____

MOTHER:
{MAge}:   ##
{MHeight}:   cm   ###.##
                                                 Feet   ##
                                                 Inches   ##
{MWeight}:   Kilos   ##.##
                                                 Pds   ###
Weight of mother before the baby was born? {PWeight}:   Kilos   ##.##
                                                                                 P.LBS   ###
Weight before the mother was pregnant {BPWeight}:   Kilos   ##.##

BP.LBS   ###
                      ###.# kg

(Mweight gain) during pregnancy: _____
 Birth Place (MBPlace): _____
 How long has the baby's mother been living in Canada? (MomCan)   ## years
 Where in China did the mother's family originate from (MChina)? _____

INFANT FEEDING PATTERNS:

What was the (first milk) received? _____
 If (not breast) fed, why? _____

MILK AND MILK PRODUCTS

(Brs) Breast Milk	<Y>	{BrsST} ###.#	{BrsSP} ###.#	{BrsFQ} ###.#
(For)tified Formula	<Y>	{ForST} ###.#	{ForSP} ###.#	{ForFQ} ###.#
(Unf)ortified Formula	<Y>	{UnfST} ###.#	{UnfSP} ###.#	{UnfFQ} ###.#
(Hom)o Milk	<Y>	{HomST} ###.#	{HomSP} ###.#	{HomFQ} ###.#
(Two)percent	<Y>	{TwoST} ###.#	{TwoSP} ###.#	{TwoFQ} ###.#
(Evp)orated	<Y>	{EvpST} ###.#	{EvpSP} ###.#	{EvpFQ} ###.#
(Cnd)ensed	<Y>	{CndST} ###.#	{CndSP} ###.#	{CndFQ} ###.#
(Che)ese	<Y>	{CheST} ###.#	{CheSP} ###.#	{CheFQ} ###.#
(Yog)urt	<Y>	{YogST} ###.#	{YogSP} ###.#	{YogFQ} ###.#
(Milk) in general	<Y>	{MilkST} #	{MilkFQ} ###.#	

CEREAL

Baby (Cer)eal	<Y>	{CerST} ###.#	{CerSP} ###.#	{CerFQ} ###.#
Rice Flour (Rfl)	<Y>	{RflST} ###.#	{RflSP} ###.#	{RflFQ} ###.#
White Root Fl (Tar)	<Y>	{TarST} ###.#	{TarSP} ###.#	{TarFQ} ###.#
(Noo)dles	<Y>	{NooST} ###.#	{NooSP} ###.#	{NooFQ} ###.#
Rice (Con)gee	<Y>	{ConST} ###.#	{ConSP} ###.#	{ConFQ} ###.#
Soft (Ric)e	<Y>	{RicST} ###.#	{RicSP} ###.#	{RicFQ} ###.#
(NRi)ce	<Y>	{NRiST} ###.#	{NRiSP} ###.#	{NRiFQ} ###.#

Home Prepared (Carb) in general	<Y>	{CarbST} ###.#	{CarbFQ} ###.#

MEATS

(Yol)k	<Y>	{YolST} ###.#	{YolSP} ###.#	{YolFQ} ###.#
(Whi)te	<Y>	{WhiST} ###.#	{WhiSP} ###.#	{WhiFQ} ###.#
(Fis)h	<Y>	{FisST} ###.#	{FisSP} ###.#	{FisFQ} ###.#
(Mea)t	<Y>	{MeaST} ###.#	{MeaSP} ###.#	{MeaFQ} ###.#
(Pli)ver	<Y>	{PliST} ###.#	{PliSP} ###.#	{PliFQ} ###.#
(Int)es	<Y>	{IntST} ###.#	{IntSP} ###.#	{IntFQ} ###.#
(Blo)od	<Y>	{BloST} ###.#	{BloSP} ###.#	{BloFQ} ###.#

(Meat) in general	<Y>	{MeatST} ###.#	{MeatFQ} ###.#

VEGETABLES AND LEGUMES

(Soy)Milk)	<Y>	{SoyST} ###.#	{SoySP} ###.#	{SoyFQ} ###.#
(Tof)u	<Y>	{TofST} ###.#	{TofSP} ###.#	{TofFQ} ###.#
(Veg)	<Y>	{VegST} ###.#	{VegSP} ###.#	{VegFQ} ###.#
(Leg)ume	<Y>	{LegST} ###.#	{LegSP} ###.#	{LegFQ} ###.#
(Sea)weed	<Y>	{SeaST} ###.#	{SeaSP} ###.#	{SeaFQ} ###.#

(Veggies) in general	<Y>	{VeggiesST} ###.#	{VeggiesFQ} ###.#

SUGAR

{Glu}cose	<Y>	{GluST} ###.	{GluSP} ###.	{GluFQ} ###.
{Hon}ey	<Y>	{HonST} ###.	{HonSP} ###.	{HonFQ} ###.
{Yel}sugar	<Y>	{YelST} ###.	{YelSP} ###.	{YelFQ} ###.
{Roc}sugar	<Y>	{RocST} ###.	{RocSP} ###.	{RocFQ} ###.
{Can}e Sugar	<Y>	{CanST} ###.	{CanSP} ###.	{CanFQ} ###.
{Sof}t drink	<Y>	{SofST} ###.	{SofSP} ###.	{SofFQ} ###.

{Sugar} in general	<Y>	{SugarST} ###.	{SugarFQ} ###.

FRUITS

{App}le	<Y>	{AppST} ###.	{AppSP} ###.	{AppFQ} ###.
{Org} Orange	<Y>	{OrgST} ###.	{OrgSP} ###.	{OrgFQ} ###.
{Ban}ana	<Y>	{BanST} ###.	{BanSP} ###.	{BanFQ} ###.
{Gra}pes	<Y>	{GraST} ###.	{GraSP} ###.	{GraFQ} ###.
{Mel}ons	<Y>	{MelST} ###.	{MelSP} ###.	{MelFQ} ###.

(Including Watermelon, canteloupe and honeydews)

{Pap}aya	<Y>	{PapST} ###.	{PapSP} ###.	{PapFQ} ###.

{Fruits} in general	<Y>	{FruitsST} ###.	{FruitsFQ} ###.

{Jui}ce	<Y>	{JuiST} ###.	{JuiSP} ###.	{JuiFQ} ###.

COMMERCIAL BABY FOODS

{BFr}uit	<Y>	{BFrST} ###.	{BFrSP} ###.	{BFrFQ} ###.
{BVg}etable	<Y>	{BVgST} ###.	{BVgSP} ###.	{BVgFQ} ###.
{BDs}ert	<Y>	{BDsST} ###.	{BDsSP} ###.	{BDsFQ} ###.
{BMe}at	<Y>	{BMeST} ###.	{BMeSP} ###.	{BMeFQ} ###.
{BDn}ner	<Y>	{BDnST} ###.	{BDnSP} ###.	{BDnFQ} ###.

Commercial {Babyfood} in general <Y>

{BabyfoodST} ###.	{BabyfoodSP} ###.	{BabyfoodFQ} ###.

{Tee}thing Biscuits	<Y>	{TeeST} ###.	{TeeSP} ###.	{TeeFQ} ###.

OTHER ITEMS

{Wat}er	<Y>	{WatST} ###.	{WatSP} ###.	{WatFQ} ###.
{Sou}p	<Y>	{SouST} ###.	{SouSP} ###.	{SouFQ} ###.
{Bou}	<Y>	{BouST} ###.	{BouSP} ###.	{BouFQ} ###.

Please specify {SpecBou}

{SpecBou}

{SpecBou}

{Coo}ling Tonics	<Y>	{CooST} ###.	{CooSP} ###.	{CooFQ} ###.

Please specify {SpecCoo}

{SpecCoo}

{SpecCoo}

{Vit}amin	<Y>	{VitST} ###.	{VitSP} ###.	{VitFQ} ###.

Please specify {SpecVit}

{SpecVit}

{Min}erals	<Y>	{MinST} ###.	{MinSP} ###.	{MinFQ} ###.

Please specify {SpecMin}

{SpecMin}

{Bre}ad	<Y>	{BreST} ###.	{BreSP} ###.	{BreFQ} ###.

{Adu}lt Cereals	<Y>	{AduST} ###.	{AduSP} ###.	{AduFQ} ###.

{Cok}ies	<Y>	{CokST} ###.	{CokSP} ###.	{CokFQ} ###.

{Tab}le Food	<Y>	{TabST} ###.	{TabSP} ###.	{TabFQ} ###.

Have you given your baby anything that we have (not asked)? <Y>

If yes, please specify

{Oth}Food _____

{Oth}er Food _____ {OthST} ###.# {OthSP} ###.# {OthEQ} ###.#_

Has the baby's (appetite) been normal over the last seven 7 days? <Y>

If (not normal) why? _____

WHO HAS INFLUENCE IN MAKING DECISIONS ABOUT WHAT THE BABY EATS OR DRINKS
SINCE BIRTH?

{MomIN}	#	{DadIN}	#	{MGmIN}	#
{MGfIN}	#	{PGmIN}	#	{PGfIN}	#
{LitIN}	#	{FrnIN}	#	{NanIN}	#
{DocIN}	#	{OthIN}	#		

WHO HAS HAD A ROLE IN TAKING CARE OF YOUR CHILD?

{MomCAR}	#	{DadCAR}	#	{MGmCAR}	#
{MGfCAR}	#	{PGmCAR}	#	{PGfCAR}	#
{DayCAR}	#	{SibCAR}	#	{NanIN}	#
{OthCAR}	#				

ANTHROPOMETRIC MEASUREMENTS:

Weight:	{WeightI}	###.## kg
	{WeightII}	###.## kg
	{WeightIII}	###.## kg
	{Weight}	###.## kg
Height:	{HeightI}	###.## cm
	{HeightII}	###.## cm
	{HeightIII}	###.## cm
	{Height}	###.## cm

	PERCENTILES	Z-SCORES	3 OF MEDIAN
Height for Age	{HAP} ###.##	HAZ ###.##	HAM ###.##
Weight for Age	{WAP} ###.##	WAZ ###.##	WAM ###.##
Weight for Height	{WHP} ###.##	WHZ ###.##	WHM ###.##

Record {Flag} #

MATERNAL EDUCATION: (Please Choose the most appropriate answer)

{MLGr6}	<Y>
{MGr6}	<Y>
{MFm3}	<Y>
{MFm5}	<Y>
{MFm7}	<Y>
{MColUn}	<Y>

PATERNAL EDUCATION: (Please choose the most appropriate answer)

(PLGr6)	<Y>
(PGr6)	<Y>
(PFm3)	<Y>
(PFm5)	<Y>
(PFm7)	<Y>
(FColUn)	<Y>

How many people are supported by your family income including yourself?
 (IncSup)   ##

What range best describes your household income?

(L15T)	<Y>
(15Tt25T)	<Y>
(25Tt35T)	<Y>
(35Tt45T)	<Y>
(45Tt55T)	<Y>
(55Tt65T)	<Y>
(65Tt75T)	<Y>
(G75T)	<Y>

□