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A DIETARY AND ANTHROPOMETRIC ASSESSMENT OF VISUALLY IMPAIRED CHILDREN

by

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ABSTRACT

Sixteen visually impaired children participated in a study designed to assess dietary intake, anthropometry and feeding skills acquisition. Research instruments included a three-day diet record and a questionnaire on ages of feeding skills mastery.

Mean daily intake of 8 nutrients assessed met recommendations, while folic acid was 31% below and kilocalories were marginally below recommendations. Intakes of kilocalories and retinol were below those reported in the Nutrition Canada Survey. Less than two-thirds of the children met recommendations for kilocalories (43%), thiamin (57%), retinol (50%) and folic acid (28%). This may or may not have reflected the fact that few subjects consumed recommended servings from Canada's Food Guide for cereal products (78%), milk, meat or produce (43%), or vegetables alone (28%).

Over 50% of the children were within average ranges for stature, weight and weight-for-stature; however, five were overweight-for-stature. Triceps skinfolds were within normal (80% subjects) or lower ranges, and arm muscle area within normal (60%) or upper (40%) ranges, indicating sufficient energy intake and expenditure, despite marginal intake of RDNI for kilocalories.

While impaired subjects accepted textural food progressions and mastered feeding skills later than sighted controls, ages were within normal ranges of a developmental standard. Application of a one-tailed t-test revealed cup-feeding mastery ("weaning") was significantly later among the visually impaired ($P<0.005$). Both visually impaired and sighted exhibited similar incidences of bottle or combination feeding

(88% vs. 81%), bottle feeding of nonmilk foods (69%), feeding problems (38% vs. 25%) and nutrient supplementation (44%).

Overall, the impaired children were analogous to sighted Canadian children, regarding the assessed parameters. Nutrition education should reinforce maintenance of energy balance, and promote adequate consumption of a wide variety of food, particularly foods high in retinol, fiber, and folic acid.

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INTRODUCTION

The aim of any intervention program for the visually handicapped child should be guidance toward attaining the greatest possible independence in a sighted world. Independence begins with the ability to care for one's own physical needs. Successful nutritional management is one such way of achieving and maintaining physical well-being; however, few (if any) dietary or anthropometric studies have been done on visually impaired children from which such management principles can be established. Therefore, the purpose of this research is to assess the dietary intake, anthropometry and feeding skills acquisition of visually impaired children in order to create a comprehensive base on which nutrition management and education can be developed.

I. REVIEW OF LITERATURE

Few studies have been done on the dietary status of the handicapped child in society (Garton and Bass, 1974). Webb (1980) commented that classifications of handicaps usually only consider the major handicap; thus, the child is labelled with a particular disability while little insight is given on possible nutritional implications. The minimal research available on the visually impaired child is desperately lacking in information regarding feeding and nutrition problems which may be present. Rather, existing literature focuses on feeding practices associated with visually impaired children which deviate from the perspective of "normal" child development.

A. Overview on Blindness

There are over 30,000 legally blind individuals living in Canada. During 1979, 13% of the people registered with Canadian National Institute for the Blind (CNIB) were under age 19 (CNIB, 1979). There are 43,000 blind children in the United States (American Foundation for the Blind, 1975). In both countries, legal blindness is defined as central visual acuity of 20/200 or less in the better eye after correction and/or, visual acuity of more than 20/200 if there is a field defect in which the widest diameter of field of vision subtends an angle no greater than 20 degrees (Taylor, 1974).

The visually impaired child has much the same needs as his sighted peer. His family life should include love, cognitive stimuli, and such activity as his body needs to grow strong and efficient. The dietary intake and anthropometric status are sensitive to the type of care and environment provided for the child; hence, these measures may reflect the degree to which the child's needs are fulfilled.

Apart from his handicap, the visually impaired individual often requires medical intervention beginning at birth. Many visually impaired infants are considered "high risk" because of prematurity, both in weight and early arrival. Barsch (1968) reported that 42% of the blind children in his study were full term, while 50% were delivered prior to term. This and other circumstances, such as multiple congenital handicaps, account for the incubation and prolonged hospitalization common among the population (Woods, 1975).

B. Dietary Practices of Visually Impaired and Other Disabled Children

Information on the dietary practices within this population is sparse. Jan and coworkers (1977) stated that breastfeeding is significantly less common than bottle feeding among the visually impaired ($p < .05$). It was theorized that early separation (such as hospitalization) is detrimental to the formation of the mother-infant bond. Woods (1975) reasoned that the handicap may shock and depress the mother, who reacts by providing only essential routine care. She is reluctant to stimulate the infant, perhaps out of anxiety, guilt, or uncertainty (Jan et al., 1977). She may feel rejection when the lack of eye contact from her infant is misinterpreted as indifference. This negative attitude is reinforced when the child does not smile or show pleasure when she enters a room, but becomes unduly quiet -- again, behavior which is incorrectly labelled as disinterest. As a result, the infant may be left alone for long periods of time with a bottle propped beside him.

Palmer and Horn (1978) define a feeding problem as "...the inability or refusal to eat certain foods because of a neuromotor dysfunction, obstructive lesions, or psychological factors interfering with eating, or a combination of two or more of these". The feeding problem should be viewed as a symptom rather than a specific clinical entity. Feeding problems are detrimental in that they limit the child's potential for receiving nutrients from a wide variety of foods. In addition, such problems can have a negative impact on the psychosocial development of the child, not to mention the peace of mind of individuals in his environment.

Studies on nutritional disorders of children have concluded that one fourth of all children present feeding difficulties (Bartlett, 1928; Kanner, 1972). More recent data indicate a somewhat higher incidence of feeding problems in handicapped children. Palmer and colleagues (1975) reported that 33% (n=500) of patients examined in specialized pediatric clinics exhibited feeding problems. Barsch (1968) investigated the incidence of feeding problems of 177 handicapped children. He found that 43% of the total population had experienced difficulties, noting that the blind subgroup, at 25%, had the lowest such incidence. This value is comparable to that found in the typical pediatric population.

Palmer and colleagues (1975) identified six categories of feeding problems while examining the incidence of difficulties. Categories included prolonged subsistence on pureed food, difficulty in mastication, bizarre food habits, multiple food dislikes, delay in self-feeding, and mealtime tantrums. A classification system was also developed, wherein the six problems were causally attributed to behavioral mismanagement, neuromotor dysfunction, and/or mechanical obstruction. Analysis of the data revealed that prolonged intake of pureed food (27%) and difficulty in mastication (24%) were the most common problems reported. Fully 74% of the problems were etiologically linked to neuromotor dysfunction, such as delayed maturation.

Few studies have examined the incidence of feeding difficulties experienced by visually impaired children. The existing literature indicates that the prolonged use of pureed food and difficulty in chewing are the most frequently observed problems -- findings which parallel those of Palmer and coworkers (1975).

Jan and colleagues (1977) investigated ages at which certain feeding skills were acquired by groups of congenitally blind, partially sighted, and sighted children in British Columbia. Significant differences were found between the two visually impaired groups and the control group concerning the introduction of solid foods (ie. chopped or junior food). While sighted children received solids at a mean age of nine months, those with partial vision or congenital blindness were maintained on milk, strained food until 12 or 19 months respectively. One blind child did not receive solid food until age five, whereas the extreme was 24 months for the sighted group.

The feeding problems for which these children are well known often begin at birth, though they are more obvious by weaning time (Freeman, 1975). Jan and coworkers (1977) found differences approaching significance ($p < .06$) after examining the age of weaning (presumably from bottle or breast to cup). While sighted children were weaned at a mean age of 12.7 months, the partially sighted and congenitally blind children lagged behind at 16 and 20 months respectively. Researchers pointed out that some children in both the partially sighted and congenitally blind groups were weaned as late as six years.

Similar findings were reported by Elonen and Zwarensteyn (1964). Their survey revealed that some blind children were not weaned until four or five years of age, far beyond the usual weaning period. It was reasoned that late weaning may be the fault of parents who dislike the mess associated with introductory cup feeding.

Frequent observations have been made on the delay or refusal to chew. An item analysis of the Vineland Social Maturity Scale for use with blind children (Maxfield-Fjeld Scale) ascertained that 50% of first successes at masticating food occurred at 18 months (Norris et al., 1957). This was compared to the average age of 10 months, at which first successes are expected to emerge among sighted children. Investigators suggested that parents of blind children have lowered expectancy levels for their children, which is manifest in the delayed introduction of foods which encourage chewing.

In order to understand chewing problems, one must have basic knowledge concerning chewing as an emergent behavior in child development. Prior to four months, oral contact with a spoon or cup stimulates the tongue-thrusting movement of the suck-swallow reflex into action (Baer, 1980). Food is typically extruded from the mouth outwards as the infant attempts to swallow in the manner used to drain a nipple of fluid. The feeding utensil is also a source of gum stimulation, resulting in the mouth closure and holding behavior characteristic of the bite reflex.

The ability to chew normally follows the disappearance of the tongue-thrust reflex (Illingworth and Lister, 1964). Mature rotary chewing patterns are not possible until the lateral bite reflex fades out, typically between three and five months (Baer, 1980). It also follows shortly after the child has established coordination between eyes and body movement, so as to grasp and bring objects to the midline (ie. mouth). These factors are thought to institute a critical period of developmental readiness for the introduction of solid foods, which in turn encourage the development of mature chewing patterns (Illingworth and Lister, 1964). A delay beyond this sensitive stage may instigate later deviance in the acquisition of feeding skills. Norris and coworkers (1957) stress that "...the more time that elapses between the time of optimal readiness and the time when the opportunity for learning is provided, the greater the difficulties in learning become". As the motivation for chewing passes without necessary stimulation (solid foods), the child retains his passive role as far as eating is concerned (Elonen and Zwarensteyn, 1964). Duncan (1971) states that the delayed progression in these basic skills is closely related to the child's potential to reach independence.

The voluntary chewing pattern is influenced primarily by visual observation and imitation; hence, its acquisition would be affected by the lack of sight. Jan and coworkers (1977) surveyed children with congenital blindness, partial vision, and normal vision to determine the incidence of chewing problems. Fifty-two percent of the blind and 21% of the partially sighted children had problems, while only 3.8% of the sighted children were reported to have difficulties.

As the visually impaired child matures the ease of using fingers may preclude the use of utensils in self-feeding. Parmalee and colleagues (1959) evaluated the development of 20 premature children, 10 of whom were partially sighted or blind as a result of retrolental fibroplasia. Researchers investigated the age of successful acquisition of independent spoon-feeding over a five year period, as one of four self-help tasks. Analysis of data revealed that some blind subjects were not yet feeding themselves by 4 1/2 years, and partially sighted subjects were not successful until a mean age of three years. It should be pointed out that half of the blind children had normal mental potential that was functionally suppressed because of severe emotional problems. In addition, all results should be interpreted with the realization that a blind child is most difficult to evaluate between one to three years of age, when language is not well developed (Parmalee et al., 1959).

A study involving mothers of visually impaired children was conducted to examine specific basic skills mastery of their children (Scott et al., 1977). Mothers reported that self-feeding and talking were the most difficult areas in which to promote independence in their exceptional children. Over half the parents polled in another survey found it more arduous to teach their visually impaired children feeding skills than was the case with their sighted children (Jan et al., 1977).

Elonen and Zwarensteyn (1964) stated that the permissive attitude of parents is partially responsible for delayed self-feeding skills. The parents give up trying to teach good eating habits, and permit the child to eat with his fingers; hence, the use of utensils is not encouraged. As the child persists in messy habits, the parents may react adversely to this behavior by increasing negative feelings towards the child.

Children who do not see others eating and enjoying food are more apt to feed themselves by hand if foods offered have a strong smell or flavor, or are unfamiliar (Scott et al., 1977). This behavior is not to be confused with a delay or regression in feeding skills. The fingers and mouth are the most sensitive receptors in the blind individual's contact with food. "The opportunity to explore the environment through the use of these senses provides valuable information to be processed and utilized with other sensory data in perceptual development" (Barraga, 1973).

A preference for finger feeding (due to its relative ease, as compared to manipulating utensils) by the older child and adolescent may result in a dependency on fast foods and frequent snacking. These individuals are often in situations where they have little opportunity to learn how to control the portions or type of food served, or to model themselves upon the eating patterns of other people (Snoy and van Benten, 1978). Parents with unresolved guilt over the handicap may provide the child with sweets and high-calorie desserts to appease their own feelings. Well-intentioned friends and relatives might offer food as a compensation for the child's disability. Frequently, gratification from food is substituted for many of the normal sources of gratification which are blocked because of the visual limitation (Snoy and van Benten, 1978).

Although emphasis has been placed on deviant patterns of feeding behavior, these patterns are <u>not</u> inevitable. Some blind children learn to eat normally, some even using utensils dextrously at an early age. "One of the most universally accepted misconceptions concerning blind children is that their development is necessarily slower than that of the sighted" (Elonen and Zwarensteyn, 1964). Rather, these exceptional children have unusual developmental patterns, with extreme acceleration in some areas, and with complete lacks in others.

C. Physical Status of Visually Impaired Children

Blind children are potentially more sedentary than their sighted peers. Normally, activity is initiated by visual stimuli and culminates in behaviors that respond to these stimuli (Rusalem, 1972). To this extent, blindness is a barrier between the individual and his environment; however, the handicap itself is not the cause for decreased activity.

Delayed motor coordination is common in blind infants who do not experience proper stimulation in an appropriate environment (Krause, 1955). The infant may not be motivated to explore his environment because he does not receive visual and other sensory cues, thereby underscoring his stereotype as a passive, dependent individual.

The urge for physical activity, especially in the early years, may be restrained by other individuals. Buell (1970) stated that two-thirds of 10,000 blind and visually impaired children of school age were categorically excused from physical education, or participated in inactive table games. Schools rationalized that these children would be subject to more injuries, unable to participate, and require additional supervision.

Overprotective parents, teachers, and friends may prevent the impaired child from joining into physical activities, "...this 'shield' from unseen obstacles, danger, and unnecessary hurt often becoming detrimental to the physical development of the visually impaired" (Oliver, 1970). Indeed, the lack of regular exercise predisposes the blind to the "hypokinetic disease syndrome" that includes obesity, hypertension, diabetes, mellitus, arteriosclerosis, increased cardiac risk, and a reduced life expectancy (Jankowski and Evans, 1981).

D. Implications of Dietary Practices and Physical Status

The nutritional implications of this dietary and physical regimen are numerous. The early introduction of bottle feeding imposes a dietary disadvantage. Formula lacks the immunological components intrinsic to breast milk such as secretory immunoglobulin A, complement, lactoferrin, lactoperoxidase, lysozyme, and the bifidus factor (György, 1971; Mata and Wyatt, 1971). These substances are thought to protect the infant through inhibiting the growth of microorganisms, decreasing allergic reactions, and promoting an intestinal flora of bifidobacteria. Human milk has been found to have a higher bioavailability of certain nutrients, such as iron and zinc, when compared to some formulas (Johnson and Evans, 1978). On the other hand, the lower mineral and protein composition of breast milk results in a desirably lower solute load and surface curd tension following ingestion by the infant (Worthington et al., 1978).

Bottle feeding may promote overfeeding, a precursor of obesity. When the caregiver can see the fluid content of a bottle, he or she encourages the infant to drain it, despite earlier signs of satiety. An artificial endpoint is introduced, with respect to the amount of fluid consumed; hence, this practice may be synonymous with overfeeding

(Fomon, 1973). Studies have shown that the bottle fed infant grows more rapidly in weight during the first four months of life (Fomon et al., 1971). However, a recent study of 403 Canadian infants found such differences were transient, and concluded that fatness during infancy is not determined by the type of feeding (Yeung et al., 1981).

The prolonged and excessive use of milk is a common problem in the handicapped pediatric population (Dufton-Gross, 1979). Such a diet may be low in certain nutrients, particularly iron. Gouge and Ekvall (1975) reported that 21% handicapped children surveyed had an iron intake that did not meet the recommended dietary allowances. This result was correlated with low hemoglobin levels (12 gm), and the use of milk as a primary source of nourishment for an extended period of time.

In and of itself, milk is a very poor source of iron; consequently, an over-reliance on milk contributes to the likelihood of iron-deficiency anemia. In fact, intakes of milk exceeding a liter per day have been cited for contributing to as much as 50% of iron deficiency anemia in children (Woodruff et al., 1972).

The intake of iron and other nutrients is affected by the physiological limitations of the child. The total volume of milk ingested quickly fills the stomach, thereby curtailing the consumption of additional food needed for optimal nutrition. As a result, many of the nutritional problems that develop are related to the lack in variety and a total absence of food sources of specific nutrients (Dufton-Gross, 1979). For example, the preschool child who consumes over a liter of milk daily is often too satiated to eat the iron-rich foods needed by his growing body (Worthington et al., 1978). This may partially explain the low intake of animal foods containing high quality (heme) iron, specifically meat, in handicapped children whose diets were composed primarily of milk (Gouge and Ekvall, 1975). Additional consideration must be made for those children whose inability to chew restricts the consumption of meat and its presentation as a textured food requiring mastication.

In contrast, foods prepared for easy mastication receive extensive surface exposure to water, air and heat during cooking, thereby facilitating the loss of water-soluble, heat-labile, and oxygen-sensitive vitamins. Water-soluble minerals are affected in a similar manner. These methods of preparation might limit further the potential nutrient intake and dietary status of the handicapped child. An investigation was made of the vitamin C nutriture of two groups of mentally subnormal subjects, one on a normal and one on a minced diet composed of the same foods (Griffiths, 1966). Urinary saturation tests revealed significant differences ($p < .005$) in total ascorbic acid excretion, with the group on minced foods showing a high degree of ascorbic acid saturation, ie., retention. The lower excretion was attribted to the low ascorbic acid content of the minced diet, in which prolonged boiling and mechanical modification led to exposure of the vitamin to heat and oxidation.

The risk of folate deficiency is heightened if food receives excessive cooking or is strained, as is the case in the diets of many handicapped children. Hoppner (1971) examined the free and total folate activity in several varieties of strained fruits and vegetables. The value for folate activity in these items was much lower than that tabulated for fresh produce of similar variety.

Studies on the diets of handicapped children demonstrate intakes lacking in fresh fruits and vegetables (Webb, 1980). Many of these children have bowel dysfunctions such as constipation, for which the diet is partially responsible (Dufton-Gross, 1979). The parent might delay increasing the texture of the diet if the child is unable or refuses to chew, or exhibits episodes of behavioral mismanagement at mealtime. On the other hand, the child might refuse any textured foods in favor of refined starches, pureed mixtures of food, and milk. Berkow (1977) states that dietary habits such as these may cause common, functional types of constipation in children. The foods offered fail to provide the variety in texture and fiber needed to facilitate elimination. Limited physical activity might enhance such a problem.

The child who subsists on pureed foods is at a sensory disadvantage. Strained, homogenous mixtures do not stimulate the child to experience the flavor and texture of individual foods. As a result, the development of taste and tactile discrimination by the tongue receives minimal promotion (Webb, 1980). The diet does not provide the variation in texture necessary to stimulate and reinforce chewing; consequently, the development of facial muscles (which are essential in speech acquisition) is also hindered (Finnie, 1970).

Energy consumption is an important aspect of the dietary profile, with reference to overall quality, quantity, and frequency of caloric intake. Handicapped children are more prone to a positive energy balance due to decreased activity; thus, their caloric needs are often less, not more, than those of "normal" children (Kalisz and Ekvall, 1978). Sabry and Kerr (1979) reported that the energy intake of the deaf adolescent was typically below that recommended by the Canadian Dietary Standard (CDS). However, the fact that mean weight was slighltly above the average weight for Canadian 15-year olds suggested that the deficit, relative to the CDS, was not only of energy, but also of expenditure.

In contrast, cerebral-palsied children may have consistently low intakes, and individuals with feeding problems may consume adequate calories (Hammond et al., 1966; Gouge and Ekvall, 1975). Freeman (1975) commented that the deaf-blind child tends to eat less than the average child, and has a poorer appetite. No literature is available on the energy intake of the visually impaired child.

The excessive use of fast foods and sweets may interfere with the intake of nutrient-dense foods, particularly when the energy content of selected foods is derived from concentrated carbohydrates and an otherwise low nutrient profile. On the other hand, the careful selection of fast foods can supply up to 50% of the recommended allowance for protein (Shannon and Park, 1980). The average adolescent consumes food two to six times per day, and those eating less than three times have poorer diets than those eating more frequently (Hampton et al., 1967). This indicates that the tendency to snack might significantly affect the quality of nutrient intake, depending on food choices. A survey of deaf teenagers in Ontario reported that one tenth of the day's food energy was consumed as snacks (Sabry and Kerr, 1979). Although snacks contributed close to 10% of the total fat and carbohydrate intake, they also provided similar percentages of the ascorbic acid and calcium consumed during the day.

A survey on food preferences of deaf children produced results that contrasted with those of Sabry and Kerr (1979). Garton and Bass (1974) reported that food preferences were analogous to those for hearing children, with salads and vegetables receiving lowest preference ratings. It was concluded that intakes of vitamin A and ascorbic acid could be affected adversely if preferences were consistent with intake.

Blindness itself has no effect on height or weight; however, associated factors may contribute to an altered physique. Lower extremities are better developed than upper extremities, particularly in children who are encouraged to walk at a "normal" age (Elonen and Zwarensteyn, 1964). The arms are utilized less because the child is not shown, nor can he see, the execution of manual skills. Krause (1955) stated that blindness is often accompanied by a flabby, undeveloped musculature in children with retrolental fibroplasia-induced visual impairment. Visually impaired children tend to lack in neuromuscular control and development because they do not use their muscular systems to an optimal extent (Oliver, 1970).

Studies of the anthropometric parameters of handicapped children provide mixed results, with regard to height and weight. Gouge and Ekvall (1975) found that 38% of the disabled children surveyed were below the third percentile for height, and 32% subjects were below the third percentile for weight. Both incidences were related to low birthweight, male sex, and the two to six year age interval. Krause (1955) observed that 33 of 107 blind children studied exhibited low weights or stunted growth at some point during childhood. The deaf-blind child also tends to have a small physique, but this does not appear to affect the final size and weight reached (Freeman, 1975).

Conversely, obesity may be a problem for the visually impaired child. A recent study of 20 blind children concluded that the average child was characterized by age-related obesity and a low tolerance for exercise (Jankowski and Evans, 1981). Obesity has been cited as a serious problem for many visually handicapped adolescents, for a number of reasons (Snoy and van Benten, 1978). Among these are poor dietary habits and an inadequate concept of their own body image and that of good physical structure. The traumatic phase of adolescence holds a double stigma for the blind youth, when the presence of a handicap leads to social withdrawal (ie., inactivity) and potential obesity. Such would be the case if caloric intake were to exceed the amount of energy expended in activity, especially if limits were imposed by virtue of the handicap.

The aim of any intervention program for the visually impaired child should be guidance toward attaining the greatest possible independence in a sighted world. This research project is being conducted in view of its potential implications. The information gleaned will expand the limited body of knowledge on the status of visually impaired children. In addition, results will serve as a basis for the development of nutrition education for visually impaired children, their primary caregivers, and health professionals -- education on successful food and nutrition management, an important accomplishment in the pursuit of a healthy, independent lifestyle.

II. PURPOSE AND OBJECTIVES

The purpose of this study is to assess the dietary intake, anthropometry and feeding skills acquisition of visually impaired children in order to create a comprehensive base on which nutrition management and education can be developed. Five objectives were developed to direct the study toward the attainment of this goal:

1. To compare the dietary intake of visually impaired children to recommendations of the Canadian Dietary Standard and to data collected in the Nutrition Canada survey;

2. To compare the food consumption patterns of visually impaired children to recommendations of Health and Welfare Canada and to data collected in the Nutrition Canada (Manitoba) survey;

3. To measure and interpret anthropometric parameters of visually impaired children with reference to standards;

4. To compare the ages of acquisition of specific feeding skills of visually impaired children with sighted children and reference norms;

5. To measure and compare the frequency of infant feeding practices, feeding problems, and vitamin supplementation with sighted children.

On the basis of the review of literature describing the dietary intake, anthropometry, and feeding behavior of visually impaired children, the following hypotheses (H_0) were formulated:

1. The dietary intake of visually impaired children does not meet selected recommendations of the Canadian Dietary Standard.

2. Food consumption patterns of visually impaired children do not meet recommendations of Health and Welfare Canada.

3. Visually impaired children have less muscle mass and more fat mass compared to reference data.

4. Visually impaired children do not acquire specific feeding skills significantly later than sighted children.

5. Breastfeeding is not significantly less common with visually impaired children compared to sighted children.

6. Visually impaired children do not have a significantly higher frequency of feeding problems compared to sighted children.

III. METHODOLOGY

A. Research Instruments

1. Food Record

a. Rationale for Selection of Food Record

Numerous studies have investigated various methods used to collect data in short-term dietary surveys (Huenemann and Turner, 1942; Bransby et al., 1948; Trulson, 1954; Young et al., 1952b). Dietary methodologists have researched the consumption patterns of individuals in specific sectors of the human population utilizing different procedures. Groups surveyed include residents of certain countries (Sprauve and Dodds, 1965; Abraham et al., 1974), people living in certain regions of a country (Haider and Wheeler, 1979; Eppright et al., 1972), people in specific age groups (Guthrie, 1963), and those with physical disabilities (Hammond et al., 1966; Sabry and Kerr, 1979).

Despite the number of techniques used, each of these surveys met the objective of a dietary survey, that is, "to obtain information about current food consumption behavior of individuals with various demographic and socioeconomic characteristics" (U.S.D.A., 1972). At the same time, differences in the objectives, sample size and traits, and limitations of time, money, and personnel affected the conceptualization and measurement of food intake (Burk and Pao, 1976; Beal, 1967). "Usual" intakes of subjects were subject to cyclical changes, so that there was no way of knowing the true "usual" dietary intake of an individual. These and other considerations draw one to conclude that there is no singular, generally accepted method of measuring the dietary intake of free-living individuals (Marr, 1971).

The three-day estimated food record was chosen to collect dietary data for this study. The estimated record, or household measures procedure, employs standard household utensils, portion estimation and description as part of keeping a dietary record. The rationale behind the selection of this method is multi-faceted. It is best explained in relation to objectives of the study, the small sample size, and the characteristics of the target population. The latter included pediatric, impaired subjects, most of whom attended school. In addition, primary caregivers were utilized in the recording of dietary intake data.

As stated earlier, the primary purpose of this study was to investigate the dietary intake and anthropometric status of visually impaired children. Objectives underlying this goal included comparing dietary intake data to reference data and other research data, and interpreting the quality of nutrient intake and anthropometric data. The needs of this research design were best met through the use of an individual dietary survey, in which measures of average nutrient intake were obtained. Intake data can also be correlated with other measures of nutritional status, such as anthropometric parameters (Caliendo, 1979).

The small sample size (less than 50 subjects) was a limiting factor in the selection of a method for data collection. The 24-hour recall was rejected for two reasons. First, such a technique requires a large sample to produce fairly reliable data on nutrient intake. Individual 24-hour recalls are sufficient only if the sample size is large enough to characterize the population of interest (den Hartog and van Staveren, 1979). Young and coworkers (1952b) stated that a recall is suitable when studying the intake of at least 50 subjects, and where ten percent variability in results is tolerable.

The recall was also dismissed because it does not take into account the high degree of day-to-day variation in the individual diet. Since a single day's intake may be atypical of usual consumption, it is naive to expect results to correlate highly with other physical or biochemical data (Beal, 1969). According to Marr (1971), "No one day's intake has shown to be valid for any group of individuals, nor for any nutrient or kilocalories. It is essential to survey...for a sufficient period to enable 'customary' intake to be assessed".

The smaller the sample, the more critical it is to have full cooperation of the subjects; hence, the researcher must select an instrument that promotes maximal participation of those involved. A review of the literature reveals the cooperation rates and other factors of surveys which utilized the dietary record. Particular attention is directed toward studies with characteristics similar to those in this project, mentioned earlier.

Children under ten years of age are usually too young to be trusted with the sole charge of recording their food intake (Young et al., 1951). Although the child is the focal point of this study, his or her young age and visual impairment require that the primary caregiver be responsible for recording dietary intake data. Guthrie (1963) had mothers keep seven-day records of foods actually eaten, rather than offered, to their infants. Seventy-seven percent of the sample (n=52) produced reliable records. Sabry and coworkers (1974) used three-day food records in a study on evaluative techniques for use with children's diets. When 58 mothers of preschool children were asked to maintain records, 47 (81%) of the mothers were able to provide completed dietary intakes. In another study, mothers of preschool children kept three-day records, in which they were encouraged to include detailed descriptions of the food. An exceptionally high cooperation rate resulted, as 95% (n=121) of the sample produced completed records. Burk and Pao (1976) speculated that some type of screening procedure was operating in the sample selection to generate such a high return. Dierks and Morse (1965) admitted that the respondents, all university students, were more highly educated than the general population; thus, the sample was biased.

Cooperation rates may be influenced by the degree of burden imposed on the caregiver by the dietary methodology. Marr (1971) reported that the record survey is generally regarded as eliciting a better response than a weighed survey. The former is less demanding, in that food is described in common household measures, or compared in size to food models. A study by Eppright and coworkers (1952) compared records of 25 children's dietary intakes that were estimated, then weighed by their mothers. Nutritive values from both types of records were found to correlate. The researchers concluded that when records are maintained by the consumer, information is probably as satisfactorily obtained by servings as by weighed amounts.

The use of nonstandard equipment, and errors in estimation of portion size may introduce variation and potential error in diet record-keeping (Young et al., 1952a; Burk and Pao, 1976).

Nevertheless, "...loss in validity can be set against the increased usefulness of data derived from samples of the population living normal lives, for whom precise weighing techniques are impractical" (Marr, 1971).

Children involved in the current study contributed data to records maintained by their caregivers. The children were encouraged to recall everything they ate or drank of which the caregiver was unaware (ie., school snack). This aspect of the design posed another question, namely, "how well do school children recall what they have eaten?". Samuelson (1970) had 8- and 13-year old children recall foods eaten at lunch, after which a like amount of food was weighed and analyzed. The results were only slightly more variable for most nutrients than the actual weighing method. It was concluded that recall and actual consumption agreed well enough to deem adequate the recall as given by children for evaluating nutrient intake.

In a similar survey, Emmons and Haynes (1973) compared lunch recalls of 6- to 12-year old children with lunches known to be eaten by subjects in the lunchroom, in order to test the validity of children's recalls of school lunches. The ability to recall correctly foods eaten improved with age, with the youngest children remembering an average of 60%, and the oldest children an average of 81% of the foods. In addition, primary foods (entrees) were easier to recall than secondary foods (ie., desserts, condiments). More significant correlations were found between the nutritive levels from the children's recalls of lunches and lunches actually eaten than between that calculated between mothers' and children's recalls for a given day. This suggests that young children _can_ provide comprehensive dietary information as accurately, or more accurately, than their mothers.

When children are required to recall food consumed at a meal, underestimation of food intake increases with an increase in the number of foods. Meredith and colleagues (1951) found that 47% of the children surveyed omitted one to four foods from recalls, thereby creating a lack of agreement when recalled and recorded items were compared. Nevertheless, relatively small differences occurred in the calculated nutrient analysis. This and other studies indicate that the average child is able to report what he or she has eaten. This helps the caregiver to provide a more reliable, accurate dietary record than the caregiver alone can provide (Burk and Pao, 1976).

b. Design of the Food Record

The multi-pronged question of "how many days, which days, and when?" had to be addressed when designing the food record collection. Chalmers and colleagues (1952) specified that the investigator must be certain the dietary record covers a sufficient period of time to furnish an adequate picture of nutrient intake, but also avoid prolonging record-keeping, which decreases the subject's accuracy in reporting subsequent food intake. Although an estimated record can be kept for an indefinite period of time, it is not usually feasible to extend the survey beyond one week (Marr, 1971). Furthermore, shorter (ie., three-day) records may be appropriate if high return rates and maximal compliance are critical to the research. Studies examining correlations of nutrient intake between three- and seven-day records denote that little information is lost by utilizing the former, as intake for the first three days (of a longer recall) agree closely with averages for the full seven days (Heady, 1961).

Ekvall (1978) outlined a multi-level approach for nutritional assessment of the mentally retarded and developmentally disabled. Dietary investigation was delineated into minimal and in-depth levels of assessment. Accordingly, the three-day dietary record kept by a parent was determined as appropriate for an in-depth investigation. Such a record must be detailed, and maintained over two weekdays and one weekend day.

The rationale for including a weekend day has been borne out in several surveys, in which significant differences were found between weekdays and weekend days for nutrient intake (Cellier and Hankin, 1963; Hankin et al., 1967). Eppright and researchers (1952) evaluated the effect of days on intake records of schoolchildren. Different children had adequate diets on different days, so that day-to-day variability of nutrient intake was fairly large. Weekend habits differed from school day habits, especially where milk and meat were concerned (lower and higher intakes on weekends). Investigators concluded that "...any combination of three weekdays may represent the weekday intake as accurately as another, but weekend habits are likely to differ significantly from those of the five school days".

Primary caregivers in the current study were instructed to keep the three-day Diet Diary over two weekdays and one weekend day. Selection of specific days within this framework was left to the discretion and convenience of the caregiver. All field data were collected between April 29 and September 9, 1981 by the author.

c. The Diet Diary: A 3-Day Food Record

The dietary intake of each visually impaired child was recorded in a three-day Diet Diary by his or her primary caregiver. The Diet Diary was designed specifically for this project (Appendix B). The first page features a sample day's entry for a 12-year old child, which was used as an instruction tool during the first interview as well as a model for recording by the caregiver. Following the sample are pages explaining how to measure and describe food in household measures, including three methods of describing mixed dishes. Each entry page was dated according to the day the intake was to be recorded. Two pages were provided for each day, and the second page for each day left space for recording whether (and if not, why) the intake was typical. The date and time of the follow-up interview were entered in the appropriate spaces inside the cover.

2. Anthropometry

a. Rationale for Anthropometry

Measurements of body size and composition are essential to the evaluation of the health and nutritional status of children (Martin and Beal, 1978). Such physical assessment has particular application to the handicapped pediatric population. Ekvall (1978) stated that growth is one of the targets in evaluating developmentally disabled children. It follows that anthropometric measurements, as indicators of growth, are of utmost importance.

Although a variety of anthropometric measurements have been recommended, height or length, weight, and skinfold thickness are the most useful (Caliendo, 1979). Following is a description of the techniques used to measure these parameters.

b. Measurement Techniques

i. Stature

Stature is the most important measurement for the assessment of linear growth (Frankle and Owen, 1978). It is generally agreed that children up to 24 months of age be measured for recumbent length, and for height thereafter. Since both measurements were used in this study, the term "stature" was adopted to include both length and height.

The Infantometer (Grafco)[1] was employed to measure stature of subjects less than 24 months of age. The technique was similar to that outlined by Fomon (1973), who devised an anthropometric examining table for the same purpose. The caregiver was instructed to hold the recumbent infant's head so that his plane of sight was vertical, and apply traction to bring the head in contact with the fixed headboard. The interviewer held the infant's feet, toes upward, while bringing the movable footboard to rest firmly against the infant's heels.

Older subjects were measured in a standing position according to a standard technique (Fomon, 1973). A flexible steel measuring tape was fixed to a true vertical flat surface, preferably the edge of a wall. The child, shoes removed, stood on a bare horizontal floor, with heels, lower back, shoulders, and occipitus touching the wall. A rigid leveler squared at right angles against the wall was lowered to the crown of the head and the measurement noted immediately

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[1] Graham-Field Surgical Co., Inc., New Hyde Park, N.Y. 11040

on the questionnaire.

The single measurement value of stature was recorded to the nearest quarter inch. Larger increments would have been too crude, especially for children at borderline levels of low stature (Frankle and Owen, 1978).

ii. Weight

Body weight is probably the best index of nutrition and growth, as it reflects the energy intake of the present or near past (Caliendo, 1979). A beam balance scale is the instrument of choice for measuring weight (Fomon, 1973; Frankle and Owen, 1978). The conditions of this project precluded such a cumbersome instrument. More specifically, it was necessary to travel extensively and conduct individual home interviews in order to maximize cooperation of the subjects and caregivers. A portable spring balance scale was chosen for its size, which offered convenience in transport and measurement. In addition, this scale was recognized as a familiar object by those surveyed, thus reducing prior anxiety over survey procedures. This scale was tested with a known weight several times to ensure accuracy and reliability in measurement.

A standard procedure was employed in weighing each subject. The scale was placed on a flat, bare surface and balanced. The child, barefoot and clad in light indoor clothing, was guided to the scale. His feet were positioned in the center of the platform and arms hung freely at the child's side. The interviewer recorded the one indicated value to the nearest half pound.

A modified procedure was used with subjects under 24 months old. The caregiver was weighed on the scale. Next, the interviewer placed the subject in the caregiver's arms, and recorded the composite weight. The infant's weight was determined by subtracting the caregiver's weight from the composite weight.

iii. Triceps Skinfold and Upper Arm Muscle Area

Although measurements of stature and weight are helpful in assessing overall growth, they fail to differentiate fat from other anatomical constituents, such as muscle and bone and soft tissue, in the evaluation of body size. The triceps skinfold is the most convenient method with which to assess body fat objectively (Frankle and Owen, 1978). Arm muscle area may indicate the amount of stored protein in, and level of activity of the subject. Results would be useful when one is considering dietary modifications in the child's caloric and nutrient intake.

The Inser-Tape (Ross Laboratories) and Lange Skin-fold Caliper were selected to measure the arm circumference and triceps skinfold because each instrument provided a distinct advantage. The insertion tape improved control, alignment, and reading of the circumference compared to conventional tapes; thus, it provides a rapid, simple, and reliable method for measurement (Zerfas, 1975). The Lange Skin-fold Caliper was preferred for measurement of pediatric subjects because the area included within the jaws (30 mm^2) was small enough to be practical for use with infants, while meeting recommendations of the Committee on Nutritional Anthropometry (Fomon, 1973).

The measurement of upper arm muscle area and triceps skinfold was performed according to methods outlined by Frisancho (1974). The distance between the left acromium and olecranon was measured and the midpoint marked. Upper arm circumference was measured to the nearest millimeter with the Inser-Tape while the left arm hung relaxed.

In measuring the skinfold, the interviewer grasped the layer of skin and subcutaneous tissue with the first finger and thumb of one hand, one centimeter above the marked midpoint. The caliper, having a pressure of $10 g/mm^2$ of contact surface area, was applied over the marked midpoint tissue. The reading was made three seconds after application of the caliper. Three readings were taken at the same site, each to the nearest 0.5 millimeter, and the figures were averaged together.

Arm muscle area was calculated according to the method described by Frisancho (1974), and recorded to the nearest millimeter.

3. Questionnaire

a. Rationale

Clinical assessment of the nutritional status of the disabled child should include information on the development of feeding skills, which should follow a well-defined sequence (Palmer and Horn, 1978). Typically, the child is compared to a standard chart, listing average ages at which feeding skills are acquired. The ensuing profile reveals the developmental level at which the child functions at various ages. In addition, it measures the child's ability to cope independently with the environment at different stages of early life.

The difficulty in using standardized developmental tables is that they may fail to account for certain influences on the child's progress. For instance, the average ages listed may have been compiled after surveying a large, multi-cultured sample, so as to be representative of the population at large, and its diversity of cultures. Nevertheless, such a criterion might not account for parents within a given culture who have nontraditional childrearing practices. Coupled with this is the fact that many developmental assessments are based on American data; hence, they may not be truly comparable to information gleaned from another country, such as Canada. The strongest reason for viewing such guides with caution is that they fail to recognize the individuality of each child. Children differ in intelligence, interest, rate of maturation and aptitudes; consequently, there is an optimum age for the learning of each particular skill in each child (Illingworth and Lister, 1964).

These drawbacks, added to the lack of information on feeding skills acquisition of visually impaired children, served as the impetus behind the development of a questionnaire on feeding skills. The primary caregiver of the visually impaired and/or sighted child supplied information on the ages of acquisition of key feeding skills. Later, the children in each pair were compared in relation to these ages. Presumably, this approach minimized the effect of some uncontrolled environmental influences on feeding skills, such as culture.

Such an evaluative technique is not without disadvantages. Children within the same family or similar environments may receive different developmental nurturance, due to influences like birth rank or the presence of a disability. Since one cannot assume that similar children are raised in an identical manner, it may be beneficial to refer to feeding skills criteria as a reference to general developmental trends. Such a guide was incorporated into the analysis of feeding skills data. The visually impaired group and sighted group were each compared to the average ages listed in the criterion on ages of feeding skills progression. Thus, the matched pairs would be compared to the same criterion.

The purpose for collecting these data on feeding skills was to provide for an in-depth examination of the trends in ages of skills progression, and how they compared to matched controls and to a developmental standard. According to Baer (1976), such an evaluation supplies valuable insight on developmental levels and behavior patterns, both of which form the basis for the creation of comprehensive nutrition programs, adapted to the special needs of special children.

b. Design

The questionnaire was divided into three sections (See Appendix B). The first section contained questions on the demographic variables of the visually impaired child's family. These facts were essential for the description of the sample, in relation to samples in similar studies and to the visually impaired population of children in general.

The second section was designed to survey the child's dietary and feeding skills history. This included questions on infant feeding practices, key feeding skills, feeding problems, and current dietary practices.

The final section was allocated for recording the child's anthropometric measurements.

4. Validity

The validity of the research tools was assessed in two ways. The tools were sent to five professionals (two nutritionists, occupational therapist, home economist with CNIB, early childhood education specialist), who were asked to comment on the adequacy, appropriateness and completeness of the tools.

Following modification, the tools were pretested with eight primary caregivers and their children (birth to 13 years old), all of which had normal vision. Further revisions were made to refine the tools as needed.

B. Implementation of the Study

1. The Sample

Parents and children contacted to participate in the study were selected by the pediatric social worker at Canadian National Institute for the Blind (CNIB), Manitoba division. The criterion for selection were: registration with CNIB of a child, between birth and thirteen years old, as documentation of legal blindness; free of any other physical or mental handicaps; and residence within a home environment. Non-English-speaking families were also excluded.

CNIB sent prepared letters to 55 families with legally blind children, informing parents of the study (Appendix A). Attached to the letter was a consent form for the parents to sign and return. In addition, CNIB enclosed a letter authorizing the proposed research and guaranteeing the confidentiality of its clients.

Response from parents was lower than expected. Consequently, a second letter was sent by school personnel from the records of the Manitoba Department of Education. Inclusion was determined on the basis of those families with a legally blind child who was registered in the provincial school system. Twenty-one families were notified in this second mailing.

Siblings of the visually impaired subjects were used as controls in the study whenever possible. A matched control was appointed in those situations where the visually impaired subject had no siblings, or no information was available on the sibling. Such control subjects were carefully matched on the basis of age, sex, and socioeconomic status. These parameters were thought to be general indicators of the environmental nutriture of the family, and therefore similar to influences held common in the upbringing of sighted subjects and their visually impaired siblings.

2. Format of Data Collection

Parents of visually impaired children expressed interest in participating in the study by providing an address and phone number on the consent form. Respondents were contacted by telephone, and arrangements were made for the first of two home visits. The interview was scheduled so that the visually impaired child would be present also.

The purpose of the first visit was to explain and implement the procedures used in the collection of data. The session began with a brief outline of the purpose of the study, followed by an oral administration of the questionnaire. The primary caregiver was asked to give the most accurate information available, and to avoid guessing if specific answers were not known. The use of baby books was recommended, particularly concerning feeding skills acquisition. This section of the interview also served to establish rapport with the primary caregiver, as well as familiarizing the child with the presence of the researcher.

The second part of the interview was used to take anthropometric measurements of the visually impaired child. Measurements were recorded for stature, weight, triceps skinfold, and upper arm area. The child was encouraged to actively participate by opening equipment containers, "examining" measuring tapes and the scale, and letting a finger be pinched by the caliper. This provided for interaction between the subject and the researcher, as well as providing a constructive diversion for the child.

The final part of the interview was used to instruct the primary caregiver on the use of the Diet Diary (Appendix B). The primary caregiver learned how to record everything that the visually impaired child would eat or drink (except water) over a three-day period. The use of household measuring utensils was advocated. The primary caregiver was encouraged to be as specific and accurate in record-keeping as possible, without changing the eating habits of the child or family. The child was urged to assist by telling the primary caregiver about any food or drink swallowed in the absence of the caregiver.

A follow-up interview was arranged within a week after the diary was completed. This interview was used to check the diary for clarity and thoroughness. In addition, time was allocated for discussing questions and receiving comments and suggestions on the methods of data collection. The primary caregivers were given a Family Nutrition Kit (a selection of booklets on family nutrition) in appreciation for their participation.

C. Analysis of Data

Data from the three-day records of food intake were coded numerically using food codes described in the United States Department of Agriculture Handbook No. 8 (Watt and Merrill, 1963) and those from Nutrition Canada for items not listed in the handbook. Data were transferred to computer data sheets and keypunch cards. Each child's intake was quantitatively analyzed by computer. Nutrient analyses were obtained for kilocalories, protein, fat, carbohydrates, fiber, calcium, iron, thiamin, riboflavin, niacin, vitamin A (retinol), ascorbic acid, and free folate.

The adequacy of diets was assessed through comparison with recommended intakes in the Canadian Dietary Standard (1975a). In addition, food consumption patterns were evaluated against recommendations from Canada's Food Guide (Health Protection Branch, 1977a) for children and adolescents. Nutrient and food consumption were compared and contrasted with results from the Nutrition Canada Survey (Health Protection Branch, 1977b).

Weight and stature measurements were interpreted by comparison to percentiles from the Nutrition Canada Survey Anthropometry Report (Demirjian, 1980). Weight-for-stature was calculated with a weight-for-stature index, featuring a ratio of actual weight over actual stature to the expected (Nutrition Canada medians for sex and age) weight over the expected stature. This index was selected because it has been found to be a reliable measure of relative body weight in research settings (DuRant and Linder, 1981). Triceps skinfold and arm muscle area measurements were assessed with the assistance of percentiles based on the Ten State Nutrition Survey (Frisancho, 1974).

Paired and independent t-tests were selected to determine the existence of significant differences in ages of acquisition of specific feeding behaviors of visually impaired children and sighted controls. The Hawaiian Early Learning Project (HELP) Test (Furuno, 1979) was selected as a standard reference against which to compare these ages. This standard was developed from data on handicapped children. In order to justify its use in this research, age ranges were cross-checked with those given in three known and accepted tests designed for use with nonhandicapped children. In comparing these three tests to the HELP Test, similar age ranges were found for feeding-related items delineated in the HELP Test.

Data on infant milk sources, feeding problems, and vitamin and mineral supplementation were analyzed using Cochran's Test for Related Observations (Conover, 1971).

IV. RESULTS AND DISCUSSION

A. Characteristics of the Sample

The number of subjects in the investigation was less than expected. Of the 55 households receiving the initial letter, 11 (20%) responded. The second letter was responded to by five additional households. In total, 16 (29%) of those contacted consented to participate in the study.

There may have been a variety of reasons for such a low response. The primary reason was probably due to the indirect manner in which potential households were notified. In the process of maintaining confidential files, it was not possible to provide further explanation of the study and its implementation prior to response. Rather, this was left to the caregiver's interpretation of the letter. For instance, a few caregivers who responded to the second letter said they had not replied initially because "my child does not have any dietary problems".

Another reason for the minimal response was an unforeseen postal strike following the second mailing. Of the five who responded to the second letter, three posted consent forms just before the strike, and two telephoned their consent. Finally, it is possible that refusal to participate was based on the caregiver's philosophy that the aim is to integrate the individual into his society as much as possible, especially during childhood.

The demographic characteristics of the final sample are illustrated in Appendix C. The demographic characteristics of the visually impaired sample must be described and integrated into the

TABLE 1. Demographic Characteristics of Target Population[1] and Actual Sample

	AGE		FUNCTIONAL VISION		RESIDENCE	
	≤5 years	6-15 years	Light or Total	Partial	City	Rural
CNIB Statistics (Potential Subjects)	16 (29%)	39 (71%)	18 (33%)	37 (67%)	39 (71%)	16 (29%)
Current Study	6 (38%)	10 (62%)	7 (43%)	9 (57%)	13 (81%)	3 (19%)

[1]Canadian National Institute for the Blind, 1979.

actual analysis because of the heterogeneity of the sample. According to Warren (1976), this approach increases economy of use of potential subjects, and allows the researcher to evaluate rather than ignore the effect of such variables.

The description of such characteristics also served another purpose. Since it was not possible to obtain a random sample, or a sample of sufficient size, it was important to demonstrate the representativeness of the sample. This was done by comparing some of these demographic characteristics in this research to those of the potential sample, the general blind population, and blind children in a similar study.

Age, functional vision, and residence characteristics of the potential sample, provided by CNIB(Manitoba division), were compared to those of the actual sample (Table 1). In both samples, there was a larger proportion of children in the 6-15 year old group, compared to the <5 year old group.

Children were also classified by the amount of functional vision which they retained. Those with light perception or less had a maximal visual capacity to differentiate light from shadow. As only one child was totally blind (106), she was also included in this category. Children with partial vision had a visual acuity of 20/200 to 20/400 in the better eye, or gradual visual deterioration in both eyes. In the current study, seven subjects were categorized in the former class, and nine in the latter class. This distribution followed the trend seen in the potential sample, as did the residential pattern (Table 1).

The causes of blindness were also determined in the study sample, and compared to those of Canadian children registered with CNIB (National) during 1979 (Table 2).

In the current study, the most common cause of blindness was optic nerve atrophy (38%). This was followed by other known causes, respectively: glaucoma, cataracts, nystagmus, and retrolental fibroplasia (RLF). The "other" column contained two cases of differing cause which could not be categorized elsewhere.

Optic nerve atrophy was also the leading known cause of blindness in the CNIB (National) survey (1979). A similar distribution of blindness was attributed to cataract, nystagmus, and RLF, compared to the sample. The study sample may have had a higher incidence of glaucoma because the Canadian survey only accounted for those registered during 1979. If the Canadian statistics had been based on the total number of children registered in CNIB (National), the incidence of glaucoma may have been higher. As a case in point, there were two more cases of glaucoma in the sample than were newly registered with CNIB during 1979.

The "other" category was quite large in the CNIB (National) study becuase it enveloped causes not found in the study sample, and those cases in which the cause was unknown.

Results of a study on blind children in Vancouver were an intrinsic part of the review of literature in this research; hence, comparisons of demographic characteristics were made between the current sample and the Vancouver study (Table 3). Characteristics of the sighted sample were also included, since these traits were the bases on which pairing was determined.

TABLE 2. Cause of Blindness in Canadian Children Registered with CNIB[1] and in Current Study

	optic nerve atrophy	cataract	nystagmus	RLF	glaucoma	other	TOTAL
Canada (birth-15 yrs.) during 1979	66 (27%)	29 (12%)	25 (10%)	20 (8%)	2 (1%)	102 (42%)	244 (100%)
Current study	6 (38%)	2 (12%)	1 (6%)	1 (6%)	4 (25%)	2 (12%)	16 (100%)

[1]Canadian National Institute for the Blind, 1979

TABLE 3. Comparison of Characteristics of Vancouver[1] and Current Studies

		(%) sex		(%) birth rank				no children in family	socioeconomic status[2]		
	n	m	f	only	first	mid	last	$\bar{x}$	1,2	3-5	6-7
Vancouver survey	92	54	46	14	31	25	30	2.2	23	54	22
Visually impaired children	16	38	62	19	25	6	50	2.2	25	69	6
Sighted children	16	56	44	12	44	31	12	2.6	25	69	6

[1] Jan *et al.*, 1977.

[2] Blishen and McRoberts, 1976.

The visually impaired sample in this study was composed of twice the number of females as males. The control sample and the Vancouver study were more alike, in that sex was more evenly distributed.

Fifty percent of the visually impaired subjects were ranked as the last, or youngest, child in the family. This was followed by those ranked as the firstborn child. Again, the control group and Vancouver survey revealed similarity, when the highest frequency was reported in the firstborn ranking. This variance in birth rank was not emphasized, however, because the use of siblings as controls effectively biased the random nature of the birth rank characteristic.

Subjects in the current study and Vancouver survey had approximately the same mean number of children per family.

Socioeconomic status was determined with a scale based on Canadian census data (Blishen and McRoberts, 1976). Both current and reference samples had the same proportion of subjects of upper socioeconomic status (Classes 1,2). The visually impaired and control samples in the current study had a slightly higher distribution of middle (Classes 3,4,5) as contrasted to lower (Classes 6,7), socioeconomic status than did the Vancouver study. This was probably the result of the nature of the samples and response. In other words, the Vancouver study may have had a more representative distribution because of its larger size and random nature. Those who chose to participate in this study may have been the more affluent or motivated members of the potential sample.

Lastly, the onset of visual impairment should be noted. All but one of the children (#116) had congenital impairments.

In general, the familial demographic characteristics may have been integral in determining the child care practices of the households. Those individuals comprising the child's home environment may have contributed to the child's attitudes toward food, priorities in food selection, and pattern of behavior around food. Halliday emphasized that human relationships are the primary factors in helping the visually impaired child to learn, by promoting security, knowledge, and curiosity about their environment from interaction with parents and siblings (Halliday and Kurzhals, 1976).

Specific characteristics were worth noting, in terms of their impact on child rearing. The functional vision that a child possessed might have affected the child's perception of food and skills acquisition. Birth rank may have been important, in that child rearing practices of the caregiver with a first or only child might have been influenced by external sources, while practices with later children might have relied on previous experience.

The number of children in the family might have affected an impaired child's environment by increasing (ie., multiple relationships) or decreasing (ie., reduced attention of caregiver) input received by the child.

Regardless of the impaired child's birth rank or number of siblings, most parents have had no experience with the development of a handicapped child, and are afraid to urge the child to partake in independent activities. As a result, no amount of previous experience in child rearing would have prepared them for their feelings of uncertainty or frustration which might have emerged when dealing with their handicapped child (Parmalee et al., 1959).

B. Results and Discussion of Research Objectives

The results will be discussed in light of each research objective. While all statistical analyses were carried out as planned, results must be viewed with the limitations of the sample in mind. Such a small sample was not truly representative of the population, nor was it randomly selected. Consequently, results of this research cannot be interpreted as being applicable beyond this sample of visually impaired children.

1. Objective One: Nutrient Intake

a. Comparison to Canadian Dietary Standard Recommendations: - Group Data

The distribution of mean daily intakes of total energy sources and ten nutrients obtained from food sources, expressed as percent of the Canadian Dietary Standard Recommended Daily Nutrient Intake (RDNI), is shown in Figure 1. Nutrients obtained from vitamin and mineral supplements will be considered later. In general, the children met or exceeded most of the recommendations; however, the intake of kilocalories (94.68%) and folate (69.4%) appeared to be marginal to low, respectively.

Table 4 further delineates mean daily intakes by age and sex. All groups were low in folate, and all but the infants and adolescents had a marginal energy consumption. Within and beyond the 7-9 year age group, vitamin A consumption was low for both sexes, while females also had borderline intakes of thiamin and iron.

Nutrient intakes were further clarified by calculating

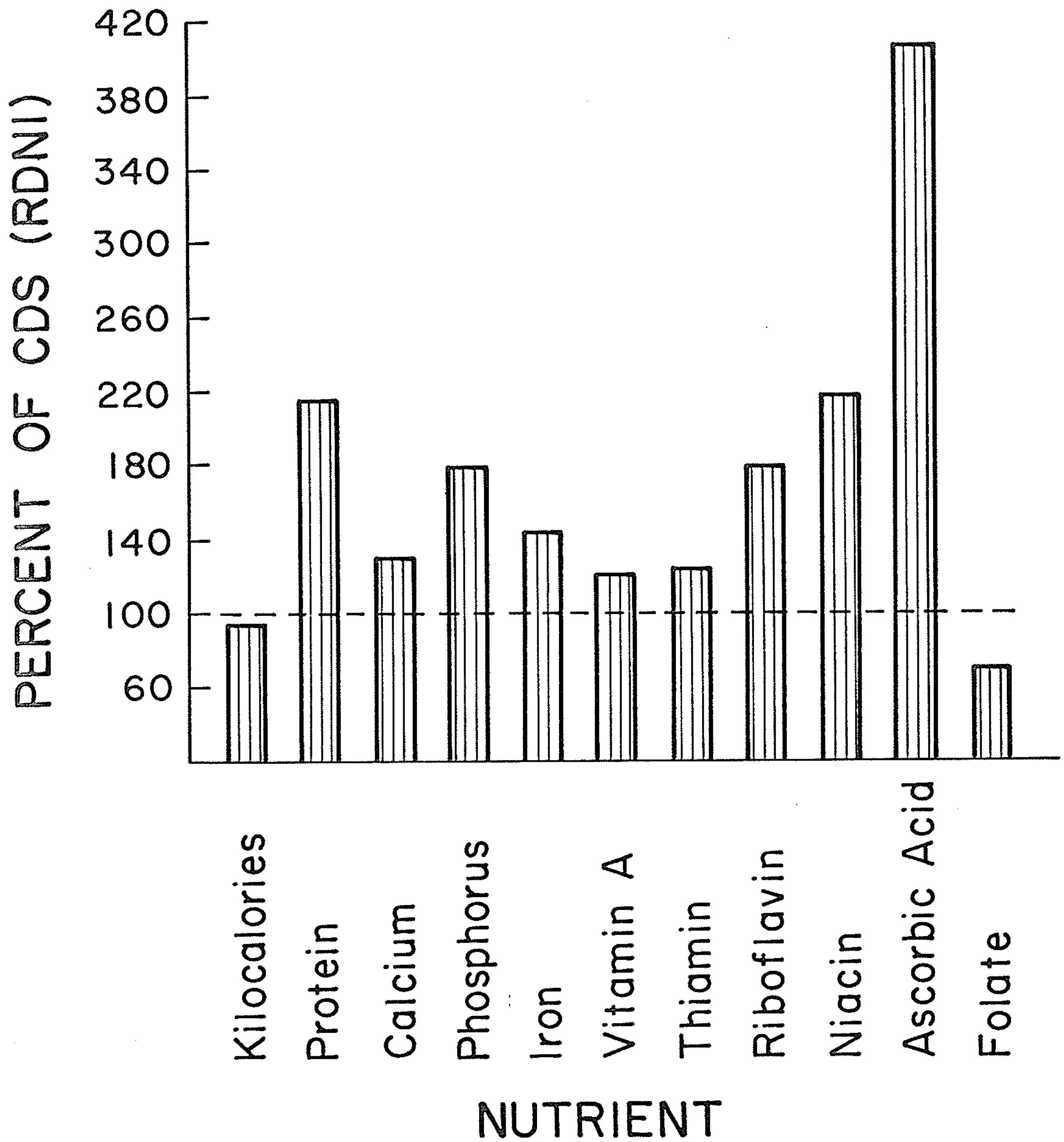

FIGURE 1. Mean daily intakes of total energy sources and individual nutrients as per cent of CDS (RDNI). (n=16)

TABLE 4. Three-Day Mean Daily Intake of Kilocalories and Individual Nutrients by Age and Sex of Subjects Compared to the Recommended Daily Nutrient Intake

Energy and Nutrients	AGE (YEARS) AND SEX OF RESPONDENTS: 1	4-6	7 - 9		10-12	13 - 15	
	Both	Both	Male	Female	Male	Male	Female
Energy[2] (kcal.)	110.8 (kg x 100)	1656.6 (1800)	1831.3 (2200)	1886.4 (2000)	2311.7 (2500)	2848.7 (2800)	2552.0 (2200)
Protein[2] (g.)	3.7 (kg x 1.4)	62.6 (27)	56.1 (33)	56.8 (33)	76.5 (41)	112.8 (52)	117.8 (43)
Calcium (mg.)	735.9 (500)	802.8 (500)	826.6 (700)	686.0 (700)	792.7 (900)	1217.2 (1200)	1621.8 (800)
Phosphorus (mg.)	709.2 (500)	1086.8 (500)	1014.0 (700)	917.6 (700)	1105.8 (900)	1829.1 (1200)	2024.9 (800)
Iron (mg.)	20.7 (7)	12.0 (9)	16.8 (10)	8.5 (10)	13.1 (11)	16.2 (13)	11.9 (14)
Vitamin A (RE)	1024.2 (400)	619.6 (500)	488.9 (700)	526.8 (700)	774.3 (800)	842.1 (1000)	858.6 (800)
Thiamin (mg.)	1.0 (0.5)	1.2 (0.9)	1.2 (1.1)	0.8 (1.0)	1.3 (1.2)	1.2 (1.4)	1.1 (1.1)
Riboflavin (mg.)	1.5 (0.6)	2.0 (1.1)	2.8 (1.3)	1.3 (1.2)	2.0 (1.5)	2.4 (1.7)	3.1 (1.4)
Niacin (mg.)	19.1 (6.0)	25.6 (12.0)	27.7 (14.0)	20.4 (13.0)	29.4 (17.0)	44.0 (19.0)	44.0 (15.0)
Ascorbic acid (mg.)	71.8 (20)	118.8 (20)	59.0 (30)	100.0 (30)	131.3 (30)	109.5 (30)	60.7 (30)
Folic acid (mg.)	30.0 (60)	86.0 (100)	54.7 (100)	71.0 (100)	75.9 (100)	98.2 (200)	84.5 (200)

[1]Canadian Dietary Standard recommendations are in brackets.

[2]Means expressed as intake per kilogram body weight for subjects $\angle 1$ year.

the proportion of children satisfying the RDNI (Figure 2). All children met or exceeded recommendations for protein, niacin, and ascorbic acid. At least 75% had acceptable intakes of calcium, phosphorus, iron, and riboflavin. Approximately half the children received adequate amounts of thiamin, retinol and kilocalories, while only 25% had recommended intakes of energy and folate.

Comparisons of the mean daily intake were also made between children with light perception and those with partial vision (Figure 3). Overall, both groups exceeded most nutrient recommendations, with the exception of folate. The light perceptive subgroup consumed a mean of 71% of the RDNI for folate, compared to 63% by the partially sighted subgroup. A similar trend was seen with regard to consumption of other nutrients, in that children with light perception tended to have higher mean intakes (and higher mean percentage of the RDNIs) than partially sighted children. The most pronounced difference involved vitamin C, of which light perceptive subjects received a mean of 493% of the RDNI, compared to 342% by those with partial vision. In contrast, the partially sighted group was also found to have slightly depressed intakes of energy (87% RDNI), thiamin (98% RDNI), and vitamin A (90% RDNI).

It is unclear as to why children with less vision had higher nutrient intakes. Imamura (1965) found that mothers of blind children were significantly ($p<.01$) more dominant and indulgent than mothers of sighted children. If these observations were used to interpret current results, one could hypothesize that such maternal traits might increase in potency or incidence with a decrease in the child's

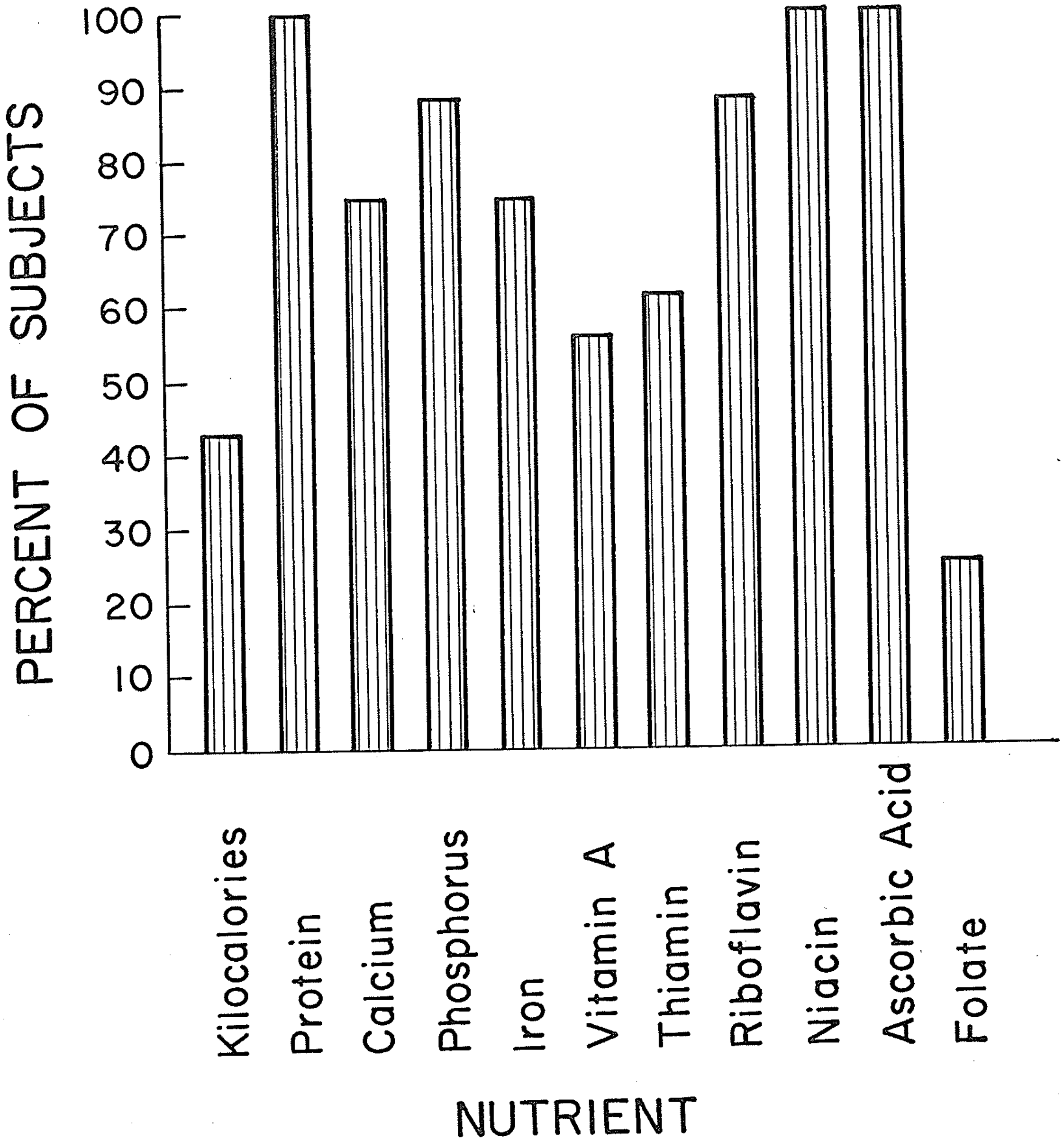

FIGURE 2. Percent of sample of visually impaired subjects satisfying the RDNI recommendations. (n=16)

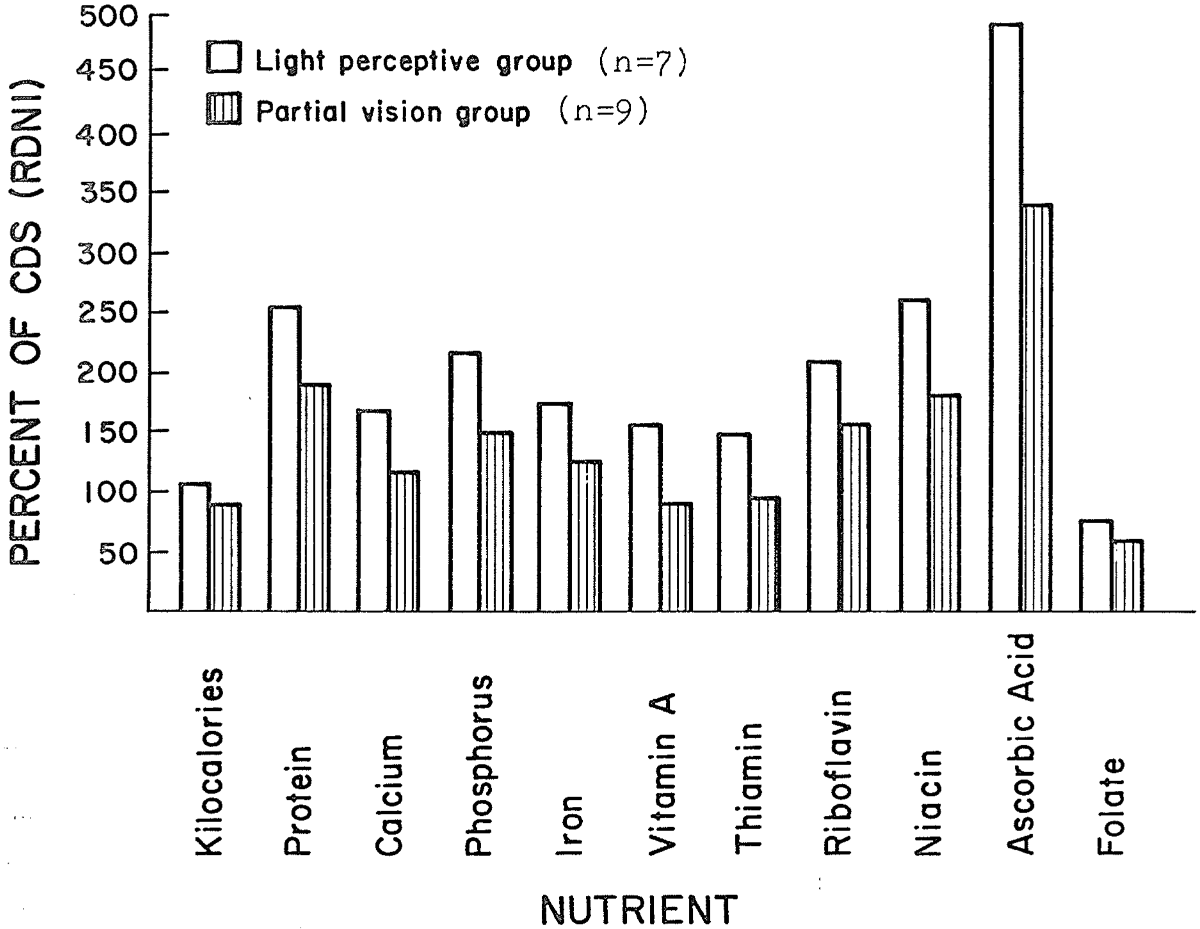

FIGURE 3. Mean daily intakes of total energy sources and individual nutrients as percent of CDS (RDNI) by children with light perception vs. partial vision.

usable vision. In other words, mothers of light perceptive children may have tended to control and encourage higher overall food (hence, nutrient) intakes than mothers of partially sighted children. The amount of functional vision may have been inversely related to the number of opportunities for children to control the type or portions of food served. Instead, children might have demonstrated a higher preference for succourant, dependent behavior (Imamura, 1965) as functional vision decreased.

In general, data revealed that three (18.7%) of the sixteen impaired children consumed diets that were nutritionally adequate when compared to the Canadian Dietary Standard. However, this does not indicate that the majority of children were nutritionally deficient. Utilizing the Canadian Dietary Standard as a measure of nutritional status is inappropriate, as it fails to recognize that the recommendations are overestimates of the requirement for most people. The RDNIs were set to meet the requirements of 97.5% of the population, and were intended as a guide in planning diets and as a standard for dietary assessment for Canadians (Health Protection Branch, 1975a; Sabry, 1970). In addition, comparing intakes of individuals or small groups (such as the study group) to the standard fails to account for the distribution of the target population (Anderson, 1980). Nevertheless, such an approach may be helpful in providing information on the relative adequacy of diets, and isolating dietary problems which could be alleviated through nutrition education.

Findings in this study were similar to those of other studies on the dietary status of Canadian children. Generally, this population has been found to meet, and often exceed recommendations for protein, niacin, and ascorbic acid (Smirl, 1973; MacFadyen, 1977; Sabry and Kerr, 1979). In contrast, other handicapped populations have been observed to have low intakes of ascorbic acid and possibly vitamin A, particularly if the preference for fresh vegetables is low (Griffiths, 1966; Garton and Bass, 1974).

At least 75% of the subjects received recommended amounts of calcium, iron, and riboflavin (Figure 2). Similar results, including slightly less than optimum thiamin and vitamin A intakes were noted in studies like the present one (Gouge and Ekvall, 1975; MacFadyen, 1977). Ellestad-Sayed et al. (1977) reported only 61% of Winnipeg schoolchildren surveyed met the standard for thiamin intake. This was paralleled in current results, when 62.5% of the children had thiamin intakes below recommended levels of intake.

While the claim that blind children consume less energy than average (Freeman, 1975) was supported here, lower intakes are not specific to children with visual impairments. Other studies have documented the incidence of children consuming less than half the RDNI for energy (Smirl, 1973; Anderson, 1980). However, most researchers have presented results as mean daily intake as a percentage of the RDNI. A survey of Winnipeg schoolchildren (Ellestad-Sayed et al., 1977) revealed a mean energy consumption of 95% of the RDNI--results which were identical to those of the current group in general. However, the light perceptive tended to exceed, and partially-sighted to fall short, of this value. Partially-sighted children received the same proportion of the RDNI for energy as deaf adolescents (Sabry and Kerr, 1979), who consumed 87% of the recommendation. On the other hand, visually impaired adolescents actually consumed more (104%) than the standard. Over an extended period, this level of intake could be instrumental in a positive energy balance, especially if the individuals had lower than normal levels of activity.

Among nutrients, folate was received in adequate amounts by the least number of children, and had the lowest mean intake expressed as % RDNI. Few studies have assessed the folate intake of Canadian children; however, Myres and Kroetsch (1978) concluded from a survey of children that the average intake of free folate in no case met the prescribed levels set by the CDS; hence, it was reasoned that the RDNI for folate was inappropriate. In other words, standards for folate were based on previous assays that assumed higher folate contents for foods analyzed in the present study; thus, folate recommendations were probably set at too high a level (Health and Welfare Canada, 1977b). Caution was advised in interpreting such data, as folate deficiency is rare in Canada in view of availablity of the nutrient to most people. Consequently, attention to folate intake is limited to an appraisal of trends in intake in the ensuing sections.

In light of the overall adequacy (except energy and folate) in nutrient intake, the appropriateness of vitamin and mineral supplementation by six of the subjects was questionable. While the relative incidence of supplementation will be discussed later, the content and benefit of these preparations is of immediate interest.

Most supplements contained at least the individual's RDNI for B vitamins, and twice that for ascorbic acid. All preparations contained two to four times the need for vitamins A and D. Ironically, those children who received supplements were individuals who had previously met the RDNIs by diet alone (except a teen male with a borderline vitamin A intake). Consequently, supplementation was of little true benefit: the excess water-soluble vitamins would have been excreted, while vitamins A and D would have been placed in hepatic storage. The inherent dangers of the latter, especially in view of excessive quantities of these two vitamins in preparations, warrants advising against such supplementation.

b. Age and Sex - Specific Comparisons to the Nutrition Canada Survey

Subjects were regrouped by age to facilitate comparisons of dietary intake to the Nutrition Canada Survey (Health and Welfare Canada, 1975b) and other pertinent research.

Infants ($<$12 months)

Table 5 shows the mean daily intake of nutrients by infants in the current investigation and in various aspects from the Canadian survey. Both national and current surveys indicated that the mean intake of all nutrients except folate was well above recommended levels.

Impaired infants appeared to consume more energy, vitamin A, niacin, and ascorbic acid than those in the national study. However, further analysis of nutrient intake of Canadian infants by age revealed that infants between 9-11 months also exceeded the mean intake for these nutrients. On the other hand, the impaired infants tended to receive a higher proportion of kilocalories from fat, and less from protein and carbohydrates.

Iron intake was less than the national mean; however, a

Table 5. Comparisons of mean daily intake of nutrients by infants (≤ 12 months) in current and Nutrition Canada surveys.

NUTRIENT	CURRENT STUDY n = 2	NUTRITION CANADA SURVEY(1975) National		Prairies
		Overall	9-11 mos.	
Kilocalories	1055.00	1055.00	926.00	968.00
% protein	13.25	16.80	15.70	16.50
% fat	38.00	25.00	30.10	32.50
% carbohydrate	48.25	59.00	53.50	52.60
protein (g)	35.00	45.00	39.00	40.00
calcium (mg)	736.00	1223.00	1131.00	1139.00
iron (mg)	21.00	31.00	27.00	22.00
vitamin A (RE)	1024.00	712.00	698.00	599.00
thiamin (mg)	1.00	0.09	1.03	0.82
riboflavin (mg)	1.54	2.25	2.12	1.92
niacin (NE)	19.00	18.00	16.00	15.00
ascorbic acid (mg)	72.00	62.00	54.00	56.00
free folate (ug)	30.00	61.00	51.00	58.00

similar value (22 mg) was reported for infants in the Prairie provinces. While the impaired infants had lower intakes of calcium, riboflavin, and folate compared to the Canadian averages, the mean values were still in excess of recommendations.

Young Children (1-4 years)

Table 6 depicts the mean daily intake of nutrients by young children (1-4 years) in this study and the Nutrition Canada Survey (1975b). Children in both surveys met all recommendations except for folate, and kilocalories.

Compared to the national means, impaired children had lower mean intakes of energy, protein, calcium, vitamin A, and folate. While a similar nutrient profile was found in the prairie provinces, the impaired group had higher mean intakes of all nutrients (except calcium and vitamin A) compared to regional averages. For example, the mean energy intake of impaired children (1287 kcal) age 4 or under fell between the 25-50th percentiles in the national survey, yet rose to the 50-75th percentile span of the regional study. This was due to the Prairies rating as the region with the lowest mean energy intake in Canada.

The proportion of energy contributed by protein, fat, and carbohydrate in current, national, and regional reports was similar; however, impaired children received slightly less of their total energy from fat. In contrast, they had higher mean intakes of fiber, and ascorbic acid. Results were parallel with regards to B vitamins and iron nutriture.

Older Children (5-11 years)

Table 7 compares the mean intake of nutrients by older

Table 6. Comparison of mean daily intake of nutrients by young children (1-4 years) in current and Nutrition Canada Surveys.

NUTRIENT	CURRENT STUDY (n = 4)	NUTRITION CANADA SURVEY (1975)	
		National	Prairies
Kilocalories	1519.00	1666.00	1499.00
% protein	15.00	14.80	14.72
% fat	34.75	37.70	37.80
% carbohydrate	50.75	48.70	48.30
protein (g)	57.00	62.00	55.00
fiber (g)	2.87	2.39	2.11
calcium (mg)	722.00	1082.00	950.00
iron (mg)	11.00	10.00	10.00
vitamin A (RE)	620.00	879.00	733.00
thiamin (mg)	0.98	0.93	0.89
riboflavin (mg)	2.01	2.11	1.95
niacin (NE)	24.00	22.00	20.00
ascorbic acid (mg)	99.00	84.00	72.00
free folate (ug)	67.00	77.00	62.00

Table 7. Comparison of mean daily intake of nutrients by older children (5-11 years) in current and Nutrition Canada surveys.

NUTRIENT	CURRENT STUDY (n = 7)	NUTRITION CANADA SURVEY (1975)	
		National	Prairies
Kilocalories	2029.00	2300.00	2226.00
% protein	13.28	13.30	14.14
% fat	35.14	37.56	37.60
% carbohydrate	51.14	50.40	50.70
protein (g)	69.00	77.00	79.00
fiber (g)	3.27	3.58	3.43
calcium (mg)	885.00	1115.00	1046.00
iron (mg)	13.00	12.00	12.00
vitamin A (RE)	622.00	1114.00	1024.00
thiamin (mg)	1.24	1.18	1.13
riboflavin (mg)	2.13	2.33	2.24
niacin (NE)	28.00	28.00	29.00
ascorbic acid (mg)	113.00	99.00	92.00
free folate (ug)	86.00	90.00	82.00

children (5-11 years) in the present and Nutrition Canada surveys. While children in both studies had lower than recommended intakes of folate, the impaired children also failed to meet standards for kilocalories and vitamin A.

Generally, the impaired children had lower mean intakes of energy, protein, calcium, vitamin A, riboflavin, and fiber. This tendency was also observed of children in the regional study, yet these Prairie children also had higher mean intakes than impaired children.

The mean energy intake (2029 kcal) of visually impaired children fell between the 25-50th percentiles of children assessed in both national and regional sections of the Canadian survey, or slightly below the average intake of kilocalories. At the same time, the contribution of energy by protein, fat, and carbohydrate was essentially the same for all groups.

Mean intakes of iron, thiamin, niacin, folate, and ascorbic acid were similar for children in current and national results, and both slightly surpassed average intakes by children in the regional survey. The excessive consumption (mean = 113 mg) of ascorbic acid by impaired children was consistent with findings in the Nutrition Canada Survey, where 5-11 year old children were noted for consuming over three times the recommendation (30 mg) for ascorbic acid.

Adolescents (12 years and older)

The mean daily intake by sex of adolescents (12-19 years) in the present and Nutrition Canada surveys is depicted in Table 8. As seen in the latter survey, both sexes were low in folate. The impaired males also had lower mean intakes of energy, calcium, and vitamin A than recommended.

Table 8. Comparison of mean daily intake of nutrients by adolescents ($\geq$ 12 years) in current and Nutrition Canada surveys.

NUTRIENT	CURRENT STUDY		NUTRITION CANADA SURVEY (1975)			
			National		Prairies	
	Male n=2	Female n=1	Male	Female	Male	Female
Kilocalories	2282.00	2552.00	3251.00	2243.00	3096.00	1983.00
% protein	18.00	14.75	13.60	13.30	14.72	14.12
% fat	44.00	38.00	40.70	40.10	41.56	39.93
% carbohydrate	38.00	47.75	46.50	48.00	44.12	47.20
protein (g)	82.00	118.00	111.00	76.00	114.00	70.00
fiber (g)	2.90	2.39	4.45	3.38	3.87	3.23
calcium (mg)	780.00	1622.00	1337.00	967.00	1472.00	895.00
iron (mg)	14.00	12.00	17.00	11.00	15.00	11.00
vitamin A (RE)	650.00	858.00	1455.00	1036.00	1267.00	1154.00
thiamin (mg)	1.20	1.14	1.65	1.07	1.60	1.01
riboflavin (mg)	1.91	3.08	2.96	1.90	2.95	2.00
niacin (NE)	32.00	44.00	43.00	27.00	43.00	26.00
ascorbic acid (mg)	108.00	61.00	101.00	92.00	85.00	76.00
free folate (ug)	74.00	84.00	109.00	84.00	105.00	77.00

Compared to other Canadian adolescent males, the impaired males had lower mean intakes of all nutrients except vitamin C, which was (similarly) consumed in amounts over three times the recommendation of 30 mg. The mean intakes of vitamin A, calcium, and energy were low enough to rank between the 5-25th percentiles of males sampled in the Canadian survey for each nutrient. However, individual mean intakes of the two impaired males revealed that most of the overall lower intakes of nutrients were heavily influenced by one of the males (#16) who had low or borderline intakes of six nutrients (Appendix D). The other subject (#115) consumed quantities similar to those in the national survey, and met all but energy and vitamin A recommendations.

Collectively, the impaired males consumed more energy in the form of protein (18%) and fat (44%), and less as carbohydrate. Those in the national survey received 50% more fiber than the impaired males.

As in the Canadian survey, the highest mean intake (2552 kcal) of energy among females was observed in the adolescent female. The impaired female met or exceeded national and regional mean intakes of energy, protein, calcium, iron, B vitamins, and folate. The proportion of energy contributed by protein, fat, and carbohydrate reflected those in the Canadian survey.

As observed among impaired males, the impaired female adolescent also had lower intakes of fiber and vitamin A. While her ascorbic acid consumption (61 mg) was twice the recommendation, females in the national sample (mean = 101 mg) received over three times the standard value.

Overall, the impaired subjects met or exceeded most of the recommendations, with the exception of folate and possibly kilocalories. Comparisons with the Nutrition Canada Survey (1975b) data revealed that impaired subjects had lower mean intakes of vitamin A and fiber, and the same or slightly lower intakes of free folate in most age groups. Intake of other nutrients was quite similar to that of children in the Canadian survey.

2. Objective Two: Food Consumption

a. Comparison of Servings of Food Groups to Canada's Food Guide

Figure 4 depicts the percentage of children that consumed the recommended number of servings of the four food groups in Canada's Food Guide (Health and Welfare Canada, 1977a). Data from the two infants were omitted from this objective because recommendations did not include infants, and insufficient data were available from which to make any comparisons with reference studies.

No child consumed the recommended number of servings from all food groups. Overall, recommendations for bread and cereals consumption were met by the largest number of children (78.5%). Approximately 43%, or six children, ate the appropriate number of servings from the meat and alternates, milk and milk products, and fruit and vegetables groups. Only four children consumed at least two servings of vegetables, however.

Similar proportions of children consumed serving recommendations in the eleven years and under group, where servings of

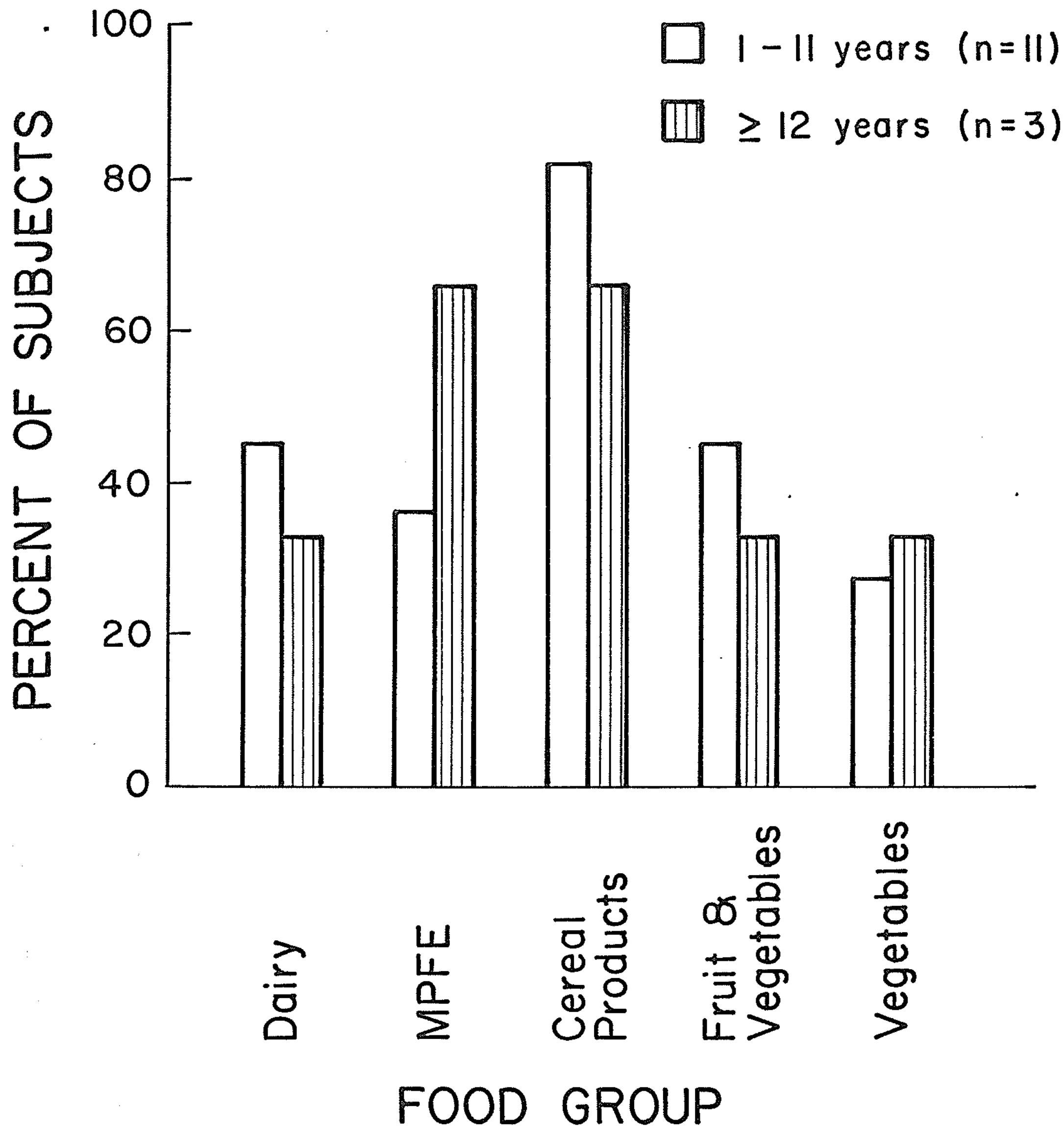

FIGURE 4. Percent of subjects in two age groups who met or exceeded recommendations of Canada's Food Guide. (n=14)

bread and cereals were adequate for nine (81.7%) of the children, followed by milk, produce, and meat. Of those over 12 years, two out of three met recommendations for bread and cereals and meat groups, while only one child met recommendations for intake of milk and produce groups. In each age group, the recommendation for at least two servings of vegetables was met by the least number of children.

Tables 9 and 10 show the mean number of servings consumed from the four food groups by children in two age groups. Both age groups ate an adequate mean number of servings of bread and cereals, and the older children ate sufficient mean quantities of meat and vegetable servings. Neither age group met recommendations for milk or overall produce intake, and younger children consumed an inappropriate mean number of servings of meat and vegetables. On the other hand, younger children fell short of recommendations for food group servings by an average of one fourth of a serving, while older children were under by an average three fourths of a serving.

These findings were the result of many factors, of which a few deserve mention. Bread and cereals were probably consumed in appropriate amounts because many children ate breakfast cereal, toast, and sandwiches on a regular basis. Of note was one child's consumption of six slices of toast in lieu of breakfast one day.

Servings of meat and alternates were calculated with one serving equal to that quantity of product containing 17-22 grams of protein (Health and Welfare Canada, 1977a). Consequently, a portion consumed from this food group actually may have been only a fraction of a serving (ie., nine slices of bologna constituted one serving, as one

Table 9. Mean number of servings selected from food groups of Canada's Food Guide by children (1-11 years) n=11.

FOOD GROUP	MEAN	RANGE	CANADA'S FOOD GUIDE RECOMMENDATIONS
DAIRY	1.81	.83-3.28	2-3
MPFE	1.76	1.00-2.78	2.0
CEREAL PRODUCTS	4.37	1.55-7.55	3.0-5.0
FRUIT & VEGETABLES	3.83	1.60-6.20	4-5
VEGETABLES	1.71	1.10-2.60	2.0

Table 10. Mean number of servings selected from food groups of Canada's Food Guide by adolescents ($\geq$ 12 years) n=3.

FOOD GROUP	MEAN	RANGE	CANADA'S FOOD GUIDE RECOMMENDATIONS
DAIRY	2.25	.50-3.75	4-5
MPFE	3.09	1.66-4.76	2.0
CEREAL PRODUCTS	4.00	2.00-4.70	3-5
FRUIT & VEGETABLES	3.24	2.13-4.70	4-5
VEGETABLES	2.05	1.41-3.20	2.0

slice contains two grams protein).

Many children consumed carbonated beverages, powdered drink mixes, and fruit juice with and between meals, and possibly diminished the volumetric capacity, thirst, or desire for fluid milk. As a result, the consumption of milk was lower than recommended.

b. Contribution of Food Groups to Nutrient Intake

Table 11 shows the percent contribution of seven food groups to the nutrient intake of younger children (1-4 years). Cereal products and meat, poultry, fish, and egg (MPFE) foods were the primary sources of kilocalories and eight nutrients. Cereal products were an important component of the diet, as they supplied the primary source of kilocalories, carbohydrates, iron, thiamin and riboflavin, and substantial amounts of niacin. MPFE foods contributed the largest amounts of protein, fat and niacin, and additional kilocalories, iron, and thiamin. Dairy products, consumed mostly as fluid milk, were the chief source of calcium and retinol, and secondary quantities of protein, fat, riboflavin and folate.

Nutrient intake results of this age group were, for the most part, similar to those taken from younger children in the Nutrition Canada Survey (Health Protection Branch, 1977b). However, dairy products were principal providers of kilocalories and most nutrients in the national survey, in contrast to the wider distribution of these nutrients among three food groups (cereals, MPFE, dairy) in the current study. Present results showed dairy products as providing less kilocalories, folate and about 50% less B vitamins relative to national values. Rather, these vitamins were more abundant with the intake of

Table 11. Percent contribution of food groups to nutrient intake of young children (1-4 years) (n=7).

NUTRIENT %	DAIRY PRODUCTS	MEAT, POULTRY FISH, EGGS	CEREAL PRODUCTS	FRUIT PRODUCTS	VEGETABLES, POTATOES	FATS, OILS	OTHERS
Kilocalories	16	17[b]	25[a]	13	10	6	13
Protein	26[b]	42[a]	18	2	6	0	8
Fat	25[b]	26[a]	14	1	11	12	11
Carbohydrate	10	1	35[a]	26[b]	10	0	17
Fiber	0	1	27	29[b]	34[a]	0	8
Calcium	64[a]	7	12[b]	4	5	0	8
Iron	1	26[b]	44[a]	13	9	0	8
Thiamin	12	17[b]	46[a]	7	12	0	5
Riboflavin	33[b]	12	41[a]	3	5	0	5
Niacin	15	37[a]	29[b]	3	9	0	6
Ascorbic acid	5	0	2	62[a]	30[b]	0	0
Retinol	30[a]	12	5	6	18	19[b]	9
Free Folate	23[b]	8	19	16	29[a]	0	4

[a]Primary food source of nutrient.
[b]Secondary food source of nutrient.

cereal products and their concommitant supply of kilocalories. Proportionally twice as much protein was supplied in the form of MPFE foods, and half as much by dairy foods, in the current survey. Such findings challenge those of other researchers that claim visually impaired children are over-reliant on milk. To the contrary, current subjects actually received a wider variety of food than children in the reference survey, for which dairy products were the primary source of all nutrients except ascorbic acid and niacin. However, more conclusive information on the importance of dairy products in the visually impaired child's diet would require a survey of a large group of children, three years and under.

Of interest is that fats and oils served as a secondary source of retinol (19%), while contributing a smaller (12%) amount of the nutrient in the national survey compared to dairy (34%) and MPFE (22%) products. In addition, vegetables and potatoes contributed twice as much fat (11%) proportionally as compared to the reference study (6%). This may have reflected the preference for vegetables prepared with fat, such as french fries and coleslaw. Vegetables were also important as a primary source of fiber (34%) and folate (29%). As with national results, ascorbic acid was principally attained from fruit products, followed by vegetables and potatoes.

Among older children (5-11 years), cereal and dairy products were primary sources of kilocalories and seven nutrients (Table 12). Cereal products provided the greatest proportions of kilocalories, carbohydrates, iron and thiamin. While dairy items were important for their primary contributions towards retinol, calcium and

Table 12. Percent contribution of food groups to nutrient intake of older children (5-11 years) (n=4).

NUTRIENT %	DAIRY PRODUCTS	MEAT, POULTRY FISH, EGGS	CEREAL PRODUCTS	FRUIT PRODUCTS	VEGETABLES, POTATOES	FATS, OILS	OTHERS
Kilocalories	17[b]	15	28[a]	10	11	8	10
Protein	28[b]	35[a]	22	2	7	0	6
Fat	22[b]	27[a]	16	0	9	22	4
Carbohydrates	11	0	38[a]	19[b]	14	0	17
Fiber	0	0	27[b]	23	43[a]	1	6
Calcium	69[a]	2	17[b]	3	4	0	4
Iron	1	23[b]	42[a]	9	15	0	9
Thiamin	12	23[b]	34[a]	10	17	0	4
Riboflavin	41[a]	13	35[b]	3	5	0	3
Niacin	17	32[a]	31[b]	3	11	0	5
Ascorbic acid	5	0	0	54[a]	40[b]	0	1
Retinol	36[a]	5	5	8	13	28[b]	5
Free Folate	23	5	15	32[a]	23[b]	0	2

[a]Primary food source of nutrient.

[b]Secondary food source of nutrient.

riboflavin nutriture, they were also significant as a secondary source of kilocalories, protein, fat and folate. MPFE foods provided the highest amounts of protein, fat and niacin.

The profile of dietary intakes of older children in the Nutrition Canada Survey (Health Protection Branch, 1977b) was highly similar to current results with reference to food sources of kilocalories and the majority of nutrients. Again, cereal and dairy products were primary sources of kilocalories and several nutrients outlined above. Children in the current survey appeared to receive slightly larger proportions of riboflavin and niacin, yet less thiamin, from cereal products. While MPFE foods supplied proportionally more thiamin, they contributed much less retinol (5% compared to 24% in national survey) and folate (2% compared to 9%). As with the younger impaired children, the fats and oils group was an important contributor of retinol (28%) -- moreso when compared to the retinol values (17%) in national results. Fruit was favored in both surveys as the primary source of ascorbic acid. In addition, it was the chief supplier of folate (54%) for the impaired children, a role held by dairy products (29%) in the reference study.

The most notable contrast emerged in comparing the contribution of "Other" foods to nutrient intake. The impaired children received proportionally smaller amounts of kilocalories and all nutrients except carbohydrates from foods in this group.

The percent contribution of food groups to nutrient intake of adolescents will be discussed with reference to sex groups. MPFE foods supplied primary proportions of kilocalories, protein, fat, iron and niacin in the diets of adolescent males, as well as substantial thiamin (Table 13). Cereal products were also important as primary sources of thiamin and riboflavin, and secondary sources of six nutrients: protein, carbohydrate, fiber, calcium, iron, and niacin.

The principal source of kilocalories and nutrients in the adolescent female's diet was dairy products (Table 13). These foods provided the maximum proportions of kilocalories, protein, fat, carbohydrate, calcium, riboflavin, retinol and folate, not to mention secondary contributions to thiamin and niacin intake. While MPFE foods were not primary to as many nutrients as in male adolescents' diets, these foods were chief suppliers of iron and niacin, and a secondary source of five other nutrients.

Both sexes received their largest proportion of ascorbic acid from fruit products, while vegetables supplied their primary fiber source. The latter was also the greatest contributor of folate in the female's diet.

In general, adolescents of both sexes had greater proportions of nutrients contributed by the same food groups as adolescents in the national survey (Health Protection Branch, 1977b). Dairy, MPFE and cereal groups served as the primary sources of kilocalories and several nutrients in both studies. Certain differences were also evident upon comparison. For instance, contributions of kilocalories, protein, carbohydrates and calcium from dairy products were less in impaired males' and more in the impaired female's diets compared to peers in the Canadian survey. The impaired female derived higher percentages of riboflavin (62% versus 44%), retinol (57% versus 21%) and folate (48% versus 24%) from dairy products than polled females. Males in this

Table 13. Percent contribution of food groups to nutrient intake of adolescents ($\geq$ 12 years) by sex.

NUTRIENT %	DAIRY PRODUCTS		MEAT, POULTRY FISH, EGGS		CEREAL PRODUCTS		FRUIT PRODUCTS		VEGETABLES, POTATOES		FATS, OILS		OTHER	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Kilocalories	10	33[a]	27[a]	22[b]	18[b]	14	12	3	12	8	7	3	13	16
Protein	15	39[a]	52[a]	39[b]	18[b]	8	1	1	11	3	0	0	2	10
Fat	13	32[a]	44[a]	28[b]	9	6	0	0	5	9	24[b]	6	4	18
Carbohydrate	6	31[a]	1	6	26[b]	26[b]	26[a]	8	18	11	0	0	21	18
Fiber	0	0	0	0	11	11	7	29[b]	69[a]	31[a]	1	0	12	29[b]
Calcium	54[a]	85[a]	11	2	16[b]	5	4	1	8	2	1	0	7	5[b]
Iron	1	8	41[a]	39[a]	32[b]	25[b]	5	6	16	7	0	0	4	13
Thiamin	8	27[b]	29[b]	18	32[a]	32[a]	5	7	24	12	0	0	0	4
Riboflavin	28[b]	62[a]	25	15[b]	35[a]	14	2	2	8	2	0	0	2	4
Niacin	10	24[b]	49[a]	40[a]	26[b]	12	1	2	15	6	0	0	0	16
Ascorbic acid	3	15	0	0	0	0	57[a]	46[a]	38[b]	38[b]	0	0	0	0
Retinol	28[b]	57[a]	20	17[b]	9	3	1	8	9	3	31[a]	10	1	2
Free Folate	18[b]	48[a]	13	9	12	4	13	13	41[a]	14[b]	0	0	4	11

[a]Primary food source of nutrient.

[b]Secondary food source of nutrient.

survey received more kilocalories and retinol from cereal products, while both sexes consumed proportionally smaller amounts of fat, carbohydrate, fiber and niacin from this food group. The current groups also relied more heavily on vegetables for dietary fiber (69% for males, 31% female) and folate (41% for males, 13% female) in comparison to the reference values (42%, 42% for fiber; 19%, 20% for folate, respectively). As in the Canadian study, fruit was relied upon as a primary source of ascorbic acid.

c. Relationship between nutrient intake, number of servings, and contribution of nutrients by food groups

Results on dietary intake, servings from various food groups and nutrient contributions of the food groups were closely related and influential; therefore, a discussion of some such relationships was deemed appropriate. Such an approach is particularly fitting in regards to those nutrients that were consumed in recommended amounts by less than two-thirds of the subjects (excluding infants): kilocalories, thiamin, retinol, and folic acid (Figure 5).

Forty-three percent of the children had an appropriate intake of kilocalories. For the overall group, kilocalories were supplied primarily by cereal products (25%), MPFE foods (18%) and dairy products (17%), as seen in Table 14. Thiamin was also provided largely by cereals (37%) and MPFE items (22%). A slightly higher, yet less than optimal proportion of children (57%) were able to consume the recommendation for this nutrient.

An investigation of the percentage of children in general consuming recommended servings from these food groups also produced less than desirable results (Figure 6). Eleven children (78%)

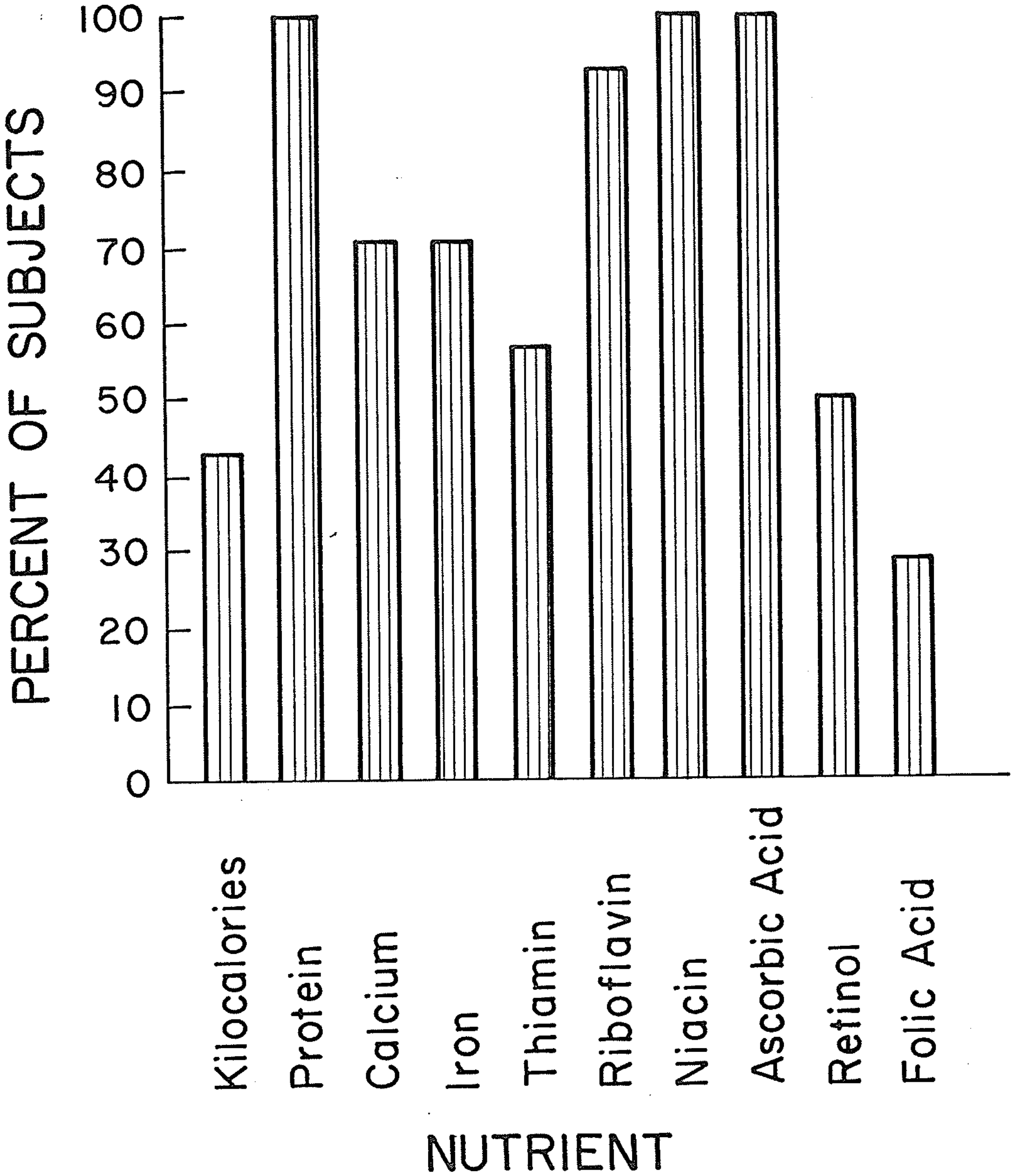

FIGURE 5. Percent of subjects (excluding infants) who met or exceeded the RDNI for kilocalories and nutrients. (n=14)

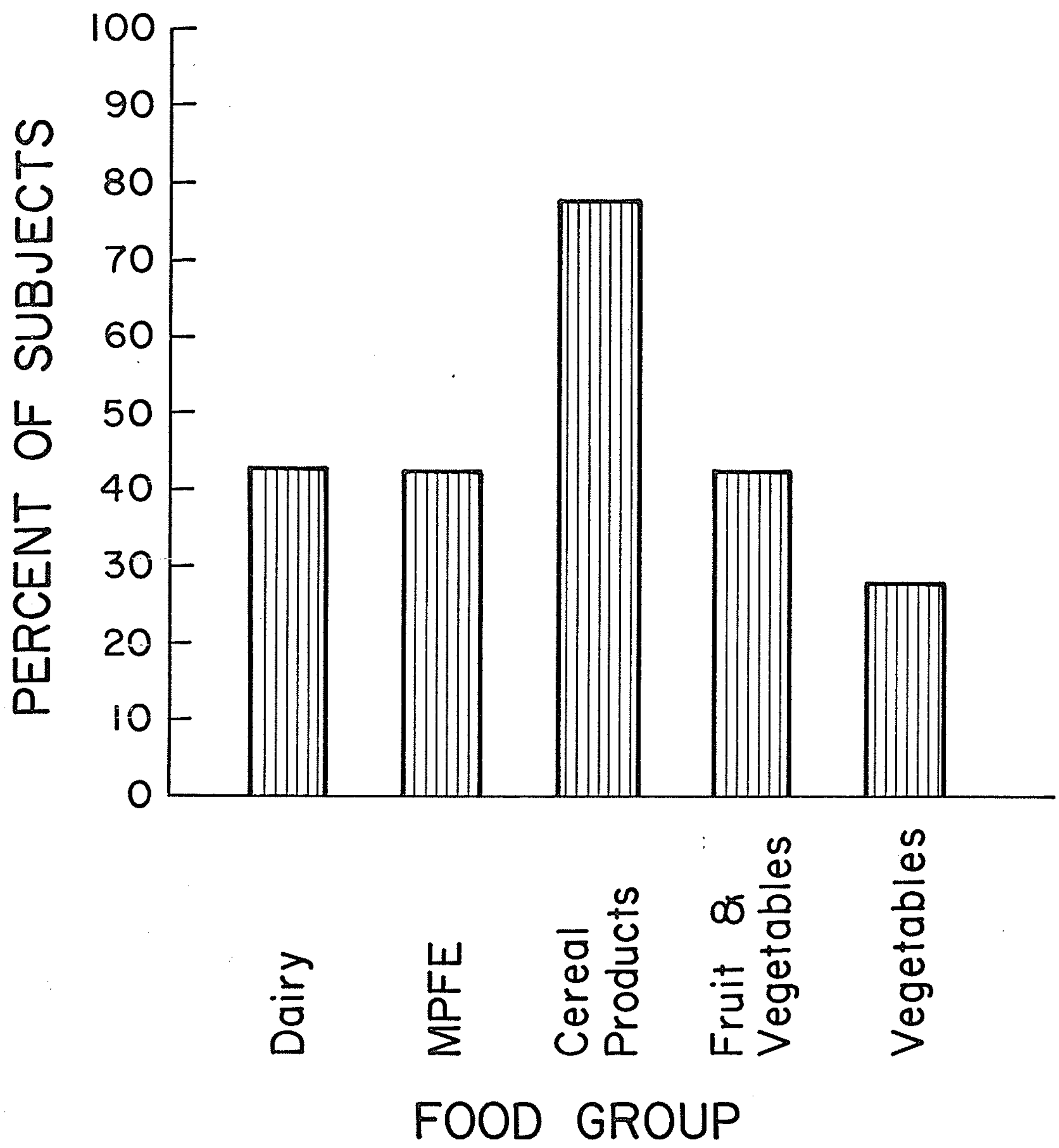

FIGURE 6. Percent of subjects (excluding infants) who met or exceeded the recommended servings from Canada's Food Guide. (n=14)

Table 14. Percent contribution of Food Groups to the intake of four nutrients consumed in recommended amounts by less than two-thirds of the subjects (excluding infants).

FOOD GROUP	NUTRIENT			
	Energy	Thiamin	Retinol	Folic Acid
Dairy	17.13	12.72	34.47	24.45
MPFE	17.72	21.93	10.13	7.43
Cereals	24.92	36.94	5.37	15.08
Fruit	10.88	8.44	6.68	23.18
Vegetables	10.61	16.23	13.14	26.55
Fats, Oils	6.85	.10	24.47	.04
Other	11.89	3.58	5.17	3.26

received the adequate number of servings of cereal products, and only six (43%) consumed the recommended number from either the dairy or MPFE groups. In other words, the fact that children ate a smaller mean number of servings from each of these groups may have resulted in a lower mean intake of kilocalories and thiamin.

Only 50% of the children (excluding infants) met the recommendations for retinol intake. Retinol was mainly supplied by dairy products (39%), fats and oils (24%) and vegetables (13%). However, just six (43%) and four (29%) subjects in the group managed to consume the appropriate number of servings of dairy products and vegetables, respectively. Again, the consumption of fewer servings of dairy and vegetable products than recommended by Canada's Food Guide (Health Protection Branch, 1977a may have contributed to a decreased dietary intake of retinol.

The role of fats and oils in providing 24% of the dietary retinol deserves further consideration. Currently, there are no quantitative recommendations for the intake of fats and oils. While the addition of small amounts of fat to the diet enhance retinol absorption (Pike and Brown, 1975), this fat is just as acceptable from more nutrient-dense foods, such as dairy and meat products which also contain appreciable retinol. In addition, vitamin A from vegetable and fruit sources would also be accompanied by other nutrients lacking in this group's intake, particularly thiamin and folic acid.

Folic acid was consumed in appropriate amounts by the least number (28%) of children. Dietary folic acid was provided by vegetables (26%), dairy (24%) and fruit (23%) products. Fruit and vegetables, which comprised over half of the contribution to folic acid intake, were consumed in appropriate amounts by only 43% of the children in general, as were dairy products. This may have resulted in the lower mean intake of folic acid (72% of recommendations), as well as a small percentage of children actually consuming recommended quantities of the nutrient. In other words, since only one-quarter of the subjects consumed those foods which did supply folic acid (and in adequate servings), a corresponding deficit in folic acid nutriture was an understandable consequence. However, strong caution is to be exercised in the interpretation of folic acid intake, for reasons mentioned earlier in the discussion on nutrient intake.

The fact that less than two-thirds of the children failed to meet the RDNI for kilocalories, thiamin, retinol or folic acid lends strength to the belief that such deficits were a reflection of inappropriate serving selections from food groups of Canada's Food Guide (Health Protection Branch, 1977a). Theoretically, the guide's suggestions were based on the types and servings of food consumed by individuals whose dietary intake met or exceeded recommendations of the RDNI (Myers and Kroetsch, 1978). Thus it would follow that consumption patterns that failed to follow serving recommendations would result in deficient nutrient intake.

However, analysis of the intake of children who did meet the RDNI for a highlighted nutrient such as retinol produced results to the contrary. Of the seven children who consumed recommended quantities of dietary retinol, none met the suggested number of servings from all the retinol-rich food groups (dairy, MPFE and vegetable groups). In fact, one child did not consume the suggested number of servings for any of these food groups. Milk was the primary retinol source in five of these diets, yet of these five, only three consumed appropriate quantities of milk. Of the two children receiving retinol primarily from vegetables, only one consumed a sufficient number of servings of vegetables. Results such as these lead one to question the degree to which Canada's Food Guide (CFG) coincides with, and accurately interprets the RDNI.

Other studies have found similar discrepancies. For instance, McNeil (1982) found that preschool subjects did not consume the recommended number of servings of two food groups, yet the mean daily intake of all nutrients (except marginal iron, and folate and kilocalories 30% below recommendations) met the RDNI. In another study of 123 young adults, it was reported that 80% of the intakes evaluated did not correspond entirely with the CFG, yet 12% of these met or exceeded all the RDNI's for the nutrients evaluated (Rewko et al., 1980). One conclusion was that rating diets on the basis of CFG recommendations was not necessarily an indicator of low nutrient intakes. To some extent, this was also the case in the current study.

3. Objective Three: Anthropometry

a. Stature, weight and weight-for-stature

Table 15 depicts the number and percentage of visually impaired males and females distributed within centile rankings of the Nutrition Canada Survey (Demirjian, 1980) for stature and weight. Over half of the subjects were within normal ranges (25th-75th percentile) for stature and weight. While females were average or shorter, two males exceeded the 95th percentile for stature. Most females were within normal or lower ranges for weight; however, the two infants were heavier (75th-90th percentile) than the average female infant. Male subjects were distributed across all ranges.

The weight-for-stature index for children is interpreted into four ranges (DuRant and Linder, 1981). The normal range is between 90% and 109%, with 100% considered the ideal score. Children scoring 89% and below can be considered underweight; those between 110% and 119% can be classified as overweight; those scoring over 120% can be considered obese.

The weight-for-stature index for impaired subjects ranged from 83% to 135% (Table 16). In general, over half (56%) of the children were within normal ranges. Two-thirds of the subjects in this range were female, while the remaining females tended towards overweight. It also bears noting that 30% of the overall sample had indices classifying them as overweight or obese. Again, male subjects were distributed in all categories, although there was a tendency towards the normal range.

Table 15. Comparison of stature and weight of subjects by sex to centiles from the Nutrition Canada Survey[1] (n=16).

PERCENTILE	STATURE			WEIGHT		
	Males	Females	Total	Males	Females	Total
	(n)	(n)		(n)	(n)	
<5	-	-		-	1	
5-10	-	-	5	-	-	4
10-25	1	4	(31.25%)	1	2	(25.00%)
25-50	1	1	9	3	2	9
50-75	2	5	(56.25%)	-	4	(56.25%)
75-90	-	-		-	1	
90-95	-	-	2	-	-	3
>95	2	-	(12.5%)	2	-	(18.75%)
TOTAL	6	10	16	6	10	16

[1] Demirjian, 1980.

Table 16. Comparison of weight-for-stature of subjects by sex and functional vision to centiles based on Nutrition Canada Survey data[1] (n=16).

PERCENT	SEX			FUNCTIONAL VISION		
	Females	Males	Total	L.P.[2]	P.V.[3]	Total
	(n)	(n)		(n)	(n)	
89%	1	1	2 (12.50%)	-	2	2 (12.5%)
90-109%	6	3	9 (56.25%)	5	4	9 (56.25%)
110-119%	3	1	4 (25.00%)	2	2	4 (25.00%)
120%	-	1	1 (6.25%)	-	1	1 (6.25%)
TOTAL	10	6	16	7	9	16

[1]Demirjian, 1980.

[2]L.P. = light perceptive subgroup.

[3]P.V. = partial vision subgroup.

Weight and stature were also assessed in relation to functional vision (Table 17). Children with light perception were average or shorter in stature, yet average in weight, compared to centile ranges. In contrast, children with partial vision were normal (66%) to taller than the average Canadian child, two of these subjects ranking in excess of the 95th percentile. At the same time, they tended to be of normal weight, although two also exceeded the 95th percentile for weight.

Five of seven children with light perception were within normal weight-for-stature ranges, and the other two were in the 110-119% (overweight) range (Table 16). Children with less impairment were within the normal range, as they were distributed throughout all four ranges in smaller frequencies.

Results on the overall stature and weight of the sample agreed with those in a recent study on Canadian visually impaired children, who were generally within normal ranges for stature and weight (Jankowski and Evans, 1981). In contrast, others have claimed that these children are less than the average stature and weight for age (Krause, 1955; Freeman, 1975); however, the only possible support of this statement in the present study, albeit the number of subjects in the study was small, was in the slightly shorter stature of females, and those with light perception. Studies on children with impairments such as retardation, cerebral palsy and spina bifida have observed subjects to be shorter and heavier than the average child, unlike the subjects in this research (Pryor and Thelander, 1967; Guy, 1978; Gouge and Ekvall, 1975). On the other hand, the visually impaired subjects exhibited the same incidence (30%) of excess weight-for-stature as children with Down's syndrome (Cronk, 1978). Guy (1978) reported twice

Table 17. Comparison of stature and weight of subjects by functional vision to centiles from the Nutrition Canada Survey[1] (n=16).

PERCENTILE	STATURE L.P.[2]	STATURE P.V.[3]	STATURE Total	WEIGHT L.P.	WEIGHT P.V.	WEIGHT Total
	(n)	(n)		(n)	(n)	
< 5	-	-		-	1	
5-10	-	-	5	-	-	4
10-25	4	1	(31.25%)	2	1	(25.00%)
25-50	1	1	9	1	4	9
50-75	2	5	(56.25%)	4	-	(56.25%)
75-90	-	-		-	1	
90-95	-	-	2	-	-	3
> 95	-	2	(12.50%)	-	2	(18.75%)
TOTAL	7	9	16	7	9	16

[1]Demirjian, 1980.

[2]L.P. = light perceptive subgroup.

[3]P.V. = partial vision subgroup.

as many children (68%) with neurological impairments were overweight for their stature.

While visually impaired subjects tended to be average or slightly in excess of the average weight-for-stature, the typical subject consumed 95% of the RDNI for energy, and 7 children failed to consume recommended kilocalories for their age and sex. It may be that the RDNI for energy is too high for this group of children, as Sabry and Kerr (1979) hypothesized following similar results with deaf adolescents. In other words, the subjects may have consumed adequate, or even extra, kilocalories for their needs in relation to energy utilized in activity.

Energy intake was not the sole influence on the weight-for-stature indices. In fact, there was only a weak ($r = {}^{+}0.329$) correlation between the percentage of RDNI for energy actually consumed and the percent of average weight-for-stature. Thus, subcutaneous fat and muscularity were measured to further define the composition of body weight, as well as the incidence of adiposity.

b. Triceps Skinfold and Arm Muscle Area

The distribution of triceps skinfold and arm muscle area measurements of subjects by sex and functional vision is shown in Tables 18 and 19. Data for one male child were not available in these measurements.

In general, 12 (80%) of the children were within the normal range (15th-85th percentile), based on centiles from an earlier study (Frisancho, 1974). The other three subjects, all female, placed in the lower range. Males and females appeared to have similar mean skinfold measurements when grouped by age. In regards to functional

Table 18. Comparison of triceps skinfold (TSF) and arm muscle area (AMA) by sex to centiles of the Ten State Nutrition Survey[1] (n=15).

PERCENTILE	TSF			AMA		
	Females	Males	Total	Females	Males	Total
	(n)	(n)		(n)	(n)	
< 5	3	-	3 (20%)	-	-	-
5-15	-	-		-	-	
15-50	3	3	12 (80%)	3	1	9 (60%)
50-85	4	2		3	2	
85-95	-	-	-	3	1	6 (40%)
> 95	-	-		1	1	
TOTAL	10	5	15	10	5	15

[1]Frisancho, 1974.

vision subgroups, over 75% (6) of the subjects in each subgroup were within the normal range.

These results both conflict and agree with similar research. Only one other study measured the adiposity of visually impaired children as judged by skinfold (Jankowski and Evans, 1981). In contrast to current findings, the study reported that body fat stores were significantly above the ideal levels for males and females. However, calculations were based on the mean of 10 anatomical skinfolds compared to a single (triceps) skinfold utilized here. Utilization of the triceps skinfold may have introduced error variance because it is technically more difficult to measure; nevertheless, summation of skinfolds does not improve the accuracy of skinfold measurements (Garn et al., 1971). In other words, neither study was more conclusive in regards to evaluation of adiposity.

Jankowski and Evans (1981) also reported that body fatness was positively correlated to age for boys and girls with impairments ($r = .66$, $.69$ respectively). The current subjects only exhibited a weak correlation ($r = .34$) between age and triceps skinfold, which also seemed to contradict claims that obesity is a serious problem particularly as the impaired child reaches adolescence (Snoy and vanBenten, 1978). On the other hand, skinfold-weight correlations were satisfactorily correlated ($r = .64$) in the current study. An assessment of 510 sighted American children (Garn et al., 1971) also found skinfolds and weight were usefully correlated ($r = .64$), in that compressed skinfolds explained a useful proportion of interpersonal weight variance.

Few Canadian studies were available for comparison. Of

Table 19. Comparison of triceps skinfold (TSF) and arm muscle area (AMA) of subjects by functional vision to centiles of the Ten State Nutrition Survey[1] (n=15).

PERCENTILE	TSF			AMA		
	L.P.[2]	P.V.[3]	Total	L.P.	P.V.	Total
	(n)	(n)		(n)	(n)	
< 5	1	1	3 (20%)	–	–	–
5-15	–	1		–	–	
15-50	3	3	12 (80%)	–	4	9 (60%)
50-85	3	3		4	1	
85-95	–	–	–	2	2	6 (40%)
>95	–	–		1	1	
TOTAL	7	8	15	7	8	15

[1]Frisancho, 1980.

[2]L.P. = light perceptive subgroup.

[3]P.V. = partial vision subgroup.

the eight subjects within the age range of a French Canadian study (Jeníček and Demirjian, 1972), half ranked above and half below mean TSF values for ages. Smirl (1973) found that less than 34% of Winnipeg schoolchildren measured had skinfold values in the normal range, and 55% had measurements above defined limits. Such contrast may be partly explained by the small size and wide age range in the current study and by the small age range (10-12 years) and low income status of subjects in the reference study.

Tables 18 and 19 also show the distribution of arm muscle area measurements by sex and functional vision. Overall, nine (60%) of the subjects were within normal (15th-85th percentile) ranges, and the remainder placed within higher (85th-95th percentile) ranges. An equal proportion of males and females were found in average and higher ranges, as were subgroups with light perception or partial vision.

Examination of mean values by age groups revealed that males tended to have slightly larger muscle areas compared to females. In addition, there was a high positive correlation (r = .832) between age and arm muscle area for the overall group of subjects. Frisancho (1974) also observed a steady increase in arm muscle area in both sexes between one and twelve years of age.

The normal or greater muscularity suggest that if skeletal muscle was maintained, protein needs for growth and body tissues were met. This was supported by the fact that all subjects met or exceeded recommendations for protein intake. In addition, perhaps kilocaloric intake may have been adequate for needs although lower than recommendations. Other researchers empirically observed that blind children had flabby, undeveloped musculatures and weak upper limbs (Krause, 1955; Jankowski and Evans, 1981). Current results were to the contrary, perhaps because subjects were not totally blind, and could participate in many physical activities.

To summarize, over half of the subjects were within average ranges for stature, weight, and weight-for-stature. An additional 30% were considered overweight for stature, but "overweight" was not synonymous to "overfat". Triceps skinfold tests revealed adiposity was within normal or lower ranges, and arm muscle area (muscularity) within normal or upper ranges for all subjects. Appendix F provides the actual anthropometric measurements of each subject. Such results are difficult to interpret, particularly in the absence of comparable studies. The absence of obesity and adiposity, coupled with average or greater muscularity suggest that subjects had adequate stores of energy and protein, not to mention kilocaloric expenditure. Buell (1973) hypothesized that increased residual tension develops when motor tasks must be done without vision, thereby increasing metabolic demands on physiological systems. As a result, impaired children might expend more energy and muscular stress than sighted peers to accomplish given tasks.

Beyond this, it bears noting that anthropometric results of impaired subjects were similar to those of studies on sighted children--moreso than compared to children with other physical handicaps, except deafness. This was probably due to the relatively small physical manifestation of the visual impairment, in contrast to other physical disabilities with more widespread anatomical involvement.

4. Objective Four: Feeding Skills Acquisition

The area of feeding skills acquisition was divided into two parts in this study, each covering a different aspect of sequential development. The first part was concerned with feeding progressions, or the advancement through different types and textures of food. A second part, skills acquisition, investigated selected motor skills relevant to the mastery of eventual self-feeding.

a. Feeding Progressions

Table 20 denotes the mean ages at which the visually impaired and sighted groups displayed specific sequential feeding progressions. The visually impaired group was introduced to food (excluding milk) at a later age ($\bar{X}$ = 4.53 months) than the sighted group ($\bar{X}$ = 2.37 months). The acceptance of puréed, chopped, and table food also occurred at later mean ages. The subsequent application of a paired t-test revealed that visually impaired children accepted chopped and table food at significantly later mean ages, compared to sighted counterparts ($p < 0.05$).

The feeding progressions of the visually impaired and sighted groups were also analyzed to determine whether the impaired group acquired them at a slower rate (Table 21). This rate was expressed as the time interval (in months) between sequential progressions. The blind group experienced a shorter interval between the introduction and acceptance of puréed food compared to the sighted group ($\bar{X}$ = .25 months, .81 months respectively). In contrast, intervals between the acceptance

Table 20. Feeding Progressions: Visually impaired versus sighted groups.

PROGRESSION	VISUALLY IMPAIRED n	VISUALLY IMPAIRED $\overline{X}$ age (months)	SIGHTED n	SIGHTED $\overline{X}$ age (months)	p
Food Introduction	16	4.53	16	2.37	NS
Puréed Food Accepted	15	3.50	15	3.20	NS
Chopped Food Accepted	13	13.20	13	8.27	<.05
Table Food Accepted	13	24.15	13	14.42	<.05

Table 21. Feeding Progressions: Difference (months) between sequential progressions in visually impaired versus sighted groups.

	VISUALLY IMPAIRED n	VISUALLY IMPAIRED $\overline{X}$ difference (months)	SIGHTED n	SIGHTED $\overline{X}$ difference (months)	p
Introduction → Acceptance of Puréed Food	15	0.25	15	0.81	NS
Puréed → Chopped Food	12	8.38	12	9.39	<.05
Chopped → Table Food	11	11.68	11	8.00	<.05

of puréed and chopped food, followed by acceptance of table food from chopped food, were longer for blind children. Such differences were significant ($p<0.05$).

Children in the impaired group were categorized according to functional vision to further evaluate feeding progressions (Tables 22, 23). Both subgroups were introduced to food, and accepted the three textural gradations, at similar ages. However, those with partial vision tended to demonstrate progressions at an overall earlier age than those with light perception. Of interest was the difference ($p<0.05$) in length of time between introduction and acceptance of puréed food, in which partially sighted children had a shorter interval between the two parameters.

The Hawaiian Early Learning Profile (HELP) was selected to provide reference age ranges at which feeding progressions and skills could be expected to occur (Furuno, 1979). In regard to progressions, both visually impaired and sighted groups' mean ages were within normal age ranges for the acceptance of puréed, chopped, and table foods (Table 24). In other words, although the impaired group acquired progressions at later dates, these ages were still acceptable from a developmental perspective. When the total of mean ages of the pairs was averaged for each progression, results were also within the normal range. The subgroups of impaired children fared similarly, with the exception that children with light perception were later in their acceptance of table food.

b. Skills Acquisition

The mean ages at which blind and sighted groups performed skills relevant to eventual self-feeding (skills acquisition) are

Table 22. Feeding Progressions: Visually impaired subgroups.

PROGRESSION	LIGHT PERCEPTION n	LIGHT PERCEPTION $\bar{X}$ age (months)	PARTIAL VISION n	PARTIAL VISION $\bar{X}$ age (months)	p
Food Introduction	6	7.00	10	3.05	NS
Puréed Food Accepted	5	4.20	10	3.15	NS
Chopped Food Accepted	5	14.10	8	13.00	NS
Table Food Accpeted	4	26.75	10	23.10	NS

Table 23. Feeding Progressions: Difference (months) between sequential progressions.

	LIGHT PERCEPTION n	LIGHT PERCEPTION $\bar{X}$ difference (months)	PARTIAL VISION n	PARTIAL VISION $\bar{X}$ difference (months)	p
Introduction → Acceptance of Puréed Food	4	0.75	10	0.01	$<.05$
Puréed → Chopped Food	4	5.25	8	9.94	NS
Chopped → Table Food	3	13.50	8	11.00	NS

Table 24. HELP Test[1]: Standard age ranges for specific feeding skills acquisitions.

FEEDING SKILLS ACQUISITION	AGE RANGE (Months)
Feeding Progressions:	
Swallows pureed food	3- 6
Chews chopped food	8-14
Chews completely, including a variety of table food	18-24
Skills Acquisitions:	
Finger fees self cracker	6.5- 8.5
Brings spoon to mouth, and licks it	12-15
Drinks from a cup, unassisted	18-24

[1] Furuno, 1979.

reported in Table 25. Compared to sighted children, the impaired children learned to finger feed and spoon feed at later ages. The subsequent application of one-tailed t-tests showed such differences to be critical at the .05 level of significance. However, the most outstanding difference between the groups emerged around independent cup-feeding skills. While sighted children mastered this skill at a mean age of 11.61 months, visually impaired children did not accomplish it until 21.89 months. Statistical tests indicated that the latter group learned to master cup feeding at a significantly later age ($p < 0.005$).

Feeding skills were also assessed in terms of the time interval between sequential motor skills acquisition (Table 26). Both impaired and sighted children advanced from finger feeding to spoon and cup feeding at similar rates, although the impaired group was slightly slower.

Feeding skills were further analyzed within the subgroups of impaired children (Table 27 and 28). Children in either subgroup mastered the skills at similar mean ages, but those with light perception tended to be later in achieving mastery of all skills. It was interesting to note that the light perceptive group tended to progress more quickly from finger to cup feeding. In contrast, the interval between finger and spoon feeding was significantly larger ($p < 0.05$) for the light perception subgroup.

According to the HELP age references, only finger and spoon feeding mastery by the sighted group fell within normal ranges, while only the impaired group fell within the range for cup feeding mastery:

Table 25. Skills Acquisition: Visually impaired versus sighted groups.

SKILLS	VISUALLY IMPAIRED		SIGHTED		p
	n	$\bar{X}$ age (months)	n	$\bar{X}$ age (months)	
Finger feeds self	13	12.88	13	7.08	<.05
Spoon feeds self	13	24.81	13	14.81	<.05
Cup feeds self	14	21.89	14	11.61	<.005

Table 26. Skills Acquisition: Difference (months) between sequential skills in visually impaired versus sighted groups.

SKILLS	VISUALLY IMPAIRED		SIGHTED		p
	n	$\bar{X}$ difference	n	$\bar{X}$ difference	
Finger → cup feeds self	11	4.04	11	5.45	NS
Finger → spoon feeds self	10	13.35	10	7.90	NS

Table 27. Skills Acquisition: Visually impaired subgroups.

SKILL	LIGHT PERCEPTION		PARTIAL VISION		p
	n	$\bar{X}$ age (months)	n	$\bar{X}$ age (months)	
Finger feeds self	5	17.70	8	9.88	NS
Spoon feeds self	5	25.10	10	22.70	NS
Cup feeds self	4	28.62	10	19.20	NS

Table 28. Skills Acquisition: Difference (months) between sequential skills.

SKILLS	LIGHT PERCEPTION		PARTIAL VISION		p
	n	$\bar{X}$ difference (months)	n	$\bar{X}$ difference (months)	
Finger → cup feeds self	3	3.17	8	4.38	NS
Finger → spoon feeds self	4	18.62	7	8.50	$<.05$

the sighted group preceded the range ($\bar{X}$ age = 11.61 months), while the impaired group satisfied it at a mean of 21.89 months. When the total of mean ages of the pairs was averaged for each skill, cup feeding was the only one to fall within a normal age range. This was probably due to the influence of the later ages of blind children within the pairs on means of each pair. Analysis of the impaired subgroups revealed that the only skills mastery to occur within a normal age range was that of cup feeding, and only among the partially sighted.

Results of the investigation on overall feeding skills acquisition underscored the fact that childhood blindness does not necessarily indicate a critical slowdown in skills development. Rather, some impaired children were able to function up to the expectations at a given age range for children in general. This corresponded to results of Norris et al. (1957), who reported that blind children's skills were similar to those of sighted children, in that they achieved developmental goals at differing ages, yet were still within normal age ranges. Such generalities were noted in the current study particularly in regards to feeding progressions.

Differences between impaired and sighted groups as well as impaired subgroups relative to progressions and skills were also of interest in comparison to past studies. Norris et al. (1957) disclosed that 50-75% of 66 blind children received credit for chewing solid food between 12 and 24 months. If chopped and table food acceptance is an indirect measure of chewing ability, the visually impaired group in the current study fell within the same age ranges.

Jan et al. (1977) failed to define solid foods when reporting mean ages of food introduction among blind, partially sighted, and sighted children. Assuming that reference was made to chopped food acceptance, mean ages of 9 months for sighted and 12 months for partially sighted children correlated with present findings. On the other hand, the same study showed those with light perception as receiving this texture later, at 19 months.

Available research suggested that handicapped children received insufficient exposure to textured foods at appropriate ages (Worthington et al., 1978; Jan et al., 1977). While visually impaired children demonstrated textured food acceptance at later mean ages than sighted children, the fact that they were within normal age ranges repudiates the theory that all impaired children have a prolonged subsistence on pureed foods. Rather, extreme ages for chopped food acceptance that exceeded normal ranges were evidenced in both groups (36 months and 24 months in impaired and sighted groups respectively). In other words, the incidence of textural progression delays was bilateral, and not unique to impaired children.

Differences in feeding progressions between impaired and sighted groups may have been affected by error on the part of the caregivers' information. Despite carefully specific definitions from the interviewer, some caregivers may have misinterpreted the meaning of certain food textures; thus, ages of mastery would have been affected. On the other hand, the motor skills identified were relatively unique behaviors which left little room for alternate interpretations. The other source of error which could have affected both feeding progressions and skills acquisition data were centered upon the ability of caregivers to recall particular events. As Barsch (1968) remarked, "Although the parent observes early stages in each child...the progressive continuation of new achievements by the child causes yesterday's victories to be forgotten in the concentration upon today's achievements".

In regards to skills acquisition, comparable data were not available on finger feeding skills. It was of interest that the age of finger feeding mastery was not available on three impaired subjects because they had refused to exhibit the behavior at all. According to Scott et al. (1977), blind children often disdain finger feeding because of an aversion to food-soiled fingers, or to the feel of the food itself (ie., moist and sticky).

Ages at which spoon feeding occurred within the impaired group and its subgroups preceded the mean age of 36 months documented in similar research on blind children (Parmalee et al., 1959; Norris et al., 1957). However, the latter study reported over 50% of the children surveyed spoon fed "with assistance" by 24 months, which paralleled current results.

The impaired group in this study mastered cup feeding skills within the same age range (18-28 months) as blind children in the extensive survey by Norris et al. (1957). Elonen and Zwarensteyn (1964) found that some blind children were bottle feeding as late as five years of age. In contrast, the maximum age reported in this collection was 36 months.

An investigation of eating behaviors of blind, partially sighted, and sighted children failed to define "weaning" when reporting ages of accomplishment. Morley (1973) pointed out that weaning can be interpreted as the period in which solid foods, or foods other than milk, are introduced; alternately, it can denote the cessation of breast or bottle feeding. Such ambiguity could have a critical effect on results. For example, impaired children in the current survey were introduced to non-milk foods at a mean age of 4.54 months, yet they did not acquire cup-feeding skills until significantly ($p < 0.001$) later, at a mean age of 21.89 months. As a note of interest, the mean age at which impaired subjects (in contrast to sighted subjects) were introduced to nonmilk foods was within the four to six month range recommended by the Canadian Pediatric Society Nutrition Committee (Anonymous, 1980).

When cup-feeding data were compared to "weaning" data in the reference study, light perceptive and partially sighted subgroups in the present research were credited with successful skill acquisition slightly later than reference means of 16.25 and 20.00 months, respectively (Jan et al., 1977).

A number of explanations may have provided for the developmental lag in skills acquisition among the impaired children. The lack of visual feedback may have depressed skills development by decreasing or eliminating opportunities to observe and imitate others. If skills acquisitions were dependent on the amount of visual input received, then it stands to reason that impaired children would be later than sighted children in skills acquisition, and those with light perception later than those with partial sight.

Food progressions might also have been affected for the same reason. Indirectly, the lack of provision of solid finger foods at critical periods would have hindered chewing and hence, progression to textured foods. More directly, the absence of visual stimuli to anticipate a variety of shapes and consistencies might have slowed progress.

While this theory was supported by the results in general, it did not account for the notably larger differences between groups concerning skills acquisitions, compared to those of food progressions. Since the former area involved motor skills, this theory could be delineated further through application to the development of sensory coordination in the child. According to Adelson and Fraiberg (1974), motor delays are probably related to a lack of external incentive during most of the first year. While vision provides a sighted child with incentive and opportunities for the development of eye-hand coordination, ear-hand coordination (reach for a distant object on sound cue only) normally occurs late in the first year for sighted and impaired children. In other words, visually impaired children may experience a delayed development in certain areas which seems unlikely to be completely eliminated, since sound does not provide the same adaptive advantages as sight. Halliday (1971) stressed that ear-hand coordination could be encouraged if appropriate experiences were provided, and that impaired children eventually pass quite well through steps assuring good gross and fine motor development.

Such reasoning may have been epitomized in the skills acquisition of impaired children in the current study. These children began to master specified motor skills only after twelve months. However, the intervals between sequential skills were similar to those of the sighted group. This suggested that increased proficiency of ear-hand coordination enabled the impaired children to experience a normal developmental rate.

5. Objective Five: Feeding Practices, Problems, and Nutrient Supplementation

The Cochran Test for Related Observations is designed to analyze the significance of a variable that may be classified into one of two categories (Conover, 1971). Cochran's test was applied to frequency data which could be nominally scaled: infant feeding practices, feeding problems, and vitamin and mineral supplementation.

a. Infant Milk Sources

Analysis of infant milk sources revealed that the impaired children and their matched controls had similar distributions of breastfeeding, bottle feeding, and combination (breast and bottle) feeding (Table 29). In both groups, bottle feeding was the most common method of supplying milk, followed by combination feeding and breastfeeding.

A pilot study on milk sources of visually impaired children found a 21.5% incidence of breastfeeding to be significantly less common ($p<0.05$) compared to bottle feeding (Jan et al., 1977). However, no mention was made regarding classification of children who received combination feeding. Similar proportions were observed when combination-fed subjects in the present study were regrouped with bottle fed children, and the incidence compared to breastfeeding (87.5% and 12.5%, respectively). Application of the binomial test to these results indi-

Table 29. Comparison of methods of infant feeding by mothers of visually impaired and sighted children.

METHOD	VISUALLY IMPAIRED CHILDREN	SIGHTED CHILDREN
	n = 16	n = 16
Breast	12.00% (2)	18.75% (3)
Bottle	63.00% (10)	37.50% (6)
Breast and Bottle	25.00% (4)	43.75% (7)

cated that breastfeeding was significantly less common than bottle or combination feeding within the impaired group ($p < 0.002$). This substantiated the claim of Elonen and Zwarensteyn (1964) that most visually impaired children are bottle fed. However, breast feeding was also less popular among the sighted group ($p < 0.01$); thus, the preference for bottle or combination feeding could not be considered unique to children with visual impairements.

Infant feeding data were also compared to other surveys on the general population. Information collected during the Nutrition Canada Survey indicated that 67% of the mothers in the Prairie region selected bottle feeding, while 33% provided a combination, and less than 1% breastfed exclusively (Myers, 1979).

Similar trends in bottle and combination feeding were observed in this study, particularly within the impaired group. In contrast, breastfeeding was more common for both groups, compared to the Nutrition Canada data. Such a difference was probably a reflection of general trends in infant feeding, in that the Canadian survey was executed in 1970-72, the period from the mid 1960s and early 1970s when breastfeeding in other industrialized populations was also relatively low (Fomon, 1973). On the other hand, the current move towards breastfeeding may have been evidenced in the increased incidence of breastfeeding in the current study, in which half of the impaired children were born since 1975.

A 1978 survey of infant feeding practices in Manitoba revealed that 28% of mothers polled breastfed (completely, or partially), while 72% bottle fed their children (Clark and Beal, 1981). When these categories were used, it was found that impaired children showed similar proportional distributions (37% breastfed partially or completely, 63% bottlefed). The inverse was true of sighted children. In other words, sighted children tended to be breastfed (partially or completely) almost two times more than impaired children. Breastfeeding may have been less common within the impaired, as contrasted to the sighted, group due to reasons cited in the literature review. It is just as likely that these differences resulted from utilizing a sighted group that may not have been representative of the normal population (ie., breastfeeding being twice as population in this group compared to results of the study by Beal and Clark [1981]). Since feeding methods among impaired children paralleled those of the general population, it was concluded that the only essential difference between impaired and sighted groups was the unusually increased tendency towards breastfeeding (partially or completely) among sighted children.

b. Incidence of feeding problems and supplementation

Cochran's test was further used to measure the significance of differences between impaired and sighted groups in relation to bottle feeding of non-milk food, feeding problems, and nutrient supplementation. Statistical tests found that the impaired group did not exhibit a significantly higher incidence in any of these areas.

Eleven impaired and ten sighted children received non-milk food by bottle. Of these children, all but one in each group drank fruit juices from a bottle. The other two children were given diluted infant cereal. Concern over non-milk feeding by bottle was specifically aimed toward solid foods (ie., cereal)--a practice which had the potential to instigate poor nutrient intake, food habits, and feeding skills. On the basis of the current results, it appears that this feeding practice may be more common among children with other handicaps (Dufton-Gross, 1979) than visual impairment alone.

Feeding problems were reported in six (37.5%) visually impaired children. This incidence fell within the 33-43% range reported for handicapped children in previous studies, and slightly surpassed the 25% incidence claimed for blind children (Palmer et al., 1978; Barsch, 1968). The 25% (n=4) incidence of feeding problems among sighted subjects substantiated prior reports that one-fourth of all children present feeding difficulties (Kanner, 1972).

All six impaired children with problems experienced difficulty in sucking, swallowing, or chewing. Caregivers cited frequent gagging on textured or unfamiliar foods. One child had difficulty adapting to a bottle, as he was "afraid" of the unseen object. While one child did not demonstrate mature rotary chewing until five years, others were purported to have problems in acquiring the mechanics of the feeding skill.

Two impaired children had a history of voluntary vomiting following meals, one whose caregiver explained that the child "had a small stomach that could not hold too much food down". However, the same child was one of two impaired subjects with multiple food dislikes. Food dislikes for both groups of children included meats, vegetables (excluding potatoes), and any strong-tasting or unfamiliar food.

Within the sighted group, two children experienced difficulties in swallowing or chewing, and two had multiple food dislikes.

While the Cochran test did not find a significantly higher frequency of feeding problems among impaired children, it was interesting to note the predominance of swallowing and chewing difficulties within this group. Such results lend strength to the theory that oral mastication problems may have been related to a corresponding lack of visual observation and imitation of eating skills. Conversely, the same theory was weakened when the comparison of impaired and sighted groups indicated both groups had similar frequencies and types of perceived feeding problems.

Six children (44%) from each group routinely used a vitamin or vitamin and mineral supplement. While the type, dosage, and frequency of supplementation varied, all but one of the twelve children received a multi-vitamin preparation. Four impaired and two sighted children used supplements containing iron. One of the impaired children also took 10 mg zinc and a garlic and parsley capsule daily "to prevent urinary tract infections". Another child ingested halibut liver oil on a regular basis.

Only one study was available on supplementation practices among handicapped children. Gouge and Ekvall (1975) stated that vitamins were routinely used by 59% (n=119) of handicapped children surveyed. In addition, supplementation was correlated with age, wherein children under 6 years were more apt to receive vitamin preparations. Similarly, the mean age of impaired children who used supplements in the present study was 5.7 years, and 6.7 years for sighted children.

More information was accessible on supplementation within the general pediatric population. A survey of 116 Ontario children between five and six years old revealed that supplements were consumed at an average of 1.5 times/child/week (Anderson, 1980). In this context, both impaired and sighted groups used supplements at an average of 1.9 times/child/week. The higher frequency of supplementation within the present study may have been a reflection of the decidedly middle and upper socioeconomic representation of the subjects. Such a relationship between socioeconomic status and supplementation was acknowledged by Owen et al. (1974), whose study of 1400 four to six year olds disclosed that the percentage of children using supplements (22% to 61%) increased as socioeconomic status rose.

V. SUMMARY AND CONCLUSIONS

A group of 16 visually impaired children (7 months - 13 years), registered with Canadian National Institute for the Blind in Manitoba, participated in a pilot study designed to assess dietary intake, anthropometry and feeding skills acquisition. In terms of functional vision, nine children had partial vision, while seven had light perception or less.

The mean daily intake, calculated from three-day food records and computer-analyzed, met the Recommended Daily Nutrient Intake for all nutrients except for a marginal kilocaloric intake, and folic acid 31% below recommendations. Mean intakes of kilocalories, fiber and retinol were below those of children (excluding infants) in the Nutrition Canada Survey, Children with light perception had higher mean intakes of all nutrients compared to those with partial vision. Less than two-thirds of the children met recommendations for kilocalories, thiamin, retinol and folic acid. These results may or may not have reflected the fact that few subjects consumed servings recommended by Canada's Food Guide for cereal products (78% subjects), meat, milk or produce (43%), or vegetables alone (28%).

Over half of the children were within average ranges for stature, weight and weight-for-stature; however, five were considered overweight-for-stature. Triceps skinfold tests revealed adiposity to be within normal (80% subjects) or lower ranges, and arm muscle area or muscularity within normal (60%) or upper ranges. This suggested a sufficient intake, storage and expenditure of energy, despite marginal intake of the RDNI for kilocalories.

While impaired subjects accepted textural food progressions and mastered feeding skills later than sighted controls, ages were within normal ranges of a developmental standard. Hypothetical application of a paired t-test revealed that cup feeding mastery ("weaning") was significantly later among the visually impaired (p 0.005). Delay in skills acquisition was thought to be related to the lack of external incentive during the first year, until ear-hand coordination develops at the normal time and opportunities allow for skills mastery to occur at a normal rate.

Application of Cochran's Test for Related Observations revealed no significant differences regarding the incidence of bottle feeding (88% vs. 81%), bottle feeding of nonmilk foods (69%), feeding problems (38% vs. 25%), and vitamin and mineral supplementation (44%).

Overall results must be viewed with the limitations of the sample in mind. Such a small sample was not truly representative of the population, nor was it randomly selected. Consequently, results of this research cannot be interpreted as being applicable beyond this sample.

The visually impaired children were analogous to sighted Canadian children, in regards to the assessed parameters; however, the need for nutrition education was evident. Such an education program should reinforce the apparent maintenance of energy balance. Emphasis is needed on diets that contain adequate servings of a wide variety of food, particularly those high in fiber, retinol and folic acid (ie., fruit and vegetables). There is also a special need for educational materials designed in large type, audio-visual and Braille formats with the visually impaired child in mind.

It is hoped that further research on larger groups of visually impaired children will continue to define, and offer alternatives aimed towards successful nutrition and health management for optimal growth and development.

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APPENDIX A

The Canadian National Institute for the Blind

MANITOBA DIVISION

Patron, The Honourable F.L. Jobin, Lieutenant-Governor of Manitoba

WEST DISTRICT OFFICE
356 Tenth Street
Brandon, Manitoba R7A 4G1
Telephone (204) 727-0631

DIVISION SERVICE CENTRE
1031 Portage Avenue
Winnipeg, Manitoba R3G 0R9
Telephone (204) 774-5421

WINNIPEG

April, 1981

Dear Parent(s):

The Manitoba Division of the CNIB has agreed to assist Kathryn Scoon, a graduate student at the University of Manitoba; in her research project. The attached letter from Katheryn Scoon and material describing her project will be self explanatory.

Since Katheryn Scoon needs to be in touch with parents of visually impaired children, the most effective way was through the CNIB. For reasons of protecting your confidential relationship with the CNIB, we agreed to mail out Katheryn Scoon's material. Whether or not you wish to participate in the research project depends entirely upon your decision. If you wish to take part, simply contact Katheryn Scoon, and if not she is unaware of you and you have no obligation.

Once again, let me assure you that this mail out has been done from the CNIB office.

Yours truly,

A. P. Heuser
Supervisor
Social Services
Manitoba Division

APH/lm

THE UNIVERSITY OF MANITOBA
FACULTY OF HOME ECONOMICS
WINNIPEG, CANADA R3T 2N2
TELEPHONE 204 474-9901

DEPARTMENT OF FOODS AND NUTRITION

Dear Parent:

My name is Kathryn Scoon, and I am a graduate student in the Department of Foods and Nutrition at the University of Manitoba. I worked with diabetics at Braille Institute of America and studied feeding problems of blind infants as a student dietitian. These studies made me aware of the desperate lack of nutrition and health information for and about visually impaired people, especially children.

I am looking at the food intake and growth of visually impaired children as a thesis project. From this research, I hope to be able to advise parents, like yourself, how to provide the best food and nutrition possible to meet the needs of a visually impaired child.

I would like to arrange a home interview at your convenience, to ask a few questions about your child's feeding skills, and measure his/her height, weight, and skinfold. A skinfold is a painless measure of skin thickness of the upper arm. I will show you and your child how to keep a brief (3-day) diet diary. The entire interview will last about one hour.

When I pick up the completed diary, I will give you a Family Nutrition Kit (a selection of colorful booklets on family nutrition) in appreciation for your help. In addition, I will send you a summary of the results and what they mean.

This project has received the approval of the Canadian National Institute for the Blind. The identities of you and your child will be kept in strict confidence. You may terminate participation in this study at any time without penalty, by contacting me by telephone or letter.

I would like to know if you could help me by taking part in this project. If so , please fill out and return the enclosed consent form. I will be happy to answer any questions you might have, at (evenings) or 474-9554 (university office).

Thank you for your time and consideration.

Sincerely,

CONSENT FORM

It has been explained to me by Kathryn Scoon of the Department of Foods and Nutrition, University of Manitoba, that she is conducting research on the food intake and growth of visually impaired children.

I understand that a short interview will be arranged in my home at my convenience. This interview will include questions on my child's feeding skills, and instruction on keeping a brief (3-day) diet diary. In addition, my child's height, weight, and skinfold will be measured.

I am familiar with the purpose of this study. The identities of myself and my child will be strictly confidential. I can terminate participation at any time without penalty, by contacting the researcher by phone or letter. I understand that on completing the Diet Diary, I will receive a complimentary Family Nutrition Kit, as well as results of this study.

I agree to participate in this study, and grant permission for my child's participation.

Date: ____________________

Signature: ____________________

For (Child's Name) ____________________

Child's Birthdate: ____________________

Address: ____________________

Telephone: ____________________

APPENDIX B

Number ______________

Interviewer ______________

Date ______________

QUESTIONNAIRE

Family Background

1. Children

   a. number (including this child) at home or elsewhere ______

   b. birth rank of this child (eg: firstborn) ______

2. Relation of caregiver to child ______

3. Marital Status

   a. married ☐

   b. single (divorced, separated, widowed, unmarried) ☐

4. Education of main wage earner ______

5. Occupation of main wage earner ______

6. Residence

   a. metropolitan ($>$ 100,000) ☐

   b. urban (5,000-100,000) ☐

   c. rural ($<$ 5,000) ☐

Child's Background

Birthdate: ______________ Sex: M ___ F ___

Birthweight: ______________ Length at birth: ______________

1. Type of Visual Impairment

   a. total blindness ☐

   b. light perception (movement, light and shadow, shape) ☐

   c. partial vision (some useful vision remains, such as to read large print; "tunnel vision") ☐

   d. other: ______________________________

2. Age of onset, as diagnosed by doctor ______

3. Feeding History

   a. Infant Feeding

      1. Was/is your child breastfed? ______

      2. Was/is your child bottle fed? ______

      3. Was your child breast and bottle fed? ______

      4. At what age was food or drink other than milk introduced? ______

      5. Was/is your child given food or drink other than milk by bottle? ______

Number ______________

3. Feeding History (cont'd)

b. Food Acceptance

1. At what age did your child accept pureed/strained foods? ________
2. At what age did your child accept chopped/junior foods? ________
3. At what age did your child accept regular/table foods? ________
4. Did your child have any difficulties when you have him chopped or table foods? ________

   If so, explain ______________________________

c. Feeding Skills

1. Age at which your child fed self with fingers? ________
2. Age at which your child fed self with spoon? ________
3. Age at which your child drank from a cup, unassisted? ________

4. Current Practices

a. Does your child receive food from school? ________

1. If so, meal(s) B ___ L ___ D ___ snack ___
2. If so, daycare/school attended ______________

b. Does your child take a vitamin or mineral supplement? ________

(Brand, type, how many, how often) ______________________________

c. Which (if any) diet restrictions does your child have? ________

ANTHROPOMETRIC MEASUREMENTS

Number ______________

1. Height ________) _____ cm ________%ile
2. Weight ________) _____ kg ________%ile
3(a) Triceps Skinfold: upper arm circumference _____ cm
(b) TSF (#1 ________ #2 ________ #3 ________) _____ mm ________%ile
(c) AMA arm muscle area (3.(a) & (b)) _____ mm ________%ile

Number________

Date________

QUESTIONNAIRE

Child's Background

1. Relation of child to visually impaired subject ________
   If unrelated,

   a. Occupation of main wage earner ________

   b. Education of caregiver ________

Feeding History

1. Infant Feeding

   a. Was/is your child breastfed? ________

   b. Was/is your child bottle fed? ________

   c. Was/is your child breast and bottle fed? ________

   d. At what age was food or drink other than milk introduced? ________

   e. Was/is your child given food or drink other than milk by bottle? ________

2. Food Acceptance

   a. At what age did your child accept pureed/strained foods? ________

   b. At what age did your child accept chopped/junior foods? ________

   c. At what age did your child accept regular/table foods? ________

   d. Did your child have any difficulties when you gave him chopped or table foods? ________

   If so, explain________________________________

3. Feeding Skills

   a. Age at which your child fed self with fingers?________

   b. Age at which your child fed self with spoon? ________

   c. Age at which your child drank from a cup, unassisted? ________

Current Practices

1. Does your child take a vitamin or mineral supplement?________
   If so, list brand, type, number, frequency:

   ____

2. Which (if any) diet restrictions does your child have?

   ____

DIET DIARY

NUMBER_______________

NEXT MEETING:
DATE___________
TIME___________

Number: SAMPLE

Date:

(12-year old child)

TIME EATEN	WHERE EATEN	ITEM	AMOUNT EATEN	DESCRIPTION; AMOUNT LEFTOVER
8:00AM	home	cereal	1 cup	Honeycomb; presweetened
	"	milk	½ cup	2%; on cereal
	"	sugar	1 teaspoon	on cereal
	"	orange juice	4 ounces	frozen reconstituted 3:1
	"	doughnut	1	glazed
12 NOON	home	soup	1 cup	Campbell's Tomato, diluted with milk (2%)
	"	crackers	6 squares	saltines
	"	cheese	3 slices	hard Cheddar; mild; 2" x 3" x ¼"
	"	carrots	1 medium	raw sticks
	"	applesauce	½ cup	Taste Tells brand
	"	cookies	2	Oreos brand
	"	milk	8 ounces	2%; didn't drink 4 ounces (12 ounce cup)
3:30 PM	home	Sandwich:		
	"	bread	2 slices	Safeway white sandwich loaf
	"	peanut butter	1 tablespoon	Empress smooth
	"	jelly	2 teaspoons	Welch's grape jelly
	"	margarine	2 teaspoons	stick margarine; Parkay
	"	punch	12 ounces	Freshie cherry with vitamin C
	"	candy bar	30 grams	Nestle Crunch Bar
6:00PM	McDonald's	Big Mac	1	with cheese; ate all but 2 bites
	"	French fries	small bag	ate all but 3
	"	ketchup	1 tablespoon	on French fries
	"	cola drink	1 medium	with ice
9:00PM	home	apple pie	2½" wedge	homemade; 2-crust
	"	ice cream	½ cup	Lucerne vanilla
	"	punch	4 ounces	Freshie cherry with vitamin C

HOW TO DESCRIBE AND MEASURE FOOD

DESCRIPTION	MEASUREMENT
1. Beverages	cups, ounces, tablespoons
Milk - whole, skim, 2%, canned; milk in cereal or eggs Juice - kind; fresh, frozen, canned, powdered Pop - kind	
2. Breads, Biscuits, Buns, Muffins	slices, number
Breads, buns - white, wheat, rye; hot dog bun Muffins - corn, bran; plain, blueberry List butter or spread used	
3. Cereal, Noodles, Rice	cup, tablespoons, packet
Cereal - dry, cooked, presweetened Spaghetti, Noodles - unenriched; enriched (vitamins; iron) Rice - brown, regular, instant, converted	
4. Potatoes, Vegetables	cup, tablespoons, pieces
Form - fresh, frozen, canned Method - boiled, fried, baked, mashed, raw List added butter, gravy, sauces, toppings	
5. Meat, Fish, Poultry, Eggs, Cheese, Peanut Butter	inches, ounces, number, cup, tablespoons
Type - beef, chicken, pork, salmon, venison, eggs Form - chop, steak, burger, drumstick, slice Method - fried, scrambled, roasted, broiled, boiled, Brand - spreads, such as cheese spread or peanut butter List milk, fat added to eggs	
6. Fruit	cup, tablespoons, number
Form - fresh, frozen, canned; pureed Canned - heavy or light syrup, or water-pack List added sugar, milk or cream	
7. Desserts	inches, number, cup, tablespoons
Form - bought or homemade Cakes - kind; kind of frosting Pastries - type filling Cupcakes, cookies - type Flavor - ice cream, sherbet, pudding, Jello	
8. Extras	tablespoons, teaspoons
Fats - butter, lard, oil, gravy, dressing, mayonnaise Sugar - sugar, honey, syrup, molasses, jelly, jam	
9. Snacks	ounces or grams (on wrapper), number, box size
Peanuts, popcorn Candy, chocolate bars	

REMEMBER

1. Brands of foods are very important, so list whenever possible under "description".

2. Mixed dishes such as a casserole can be listed in any of three ways:

   a. List each ingredient and amount eaten on separate line

6:00 P.M.	home	carrot beef potato	1/2 4" carrot 4 1" pieces 3 pieces, 1"x1"x1"	} in stew

OR

   b. List recipe on back of diary sheet, and amount eaten by child

OR

   c. Record brand of purchased (frozen, canned, mix) product, and amount eaten:

6:00 P.M.	home	beef stew	1 cup	Puritan Beef Stew - canned

3. Only list foods and amounts actually eaten by the child, even if it is only "two bites".

4. Please do not change the child's diet for this study, but have him/her eat in the usual way.

5. You may use more than one line for a single food item. For even more space, feel free to write on the back of sheets..

If you have any questions, please call me (Kathryn Scoon):

(evenings)
474-9554 (university office)

Number: ________________

Date: ________________

TIME EATEN	WHERE EATEN	ITEM	AMOUNT EATEN	DESCRIPTION; AMOUNT LEFTOVER

Number: ____________________

Date: ____________________

TIME EATEN	WHERE EATEN	ITEM	AMOUNT EATEN	DESCRIPTION

Is this a usual day? Yes ______

No ______

If not, please explain why: ____

____

____

APPENDIX C

Characteristics of Visually Impaired Subjects

Subject No.	Sex	Age -yrs-	Functional Vision*	Etiology	Birth Weight -gm-	Birth Length -cm-	Age Onset -yrs-	Birth Rank	No. Children n	Res.	Socioeconomic Status -class-
101	M	9.0	P	nerve atrophy	2940	52	birth	last	4	urban	middle
102	F	4.9	P	glaucoma	3110	48	birth	only	1	urban	middle
103	F	4.6	L	nerve atrophy	2180	N/A	birth	first	3	urban	upper
104	F	9.0	P	coloboma	3220	N/A	birth	last	2	urban	middle
105	M	11.8	P	cataracts	3160	53	birth	only	1	rural	upper
106	F	6.0	L	RLF	990	N/A	birth	last	3	urban	middle
107	F	10.6	L	aniridia	2820	48	birth	last	2	urban	upper
108	F	13.1	L	nerve atrophy	2760	48	birth	last	4	urban	middle
109	F	0.9	L	nerve atrophy	3330	51	birth	last	2	urban	lower
110	M	7.5	P	nystagmus	3530	50	birth	last	2	urban	middle
111	F	6.6	L	cataracts	2940	51	birth	middle	4	urban	middle
112	F	7.6	P	glaucoma	2850	50	birth	first	2	urban	middle
113	F	4.3	P	glaucoma	2950	51	birth	last	2	urban	middle
114	M	4.0	P	glaucoma	4050	55	birth	first	2	urban	upper
115	M	13.2	L	nerve atrophy	2340	46	birth	only	1	rural	middle
116	M	12.2	P	nerve atrophy	4190	57	6 yrs.	first	3	rural	middle

*Functional Vision: P = partial; L = without light perception

APPENDIX D

Mean Intake of Nutrients During Three-Day Food Records

Subject	Kcal	Protein	Fat	CHO	Fiber	Ca	P	Fe	B_1	B_2	B_3	Ascorbic Acid	Retinol	Folic Acid
101	1821	59	79	220	2.24	946	1115	18.22	0.88	2.76	29	55	355	56
102	1307	63	47	171	2.87	474	915	10.72	0.92	1.78	28	43	789	62
103	1698	58	67	225	4.68	819	1070	11.84	1.35	2.40	25	167	850	108
104	2204	70	99	267	3.47	842	1198	9.11	0.86	1.58	25	82	725	72
105	2907	112	114	392	3.87	1243	1706	15.09	1.36	2.67	39	155	1090	102
106	1838	86	65	239	4.48	976	1561	16.55	2.26	2.28	36	153	582	114
107	1062	43	44	125	1.43	783	840	16.92	1.13	1.62	22	90	1033	42
108	2552	118	126	245	2.39	1622	2025	11.92	1.14	3.08	44	61	858	84
109	1048	28	46	134	1.24	689	579	24.48	0.88	1.45	17	54	1015	18
110	1842	54	67	266	4.14	707	913	15.34	1.58	2.84	26	63	623	54
111	2025	61	85	263	2.50	951	1067	11.10	1.00	1.78	22	163	654	133
112	1569	44	63	211	2.33	530	638	7.81	0.72	1.03	16	118	328	69
113	1328	40	59	167	1.42	474	626	8.11	0.83	1.14	16	139	353	40
114	1723	69	66	220	2.58	1122	1282	13.57	0.81	2.74	26	46	488	54
115	2849	123	148	259	3.50	1217	1829	16.20	1.19	2.39	44	110	842	98
116	1716	41	58	263	2.30	342	506	11.19	1.43	1.43	20	107	458	50

Percent RDNI Received from Mean Intake During Three-Day Food Records

Subject	Kcal %	Protein %	Calcium %	Phosphorus %	Iron %	Thiamin %	Riboflavin %	Niacin %	Ascorbic Acid %	Retinol %	Folic Acid %
101	82.8	178.1	135.1	159.4	182.2	80.0	212.3	208.6	183.9	50.7	55.6
102	66.4	230.6	94.9	182.9	111.6	96.7	154.5	234.08	169.95	157.8	88.26
103	94.3	213.2	163.8	214.0	131.6	150.0	218.2	209.2	836.6	170.0	108.4
104	110.2	210.3	120.2	171.1	91.1	86.0	131.7	193.1	271.9	103.6	72.6
105	116.3	272.5	138.1	189.5	137.2	113.3	178.0	230.2	518.1	136.3	102.0
106	102.1	316.6	195.2	312.2	183.9	251.1	207.3	300.8	510.5	116.4	114.3
107	108.0	338.5	156.6	209.9	241.7	226.0	270.0	360.3	447.6	258.3	69.4
108	116.0	273.8	202.7	253.1	85.1	103.6	220.0	293.2	202.3	107.3	42.3
109	97.1	196.5	137.7	144.7	349.7	176.0	241.7	277.5	270.7	253.8	30.7
110	83.7	162.0	101.1	130.4	153.4	143.6	218.5	186.7	209.5	89.0	53.8
111	112.5	224.8	190.2	213.3	123.3	111.1	161.8	183.0	819.4	130.8	129.8
112	78.4	134.2	75.8	91.1	78.1	72.0	85.8	120.4	395.0	46.9	69.0
113	74.9	150.2	94.8	125.3	90.1	92.2	103.6	133.8	697.0	70.7	40.4
114	95.7	256.2	224.5	256.4	150.7	90.0	249.1	219.9	232.7	97.7	58.8
115	101.7	216.9	101.4	152.4	124.6	85.0	140.6	231.7	365.0	84.2	49.1
116	63.5	36.9	36.9	47.8	101.7	101.7	95.3	99.7	357.3	57.3	49.7
Mean	94.68	217.19	135.63	178.86	146.52	123.99	180.98	218.61	408.17	120.68	69.43

APPENDIX E

Mean Number of Servings from Food Groups Consumed During Three-Day Food Record by Visually Impaired Subjects

	FOOD GROUP				
SUBJECT	DAIRY	MEAT	GRAINS	FRUITS AND VEGETABLES	VEGETABLES
101	2.60	1.00	7.55	1.60	1.60
102	0.85	2.25	2.17	3.96	2.30
103	2.10	1.80	4.50	6.20	2.60
104	1.56	1.56	5.00	3.50	1.10
105	3.75	2.86	5.60	2.91	1.41
106	2.60	1.56	2.70	2.80	2.50
108	2.36	2.78	3.81	3.69	1.40
110	1.10	2.16	4.25	3.70	1.10
111	1.60	1.37	3.90	5.17	1.40
112	1.00	1.70	4.40	4.48	1.88
113	0.83	1.40	3.69	3.96	1.66
114	3.28	1.41	4.32	3.13	1.30
115	2.50	4.76	2.00	4.70	3.20
116	0.50	1.66	4.70	2.13	1.53
$\overline{X}$ =	1.90$\pm$.99	2.02$\pm$.95	3.99$\pm$1.58	3.71$\pm$1.20	1.78$\pm$.63

APPENDIX F

Anthropometric Measurements of Visually Impaired Subjects

SUBJECT	ANTHROPOMETRIC MEASUREMENT			
	STATURE (cm)	WEIGHT (kg)	TRICEPS SKINFOLD (mm)	ARM MUSCLE AREA (mm)
101	123.2	22.2	17.5	1837
102	104.1	16.1	16.6	1431
103	103.5	16.4	16.5	1537
104	132.1	32.3	23.7	2851
105	152.1	48.2	26.9	3478
106	111.1	18.2	17.0	1577
107	67.5	9.1	15.8	1203
108	158.8	51.3	25.5	3402
109	68.0	10.0	17.7	1628
110	130.8	33.2	23.2	3154
111	111.1	18.2	17.9	2096
112	120.6	19.0	16.0	1638
113	100.3	13.4	14.9	1374
114	102.9	15.4	17.2	1672
115	149.9	39.0	21.9	3045
116	148.0	36.0	–	–