

NUTRITION OF TWO GROUPS OF INDEPENDENT ELDERLY INDIVIDUALS
as determined by dietary history
and biochemical data with a
PRELIMINARY ASSESSMENT OF A MEALS DELIVERY PROGRAM

by

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Two groups of elderly individuals living alone were interviewed regarding food intake. The experimental group was mainly home-bound and associated with the Winnipeg Meals Delivery Service. The comparison group was not home-bound. Sixteen and twelve dependable meal patterns were obtained from the experimental group prior to meals delivery and after ten weeks of meals delivery respectively. Fifty-three dependable meal patterns were obtained from the comparison group.

Evaluation of nutrient intake showed vitamin A and ascorbic acid to be the nutrients most frequently consumed in less than recommended levels among both groups. Calories and protein were also frequently consumed in less than recommended levels among the home-bound group. The comparison group had a better intake of food both in quantity and quality than the home-bound group.

The biochemical data tended to confirm this finding. Few in the comparison group had blood levels of components below an acceptable range. A greater percentage of the experimental

group appeared to have blood levels of components in a deficient or low range. Five of six men in this group had hemoglobin levels below the acceptable range. Urine analysis together with data on nutrient intake showed thiamine, riboflavin and niacin were consumed in adequate amounts among subjects in both groups.

The food intake of the experimental group had improved both in quantity and quality after ten weeks of meals delivery. The percentages with intakes below recommended levels of ascorbic acid and iron dropped from forty-four and thirty-eight respectively to zero with meals delivery. Blood levels of components were similar prior to meals delivery and ten weeks later. A study comprising larger numbers over an extended period of time will be required for a more adequate assessment of the value of a meals delivery program on the nutritional status of home-bound elderly individuals.

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I wish to thank Mr. D. Brown, Executive Director of the Greater Winnipeg Day Center Board Incorporated, for his help in finding suitable subjects and for his encouragement. I wish to thank Mr. G. Pearce, Executive Director of the Home Welfare Association, who is responsible for the operation of the Meals Delivery Service and who has given support to this study.

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C. M. Moore

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INTRODUCTION

This report continues study of the nutritional problems of elderly individuals. An earlier nutritional survey conducted in Winnipeg in 1963 revealed the need for a meals delivery service to home-bound aging individuals. Such a service began June 21, 1965, as a three-year pilot project under the supervision of the Home Welfare Association of Winnipeg. One hot meal is delivered five times a week to home-bound individuals.

This report compares data concerning the nutritional status of two groups of independent elderly individuals. One group comprised home-bound individuals who received meals provided by the Meals Delivery Service. The other was a comparison group of individuals who were not home-bound. The effectiveness of the Meals Delivery Service over a short period of time has been studied. A long term study comprising a larger number of subjects will be necessary for adequate assessment of the nutritional value of a meals delivery program for aging individuals.

REVIEW OF LITERATURE

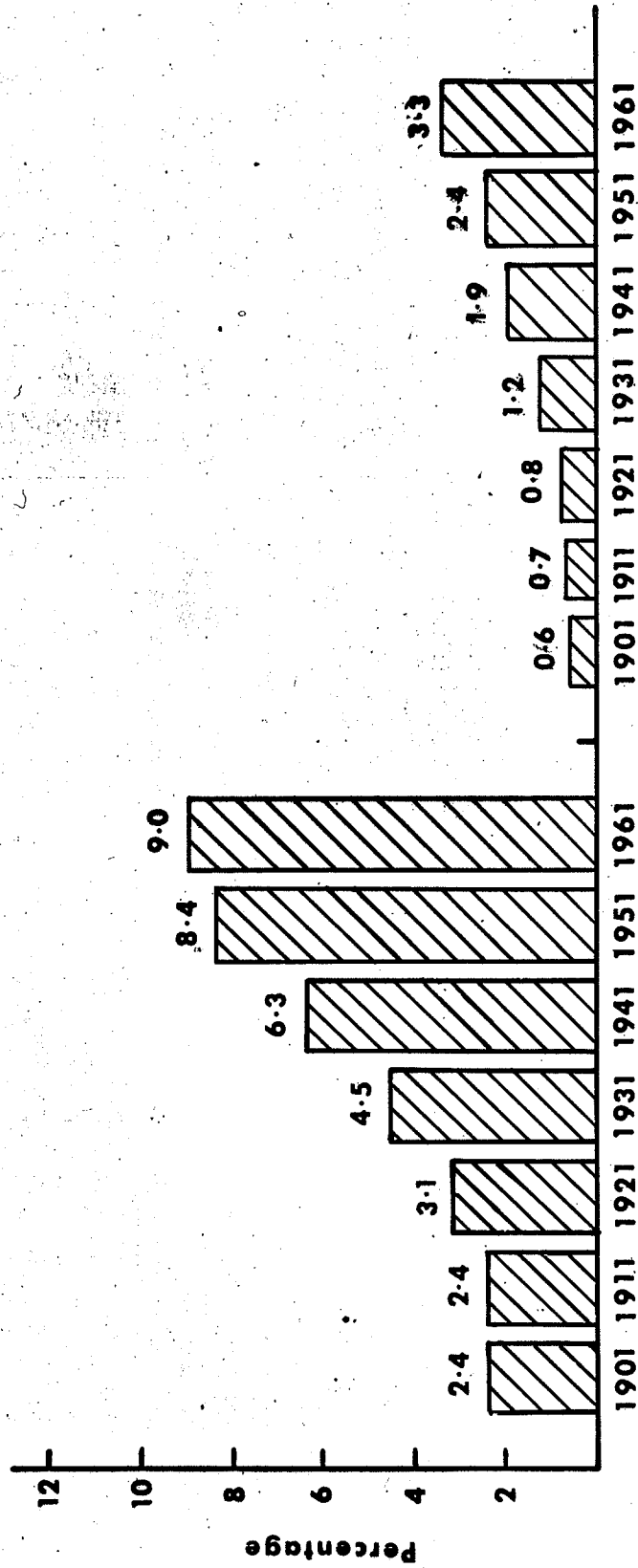
There is now a higher proportion of older people among populations than ever before. This increase in proportion has resulted from scientific, economic, and social advances. In Canada, in 1931, the average age at death was 43.1 years for males and 44.8 years for females; by 1962, it was 59.9 years for males and 63.2 years for females (12). The median age at death increased during this same period from 50.8 to 68.0 years for males and from 52.1 to 72.4 years for females. In the province of Manitoba, the proportion of persons sixty-five years of age and over has doubled in the period 1931 - 1961, while the proportion of those seventy-five years of age and over has nearly tripled (Figure 1).

The very scientific, economic and social advances that have helped increase the proportion of older people have also created problems for the aging with the result that many suffer rather than enjoy their old age (27). For example, industry's requirement for newer skills and a higher education level and its emphasis on youth and adaptability have resulted in unemployment among many older workers. And the high rate of mobility among the population has isolated many aging individuals from relatives and close friends. Many studies have been conducted on the problems of aging, and more research in this field is still needed.

Figure 1

CHANGES IN AGED POPULATION, MANITOBA 1901 TO 1961

Percentage 65 Years of Age and Over Percentage 75 Years of Age and Over



Data from: Sharp, E.J., Kristjanson, G.A., The People of Manitoba 1951 To 1961, Manitoba Dept. of Agriculture and Conservation, p. 27, 1965.

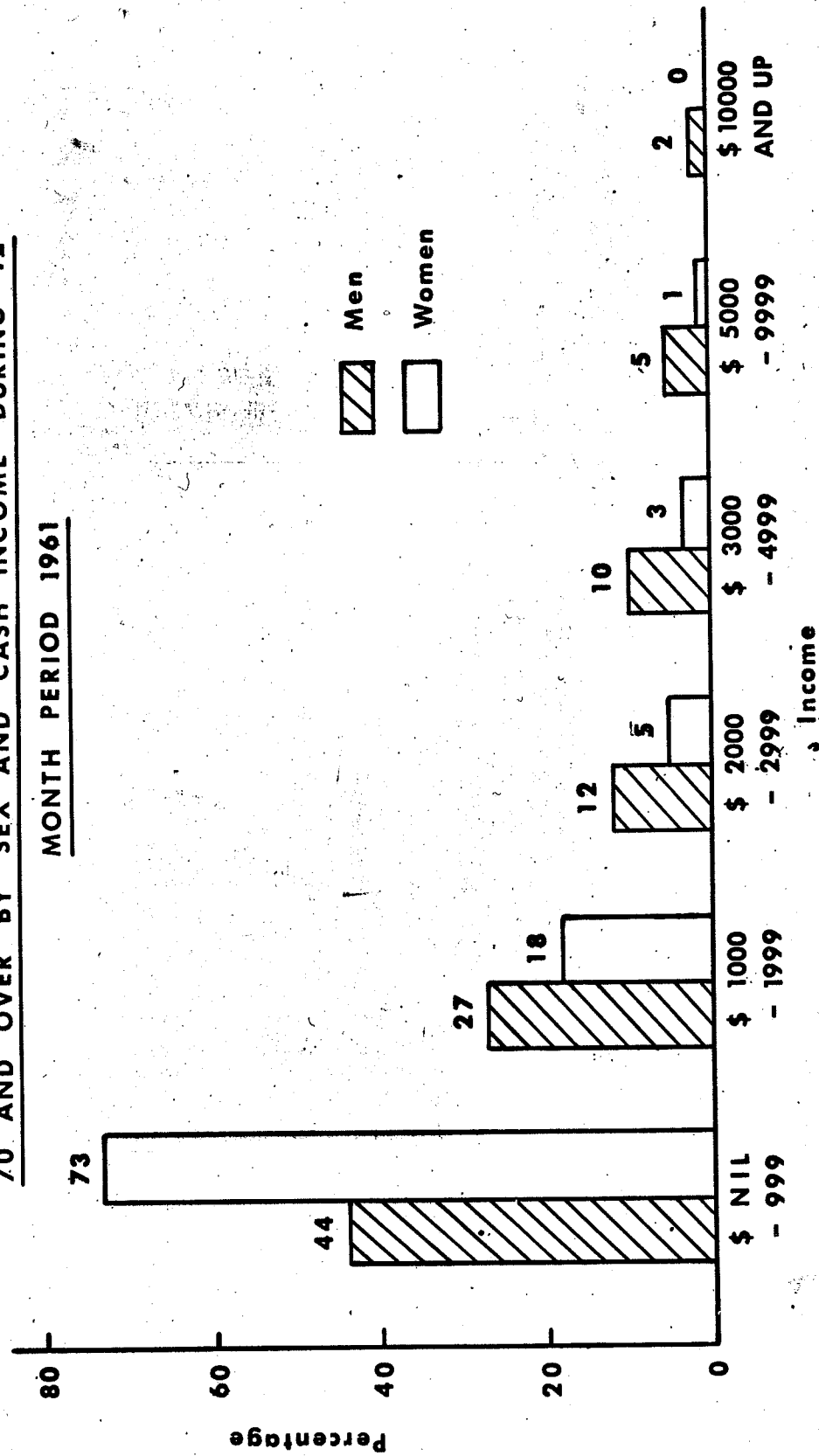
Factors Affecting Food Intake in the Aging

The aging person's choice of food is influenced by economic, social, psychological and physiological factors individually or in combination. Economic conditions are often prominent factors. Most older people live on reduced incomes. Data derived from tabulations of the 1961 Census of Canada Population Sample shows that the median cash incomes for the group sixty five years and over are substantially lower, and less varied, than those for all ages (41). Two-thirds of the women and close to half of the men past age seventy had cash incomes between \$500 and \$999 (Figure 2). People on low incomes are more apt to eat less expensive foods which tend to be predominately carbohydrate and low in other nutrients.

Social factors affect food intake. Many older individuals live alone in an environment not conducive to pleasure in preparing or eating meals. Davidson and associates (11) reported on 104 older people at the Age Center of New England whose ages ranged from fifty-one to ninety-seven. Two-thirds of the subjects were seventy or older. They were all mobile although many were not in the best of health. Most of the subjects were "middle class" or above who were frequently living alone in a furnished room on an income reduced from previous years. The ten with the highest rating in socialization were compared with the ten rating lowest in socialization. The group highest in socialization ate a greater variety of foods, an average of seventy one varieties, compared with the most isolated, who had a mean

Figure 2

PERCENTAGE DISTRIBUTION OF SAMPLE POPULATION AGED 70 AND OVER BY SEX AND CASH INCOME DURING 12 MONTH PERIOD 1961



Data from:

The Senate of Canada. Proceedings of the Special Committee of the Senate on Aging. No. 24, Table II-4, p. 1610, December 10, 1964

average of fifty three varieties, and their mean daily intake for eight nutrients was higher. The individuals highest in socialization tended to be in better health than the most isolated although they were apt to be more above desirable weight.

Some older people take up food faddism in search of a solution to their health problems. Jalso, Burns and Rivers (23) in a study of 340 subjects, members of various community organizations in New York State, found that, on the basis of age, the highest concentration of food faddists was in the older age group, and that the trend was reversed for the non-faddists. The Davidson study (11) considered the effect of faddism on food intake. The ten subjects with the highest food faddism scores had higher intakes of protein, vitamins A, C, thiamine and riboflavin than the ten subjects with the lowest food faddism scores both when supplements were included and excluded.

Davidson (11) found that dislike of or aversions to specific foods was a common experience among his subjects. Jung (26) reporting on a study of 320 people over sixty years of age in Dusseldorf concluded that the main factor influencing food choice in old age is prejudice about certain foods. According to Savitsky and Zetterstrom (40), food prejudices are related to the psychology or ritual, an adaptive technique designed to avoid anxiety. Security is achieved through the maintenance of rigidly held attitudes and rituals. Attempting to rid an elderly individual of their food prejudices may result in diminished capacities for protection against anxiety.

Anxiety and depression are commonly associated with loss of appetite (39). Unhappiness of elderly individuals may result from such factors as reduced financial conditions or loneliness or physical inability or illness. Some older people develop many fears, some of which concern certain foods they believe give them indigestion.

Emotional upsets may result in poor nutritional status even in individuals with satisfactory food intake. Swanson (47) reported the case of one of her elderly subjects, who normally had a happy disposition but who suddenly became depressed, nervous and irritable, and concurrently dropped from a nitrogen equilibrium on her regular self-chosen diet to a period of severe loss of body nitrogen. During this period she was spending her time with a dying aunt at the hospital. She was obsessed by the fear that when it came her time to die there would be no one to sit by her bed. After the aunt's death, the emotional crisis ended, and the subject regained her happy disposition and began restoring lost body protein.

Educational achievement appears to have a definite influence on choice of food. Young and associates (61) did a nutritional study of 1,640 sixty-four year old industrial workers in twenty-one major industrial and occupational categories from 250 companies. Adequacy of the diet increased as the educational level rose. When food usage was studied by income level within each educational group, thus separating

the effects of education and income, it was found that the educational level was of more significance than income level in choice of food.

Physiological factors influence food intake. Johnson (24) found that many of her subjects were without teeth or dentures. Their diets were very monotonous and unappetizing since they tended to avoid meat, fresh fruits and vegetables due to chewing difficulties.

The physiological changes of aging extend over the entire adult life span (43). In man, there is a gradual reduction in the performance capacities of most organ systems starting about thirty to thirty-five years and extending to death. The gradual reduction of reserve capacities that occurs in many important organ systems may be due to the loss of functional units or to impairment in the remaining units or both combined. For example, studies of various renal functions such as glomerular filtration rate, blood flow, maximum excretory capacity, and maximum resorptive capacities for glucose, show direct relationship with age. Data shows that, with aging, nephrons are lost from the kidney as functioning units. These physiological changes make it more difficult to estimate nutrient needs.

Present Status of Research Findings with Respect to Nutrient Requirements of the Elderly

Evidence so far indicates that the nutritional needs of

older people are similar to those of younger normal adults. One change with aging that is clearly indicated is a decrease in Calorie requirements due to lessened physical activity and to the reduction of functional protoplasm and the progressive atrophy of muscle tissue (21). The Canadian Dietary Standard (8) considers that the total energy requirement for maintenance living of those fifty-five to sixty-five years of age is eighty-seven per cent of their requirement at twenty-five years, and of those over sixty-five, eighty-three per cent of their requirement at twenty-five years. There is no change in the recommended level for protein per kilogram of body weight. But in order to meet the protein requirement a slightly higher concentration of protein foods is needed in a lower Calorie total. Reduction to a moderate intake of fat, with a high percentage in the form of unsaturated oil, is often recommended for the aged, a group showing a high incidence of atherosclerosis(57).

Animal Studies

Research on the problems of aging with animals is more amenable to experimental control than with humans, and the effect of dietary factors can be seen in a shorter period of time. A number of experiments suggested that rats receiving a diet moderately restricted in calories lived longer and had a lower incidence of degenerative disease than animals fed ad libitum. Berg and Simms (5) observed rats, divided into two groups, for a period up to 1,200 days. The one group ate

ad libitum and the other group was restricted to fifty-four per cent of the dietary intake of the ad libitum group. In comparison with the unrestricted rats, the life span of the restricted animals was increased about 200 days in males and about 350 days in females. With this forty-six per cent reduction in intake, little retardation of skeletal growth or sexual maturity was observed, and no storage of excess body fat developed as in the ad libitum group.

A forty-six per cent reduction in dietary intake from the ad libitum level appears to have beneficial effects on the life span and health of rats as reported by Berg and Simms. However, restriction beyond this level does not appear to be of any benefit. Barrows and Roeder (4) divided rats into groups with ad libitum food intake and experimental groups who were given fifty per cent of the food consumed by the ad libitum groups. Attempts to increase the life span in the male rats by the fifty per cent restriction throughout adulthood were unsuccessful, and the fifty per cent reduction in food intake during the latter part of life resulted in a small but significant decrease in mean life span. Factors other than differences in caloric level may have influenced the results of these two experiments.

Harman (19) found antioxidants incorporated at a one per cent level into a pellet diet prolonged the normal life span of some mice. 2-Mercaptoethylamic hydrochloride prolonged the half-survival time of C3H female mice by twenty six per cent

while hydroxylamine hydrochloride prolonged it by seven per cent. According to the free radical theory, aging is partly due to the oxidation reactions initiated by free radicals normally produced in metabolism or by the interaction of oxygen with oxidation catalysts in the intracellular spaces. (18) . Antioxidants would thus prolong the life span by retarding the effects of the free radicals.

Barrows and Roeder (3) reported on a study designed to determine age differences in the ability of various tissues of rats to synthesize proteins. Protein synthesis was estimated by changes in the concentrations of a variety of enzymes in the livers, kidneys and hearts of groups of rats of different ages ranging from one to twenty-four months, following periods of protein deprivation and refeeding. Control levels were obtained by determining the enzymatic activities in the tissues of normal animals of the same age. Results showed that the most noticeable age-dependent changes in enzyme concentrations occurred during the early part of life. Except for increased catabolism in the oldest animals, no marked agewise changes were noticed and no marked differences associated with old age were observed in the changes in enzymatic activities during protein depletion or repletion. The workers concluded that there is no impairment in enzyme synthesis in old animals.

Womack, Marshal, and Hildebrand (58) put 100 day and day old rats on diets containing wheat gluten at three different levels. Eight per cent wheat gluten was adequate for maintenance

of tissue protein of young adult rats but inadequate for older animals. Their conclusions were that either amino acid requirements of the older animals were greater than those of the younger animals or that requirements were similar but higher intake of one or more amino acids was needed for the older animals to maintain a greater amount of body protein.

Work by Moore and co-workers (32) indicated the influence of the previous diet in the prevention of osteoporosis in rats. The first group of rats in Moore's study were middle-aged with similar backgrounds and on the same stock diet adequate in calcium. They were put on a calcium deficient diet of raw minced beef with a supplement of calcium carbonate as the variable factor. All subsisted quite well on the diet. After death through old age, disease or killing, analysis of the framework showed no marked skeletal abnormalities in any of the animals. A second experimental group of weanling rats was put on a similar regime. Those with no calcium carbonate supplement were emaciated, and five of the six died shortly. Autopsy showed severe skeletal lesions. Those with only twenty two days of calcium supplement grew normally during the 125 day experiment and appeared to be in perfect health with normally shaped bones. However, the ash content of their femurs was only one-half that of rats that had the calcium supplement throughout the experiment. Severe stunting of growth and fractures occurred only when the ash content of the femur was one-third or less of the normal level. Thus, middle-aged rats who had been on an adequate diet were able to withstand calcium

lack with no change of bone structure whereas weanling rats on calcium poor diet could not.

Age appears to have some effect on iron absorption. Yeh, Soltz and Chow (59), after finding the mean values for hematocrit readings and hemoglobin concentration in the blood of a number of senior residents at a home for the aged to be lower than in younger individuals, tested male and female rats from one to twenty months of age for ability to absorb radioactive iron ⁵⁹ as measured by fecal excretion, the uptake of radioactive iron by organs, and radioactivity in blood following an oral dose. Results showed a decrease in iron absorption with age. A greater age decrease in iron absorption was observed in females than in males. However, there was no indication of impairment of erythropoiesis due to aging, since young and old rats were equally capable of blood formation when exposed to reduced atmospheric pressure or when iron was injected prior to a test dose of radioactive iron.

Animal research is helpful in studying nutritional requirements with age but application to humans is limited due to some basic differences between experimental animals and humans. For example, metabolism of the rat increases with age, whereas metabolism of the human, based on surface area, decreases or, based on intracellular water, shows no change with age (38). Consequently, studies with humans are essential.

Human Studies

Human studies are necessary to come to definite conclusions as to effect of age on human nutrient requirements. In recent years much work has been done on the amino acid requirements of individuals at various ages.

Tuttle and co-workers have carried on a number of investigations on the amino acid requirements of men over fifty years of age. Tuttle (49,51) found that subjects over age fifty went into negative nitrogen balance on diets containing levels of essential amino acid nitrogen sufficient to maintain college-age men in nitrogen equilibrium. In one of the studies by Tuttle and co-workers (50), the essential amino acid requirements of older men in relation to total nitrogen intake were studied. The results suggested that the requirements of men over fifty for one or more of the essential amino acids may increase with increases in total nitrogen intake, and thus amino acid deficiencies may occur among those men over fifty years of age with diets low in high quality protein. In another of their studies (52) in which diets containing various levels of methionine and lysine were administered they concluded that, under the experimental conditions involved, the amounts of methionine and lysine needed to maintain nitrogen balance appeared to be greater in older than in younger men. This work indicates an apparent increased requirement for essential amino acids with age.

According to Lutwak (29), ten per cent of the population over the age of fifty suffers from osteoporosis. Its occurrence seems to be related, in a number of cases, to calcium intake. One study showing that nutrition may be significant to senile osteoporosis was conducted by Vinther-Paulsen (54) in a home for the aged in Copenhagen. Thirty-three patients, five men and twenty-eight women, ranging in age from sixty-eight to ninety-six years were examined at the hospital department of the home. Senile osteomalacia was the main diagnosis in only one case. Care was taken to select subjects eating with the same appetite during as before the experimental period. Calcium and phosphorus intake was determined by weighing all food consumed during two periods of seven days, and calculating from standard food tables. Serum calcium, phosphorus, and alkaline phosphatase levels were determined and X-rays of the vertebral column were taken. Results showed fifteen out of the thirty-three subjects had osteoporosis. Seventy-four per cent of the subjects with a calcium intake below 0.5 grams compared to fourteen per cent with a calcium intake above 0.5 grams suffered from osteoporosis. Sixty-four per cent of the subjects with a phosphorus intake below 0.9 grams compared to nine per cent with a phosphorus intake above 0.9 grams suffered from osteoporosis. Serum calcium and phosphorus were within the normal range in all subjects and alkaline phosphatase levels were normal in all except two subjects. Thus, a marked relationship between a low calcium and phosphorus intake and a high incidence of osteoporosis appeared.

Ascorbic acid is one nutrient that tends to be ingested by the aging in levels below the recommended. In a study by Alder (1) at Tooting Bec Hospital, plasma ascorbic acid levels were determined in a representative group of fifty patients ranging in age from seventy to ninety years. Tests were carried out at the same hour of the day after breakfast. Results showed twelve of the subjects to have a plasma ascorbic acid level of 0.29 milligrams per cent and below, and thirty-eight of the subjects to have a plasma ascorbic acid level of 0.30 milligrams per cent and above. Of the twelve with the lowest plasma ascorbic acid levels, seven died within less than a year following admission to the hospital. Three of the seven died with signs of advanced ascorbic acid deficiency. A follow-up survey within two years revealed that twenty-one of the fifty were still alive and in good health. Reasons given for the twenty-nine deaths were ascorbic acid deficiency in seven cases, bronchopneumonia in two, cardiovascular degeneration in nineteen and an accident in one case. The average blood ascorbic acid level of the twenty one who were still alive had originally been 0.52 milligrams per cent whereas the average blood ascorbic acid level of those who had died had originally been 0.36 milligrams per cent.

While human studies are essential in determining human requirements, there are a great many difficulties in controlling experimental conditions and coming to any definite valid conclusions. This is especially true in studies with the aged.

Biological variance among individuals is great. Each person has quantitatively a distinctive pattern of nutritional requirements (56). By the time people have reached sixty years of age or beyond, they have experienced a lifetime of environmental conditions peculiar to them to which they have become adapted. To do a conclusive study of the effect or amount required of any one nutrient is impossible because the results for each subject would be influenced by their unique genetic make-up and whole past environment. Both of these sets of factors vary tremendously from one individual to the next.

Some of the difficulties in a study of aging subjects were apparent in a study by Ravetz (37) to evaluate the effects of a high protein supplement on a controlled group of geriatric patients in a convalescent home. The experimental group of twenty-two subjects received, along with the regular diet, thirty grams of a high protein supplement providing 18.4 grams of protein in the form of casein three or four times daily. Observations of each patient were made daily noting particularly the patient's physical and mental vigour and weight change. The control group of twenty-two patients received identical care without the protein supplement. Although the caloric intake was not measured, approximately one hundred additional Calories per meal were served to the control group than to the experimental group to attempt to compensate for the caloric intake of the protein supplement. Within the two month test period, none in the experimental group showed any weight loss

and fifteen experienced a rapid increase in weight. At least eleven of the experimental group showed a definite increase in physical vigour, and also in mental attitude, as signified by an elevation of mood and an increase in mental clearness. Three of the experimental group made remarkable progress in their convalescence. Contrasted with the weight gains in the experimental group, weight changes in the control group were slight varying from a loss of two pounds to a gain of two pounds. Physical and mental vigour appeared to be the same at the end of the two months as prior to the experiment.

The conditions of such an experiment do not allow any definite conclusions to be drawn from the data. Caloric intake could not be controlled exactly due to the necessity of respecting the food idiosyncrasies and medications of individual patients. Two of the subjects in the experimental group could not be weighed because of the nature of their illnesses. One of the experimental group refused to take the protein supplement after one month because he believed it was causing constipation. Ravetz could give examples of patients in whom the protein supplement appeared to bring about a decided improvement in their physical and mental condition. But he did not make any definite conclusions about the effect of giving a protein supplement to geriatric patients. Any change in the physical and mental health of an individual subject would be affected not only by their food intake but also greatly by the nature and severity of their illnesses, their whole past environment and their mental outlook on life.

It is difficult enough to do a study such as Ravetz's in an institution where conditions can be kept uniform to a certain extent, and data can be gathered fairly easily. It is much more difficult to do a study of the aged outside an institution. Co-operation in conducting the study may be lacking in many cases, and difficulties arise in trying to gather dependable dietary data.

Surveys of the Nutritional Status of the Elderly
Long Term Nutrition Study

Long term studies on a large scale are important in studying the nutritional problems of the aging. The San Mateo Nutrition Study started in 1948 when Gillum and Morgan (14) studied the food habits of 577 volunteer subjects in San Mateo County, California. The subjects, 280 men and 297 women, were over fifty and in good health. Forty-seven of the men lived in a county home while the rest of the subjects lived in their own homes. Almost eighty per cent of the subjects were "middle class". Seven day food records were kept by subjects in their own homes whereas three day records were kept by nutritionists for the male subjects in the county home. Blood samples by venipuncture, urine samples, and X-rays were also obtained.

Analysis of the data showed the hemoglobin levels of the men living in their own homes to be higher than those of the women. In the group seventy-five years and older, hemoglobin values declined in both men and women and the difference between

the sexes became insignificant. It was suggested that the sex difference among groups under seventy-five years may have been due to the influence of male hormone on blood production up to seventy-five years. Volume of packed cells was greater in men than in women. Sedimentation rates were higher in women than in men, and they tended to increase with advancing age. The men living in their own homes consumed an average of twenty-seven per cent more Calories and protein and an average of twenty-six per cent more iron per kilogram of body weight than the women in the same age groups. The protein Calories were fourteen per cent of the total Caloric intake in both sexes. The average iron intake was 6.0 milligrams for males and 6.1 milligrams for females per 1,000 Calories. In the majority of subjects, levels of protein and iron intake were related to levels of hemoglobin. The majority of the higher intakes of both protein and iron were found in the groups with higher levels of hemoglobin, intermediate intakes in groups with intermediate hemoglobin levels and the lowest intakes in groups with the lowest hemoglobin values.

Serum ascorbic acid levels were determined for 569 of the subjects who ate a high carbohydrate meal with little fat and no fruits or vegetables not less than two hours before a venipuncture blood sample was taken (33). Results showed that women at all ages had a lower total intake of ascorbic acid even when the intakes were estimated per kilogram of body weight, but higher serum ascorbic acid. The suggested reason for this difference was influence of the sex glands.

Serum cholesterol levels were determined for 573 of the subject (15). Significantly higher serum cholesterol levels were found in the women than in the men between sixty and eighty years. Serum cholesterol levels showed a downward trend in the men with each decade whereas in the women there was a sustained high level from sixty to seventy-five years following a sharp drop in the group fifty-four to fifty-nine years possibly due to the post-menopausal spurt in steroid hormone production. In the women, but not in the men, serum ascorbic acid paralleled serum cholesterol levels. A possible relationship between serum cholesterol and serum cholesterol levels and steroid hormone manufacture and circulation was suggested. In men, but not in women, extreme under or overweight of twenty per cent or more was found to be associated both with low and high serum cholesterol levels respectively and with low and high intakes of fat and cholesterol.

Serum vitamin A and carotene levels were determined for 514 of the subjects (16). A small decline in both vitamin A and carotene serum levels occurred with age in both sexes. There was no significant differences between the sexes. Only 5.6 per cent of the subjects had serum vitamin A levels below thirty micrograms per cent and 5.2 per cent above eighty micrograms while nearly one-half of the subjects had serum vitamin A levels between forty and sixty micrograms per cent. Serum carotene levels varied more widely with about sixty-two per cent falling between sixty and 150 micrograms per cent. Average total intakes

of vitamin A from all sources were 11,470 I.U. for men and 10,200 I.U. for women. For both sexes there was a slight positive correlation between total vitamin A intake and serum vitamin A level and a greater positive correlation between serum carotene and carotene intake.

Serum protein levels were determined for 573 of the subjects (34). The average serum protein level was 6.47 ± 0.06 grams per cent in men and 6.44 ± 0.05 grams per cent in women. About ninety per cent of all values were between 6.0 and 7.0 grams per cent. These levels were ten to fifteen per cent lower than those usually found in young adults. There was no correlation with protein intake, age or sex, but some positive correlation to hemoglobin levels.

The 1948 survey was followed up in 1952, 1954 and 1962-63 (46). In 1962, after fourteen years, information was available for eighty-eight per cent of the original subjects. Two hundred and seventeen of the subjects, thirty-eight per cent of the original 1948 study, were known to be dead. From the 290 whose addresses were known, 229 usable dietary records were obtained. An over-all decrease in calories with aging was noticed. Both sexes had significantly reduced total food intake after age seventy five. The 1962 caloric intakes for all men were significantly less than in the three previous studies. Within all groups of subjects, the mean per cent of calories obtained from carbohydrate, fat and protein remained relatively constant in all four studies. Thus the agewise

decrease in calories seemed to be related to a general decrease in amounts of foods consumed rather than decrease in a particular food or food groups.

North Central States Survey

Swanson and associates (48) conducted a study of 2,189 women to determine changes in dietary intake with aging. The subjects ranging in age from thirty to more than ninety years lived in five North Central states. Dietary information was obtained by the twenty-four hour recall method and from supporting data on personal factors influencing food intake. Results showed a distinct downward trend with age in mean intakes of food energy, protein, calcium, ascorbic acid and vitamin A. There appeared to be relatively little difference between mean nutrient intakes of the women in successive decade groups up to seventy years, but beyond seventy there was a marked decrease. With age, a greater percentage of Calories came from bread and cereal sources and less from meat. For every ten year increase in age, the nutritive value of the diets decreased on the average by about eighty-five Calories, 4 grams of protein, 0.03 grams of calcium, 1.4 milligrams of ascorbic acid and 194 I.U. of vitamin A.

Canadian Studies

The Nutrition Division has done an extensive survey of a cross-section of Canadians sixty years and older (45). The chief sampling method used was a random selection from the files

of the regional Old Age Security officers. Diets were classified as good, fair, borderline or poor according to the number of food groups neglected. Preliminary tables drawn up on the basis of 527 subjects showed forty-nine per cent of the diets to be satisfactory and fifty-one per cent unsatisfactory. Men appeared to have a better dietary intake than women. Fifty-two per cent of the men and forty-seven per cent of the women had satisfactory diets. There was no trend according to age for either sex as in the San Mateo Study (46) and the North Central States study (48). No medical examination was required but subjects were asked about their general health status. A close connection between a satisfactory diet and good health was very apparent. Seventy per cent of those with very good health had satisfactory diets whereas fifty-two per cent of those in good health, forty-seven per cent of those in fair health and thirty-two per cent of those in poor health had satisfactory diets.

A dietary survey was conducted on 120 elderly individuals in Moose Jaw in the spring of 1957 as part of the extensive survey by the Nutrition Division, Department of National Health and Welfare (36). Food records were obtained for four consecutive days along with information on health and socioeconomic background. Samples of urine were analyzed for thiamine, riboflavin and niacin. Analysis of the food records showed that citrus fruits and vegetables were the food groups most frequently neglected. Sixty-four per cent of the individuals neglected

citrus fruit and tomatoes. The women ate more fruit than the men. Twenty-seven per cent of the group had less than the requirement for ascorbic acid. Only six per cent of the group had no potatoes but fifty-six per cent of the group neglected vegetables other than potatoes. This neglect of vegetables was reflected in the vitamin A intake level. Milk consumption was very good especially compared to other Canadian surveys of all ages. Little relationship was found between the quality of the diet according to the criteria used and results of urinary analysis.

Studies of Aging Individuals Living Alone or with One

Other Individual

Living alone as compared to living as married couples or with families appears to influence the food choice of elderly people. In a preliminary report of the comprehensive survey of elderly Canadians by the Nutrition Division of the National Health and Welfare Department (44), the factor which appeared to have the most effect on food habits particularly among men was living alone. Sixty-seven per cent of the men living alone and fifty-six per cent of the women neglected three or more food groups as compared with forty-four to forty-six per cent of men and fifty-three to fifty-five per cent of women living as married couples or with their families or under other arrangements.

Bransby and Osborne (7) carried out a social and food survey of 303 elderly men and women in Sheffield in 1950-51.

The subjects, 125 men, sixty-seven years and older, and 178 women, sixty-two years and older, lived alone or as married couples without any other person. Results showed that living alone as compared to living with a spouse affected food consumption. Generally both men and women who were living alone ate less of foods requiring some preparation than those living with a spouse. For example, living with a spouse, men ate 9.1 ounces more and women, 8.2 ounces more of puddings and sauces than men and women living alone. Men living alone ate less fish but more meat and bacon. They ate more bread than men living with a spouse even though they were on the average older.

Jordan and co-workers (25) did a diet survey in Westchester County, New York, to find gross dietary deficiencies, if any, of individuals sixty-five years of age or older living alone. The 100 subjects, twenty-four men and seventy-six women, were not restricted in their choice of foods. A dietary history and answers to a set of questions on health habits and nutrition were obtained from each subject. Diets were evaluated by Joliffe's Check List. All food groups were included in seventeen per cent of the diets studied. Yellow and leafy green vegetables were the food group most frequently omitted. Dairy products and citrus fruits were also consumed in less than desirable amounts. All subjects met the standard for daily intake of bread and cereal. Economic status did not make any gross differences in the eating habits of the subjects. Any changes

in eating habits were more apt to be due to medical and social factors than to economic factors. Of the reasons given for changes in food habits, forty-one per cent were medical and thirty per cent social as compared to twenty per cent economic and four per cent dental deficiency.

LeBovit (27) reported on a food consumption survey of 283 Rochester households conducted in 1957. The average age of the men was seventy-four years, of the women seventy-one years. Of 283 households, 174 were two-person households while twenty-three men and eighty-six women lived alone. Information on food used the previous week was collected by personal interview using the "recall" method. On the average, family food supplies exceeded the quantities for each food group recommended for elderly people in the United States Dietetics Association's low-cost food plan. While the mean nutrient content exceeded the National Research Council's 1963 Recommended Dietary Allowances, shortages occurred when the nutrient content of each household's food was compared with the allowances. Calcium and ascorbic acid were the two nutrients in shortest supply. Diets were classified as good, fair, and poor. Good diets met allowances in full for all eight nutrients calculated; fair diets met at least two-thirds of allowances but were below the full recommendation in one or more; poor diets were below the two-thirds mark in one or more of the nutrients studied. A higher percentage of men than women living alone achieved both good and poor diets.

In LeBovit's study, all of the homemakers were over fifty-five years of age, and most were over sixty-five. The quality of diets they provided for their households was directly related to age. Diets of households with homemakers under seventy-five years met allowances much more frequently than those of the older households. There were also more poor diets among those households with incomes of under \$1,000 for one-person households and under \$2,000 for two-person households than among those with higher incomes.

A survey in Winnipeg of the food practices and nutrient intake of aging home-bound individuals was conducted by Johnson (24) in 1963. Reasonably dependable dietary information was gathered from seventy-four subjects, and forty-three blood and forty-one urine samples were obtained. The annual average income of the group was about \$780. Typical daily meal patterns were established from records of one day food intakes, dietary histories and personal data affecting food intake. Bread and cereal products seemed to predominate in the diets and the intake of animal protein foods, fruits and vegetables tended to be low. Only fifteen per cent of the subjects had diets sufficient in all nine nutrients checked. The calorie deficiency appeared as the most serious lack. Sixty-seven per cent of the subjects had fewer calories than the amount recommended in the Canadian Dietary Standard as maintenance requirements for persons of their age and body size. The older the subject was, the greater the calorie deficiency was apt to be. The biochemical data

tended to confirm the nutritional deficiencies indicated by analysis of the dietary intake. Thirty-one per cent of the blood samples were below the level considered minimal by the Nutrition Division for serum protein, twenty per cent for hemoglobin and eleven per cent for ascorbic acid. The greatest discrepancy between deficiency as indicated by dietary intake records and biochemical data occurred with protein. The biochemical data indicated thirty-one per cent of the subjects were deficient in protein whereas analysis of dietary records indicated only eighteen per cent were deficient in protein. Suggested as reasons for these differences were the total low caloric intake of the majority of the subjects and the possibility, in some cases, of urinary loss of nitrogen due to disease and prolonged inactivity.

Improvement of the Nutrition of the Aged by Provision of
a Noon Meal

Adequate nutritional status among older people contributes to their physical and mental sense of well-being. A great variety of community services has been developed that help older people living in their own homes or rented rooms obtain adequate nourishment (9).

Senior citizen clubs and day centers can be instrumental in providing nutritious snacks and meals in a social environment conducive to a good appetite. There are a number of church sponsored luncheon clubs for senior citizens where elderly people

are driven to the church for a hot meal, a program and tea, once a week (55). In Ottawa the Good Companions' Day Center, operating since 1955, has a well-set up food service under the supervision of a volunteer home economist. Two nutritious meals, luncheon and dinner, are served six days a week. A good food service on a smaller scale is provided by the Notre Dame Day Center in Winnipeg. At this center a hot nutritious noon meal is served five days a week. At both these centers the meals served are low-cost, nutritious and well-received by members of the centers. The Jewish Home for the Aged in Toronto runs a day care center for people on their waiting list (9). The people are brought daily to the home where they take part in the program and therapy and have their noon and evening meals.

In England the idea of sending a hot meal to the homes of "invalids" started in 1905 with the organization of the "Invalid Kitchens of London" (10). Meals delivery programs became widespread in the British Isles during World War II. According to a 1960 survey, about 21,000 individuals were receiving meals through meals delivery programs.

Meals delivery programs are among the newer types of services in the United States and Canada (10). In 1962, there were approximately twenty-four non-profit programs delivering meals to homes in the United States. Most of the programs were small, while the few largest served from fifty to seventy-five clients each.

In 1962, the Meals-on-Wheels program in Rochester, N.Y., serving fifty people, successfully completed a three year test period (20). The turnover of clients was much greater than anticipated due to a need for short term service following hospitalization. During the three year test period, there were 399 admissions and 347 discharges. Almost half of those discharged returned to self care. Others were admitted to senior citizen or nursing homes or hospitals. Success was evaluated by increased well-being both mentally and physically as reported by the Public Health nurse. Failures were only three per cent. These were individuals who could not or would not eat meals, hoarded the food and were mentally confused. In many cases, maintaining the status quo of the individual was considered to be an achievement.

In Canada, meals delivery services are in the developing stage. The first Canadian program started in Brantford (17). By October 1965, the Brantford service was providing twenty-eight to thirty meals once a week. The meals delivery program in Peterborough was modeled on the Brantford plan. The first five day a week service in Canada was started in Winnipeg in June 1965 by the Home Welfare Association. Another five day a week service started later in 1965 at the St. Christopher House in Toronto. A third such program started in Calgary in November 1965. Besides providing a hot mid-day meal as the Winnipeg and Toronto programs do, the Calgary program provides the makings of a cold supper. In the near future, expansion

of the meals delivery services now in operation are planned, and inauguration of similar services in other centers is expected.

METHOD

The meals delivery program under the Winnipeg Home Welfare Association started operation in June 1965 after a number of delays due to financial and other problems. It had been planned that clients of the Meals Delivery Service would form the experimental group for this study. However, the delayed start of the program, the fact that hospital home care patients formed a large percentage of the early referrals, and occasional failures of communication in receiving names of suitable additional clients resulted in only a small number of individuals going on the meals delivery program before compilation of this report in March 1966.

A second group of individuals similar in age to those on the meals delivery program but not home-bound and fairly active and healthy was selected for comparison of nutritional status between home-bound and non home-bound elderly individuals living alone. Henceforth the comparison group will be referred to as Group A, and the clients of the Meals Delivery Service as Group B.

Preliminary Check on Group Previously Studied

A preliminary survey was conducted in the spring of 1965 among the elderly home-bound individuals of Johnson's study (24). Johnson had found many of her subjects to be in poor nutritional status. The follow-up survey was carried out to evaluate their

current nutrient intake and to locate those individuals who would benefit from the meals delivery program. From individuals whose addresses were known and who were willing to co-operate in the follow-up, dietary histories were obtained from sixteen of the original seventy-four. Current nutrient intake was compared with that of two years previous.

Survey Population

Qualification for Group A required each individual be sixty years of age or older, live alone, be fairly active and in at least fair health. Permission was obtained to interview suitable volunteers at the Notre Dame Day Center. A number of names of individuals suitable for Group A but not associated with the Notre Dame Day Center were obtained and these individuals were interviewed in their own homes. Dietary histories were obtained, and, where permission was granted, blood and urine samples were collected. Statistical comparisons were made between nutrient intake of those interviewed at the Notre Dame Center and those interviewed at home and between the nutrient intake of the men and the women. Individuals of Group A who were willing to keep records were asked to fill out a food record for three days in order that the relationship between daily nutrient intake as determined by the twenty-four hour recall method and that obtained through use of a three day food record kept by the individual might be studied.

Individuals in Group B were all home-bound and clients of the Meals Delivery Service. These elderly individuals all lived

alone except in the case of two couples in their eighties. They were included because of the very low numbers that were available for Group B, and because it was felt that living with spouse did not make much difference in nutrient intake since, in each case, both individuals were very frail and greatly restricted in activity. Dietary histories and blood and urine samples were collected before members of Group B started receiving delivered meals, or, where that was impossible, within two days following the first delivered meal. Re-visits were made at ten week intervals as long as the individuals continued on the program and were willing and able to supply data. At each re-visit, a twenty-four hour dietary recall record, and blood and urine samples were obtained, and weight was noted. Because of limitations of time and the number of subjects, information on Group B presented in this report is primarily data obtained in the initial interview prior to the meals delivery and that obtained in the first re-visit. Statistical comparison was made between nutrient intake prior to meals delivery and that of ten weeks later.

Food Intake

The booklet used to record food intake is in Appendix A. During the course of an interview, a twenty-four hour recall record was obtained first followed by information on typical food intake. Towards the end of the interview, when rapport was well established between interviewer and subject, background information on factors influencing food intake was collected.

Information on typical food intake was obtained partly as a cross-check on the validity of the twenty-four hour recall record and partly as an indication as to whether the record was typical of the individual's food intake. Where it had been highly unusual and the subject normally had fairly set food habits, a twenty-four hour record was made of food intake on a more typical day. In a few instances, the initial interview with an individual of Group B took place one or two days after starting meals delivery. In these cases, the record of food intake was made of the twenty-four hours prior to delivery of the first meal rather than of the immediate previous twenty-four hours.

Daily intake levels of ten nutrients, namely, Calories, protein, fat, calcium, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid, were calculated from dietary histories. The "Food Composition Table for the Short Method" (28) was used for most calculation. Values for foods not included in this table were obtained from Bowes and Church's "Food Values of Portions Commonly Used" (6). The short method in which food groups are weighed according to United States food consumption levels is a convenient and time-saving approach to diet analysis. The use of this American table was considered suitable due to the basic similarity of Canadian and American food consumption patterns as indicated by a comparison of U.S.D.A. Bulletin No. 62 (53) with Canadian Food and Nutrition Statistics (35).

The estimated daily nutrient intake for each subject was

compared with levels recommended in the Canadian Dietary Standard 1963 (8) for an individual of that age and size. For an individual who was either overweight or underweight, recommendations for calories and protein were based on an ideal weight estimated from the "Metropolitan Life Insurance Tables of Desirable Weights for Adults" (30). Estimate of energy requirements were made on the basis of maintenance level of activity. The percentage of individuals in both Groups A and B failing to meet the recommended intake level was noted.

Biochemical Data

Blood samples were taken by a registered technician. The venipuncture method was used except in the case of the first seven samples where the fingerprick method was used but found unsatisfactory. Hemoglobin determinations were made in Winnipeg. Frozen sera samples were placed on dry ice in insulated containers and shipped air express within a week of collection to the Clinical Laboratory of the Department of National Health and Welfare in Ottawa. Analysis of sera samples was carried out for total protein, albumin, cholesterol, vitamin A, carotene and ascorbic acid. Morning fasting urine samples were usually collected the same day as blood samples, and shipped rail express to the laboratory in Ottawa to be analyzed for the presence of thiamine, riboflavin and niacin.

Evaluation of Nutrient Contribution of Noon Meal Supplied by the Meals Delivery Service

Menus of noon meals provided by the Meals Delivery Service

for a ten day period in November 1965 were obtained (Appendix B). The "Food Composition Table for the Short Method" (28) was used to calculate nutrient content of the menus. The nutrient levels supplied in the noon meals were compared with the daily recommended intake for a representative person, selected as a man of sedentary activity, aged seventy-five years and weighing 150 pounds.

Daily nutrient intake was calculated for the twenty-four hour recall diet records obtained on each re-visit. The nutrient value of food eaten during the day supplied by the delivered meal and the percentage of the daily nutrient intake supplied by the meal were calculated.

DISCUSSION OF RESULTS

Stability of Food Intake Among the ElderlyPreliminary Check on Group Previously Studied

Only seventeen of the seventy-four subjects, who had participated in the 1963 survey, were available for interviews. Many had moved away, others were deceased, and some did not wish to be visited again. Sixteen usable food records were obtained.

The average age of the group of sixteen was seventy-three years. Comparison of the mean intake levels showed the 1965 levels to be fairly close to those obtained in 1963 (Table I). For all nutrients except ascorbic acid, the calculated mean intake level obtained in 1965 appeared higher than that obtained in 1963. This difference might be due to the fact that different interviewers conducted the two surveys. However, application of the t test failed to show significant differences between the two sets of data at the ninety-five per cent confidence level. The only exception was thiamine for which there was a significant difference between the 1963 mean intake and the 1965 mean intake at the 95 per cent confidence level but not at the 97.5 per cent confidence level. It thus appeared that, in the two year interval between interviews, the sixteen subjects participating both times had maintained basically the same food habits.

TABLE I

MEAN DAILY INTAKE IN 1965 COMPARED WITH
THAT IN 1963 FOR SIXTEEN ELDERLY INDIVIDUALS

Nutrient	Mean Daily Intake	
	1963	1965
Calories	1671 ± 40*	1799 ± 310
Protein - gm.	66.1 ± 21.3	69.9 ± 15.4
Fat - gm.	76 ± 30	81 ± 20
Calcium - gm.	0.73 ± 0.34	0.95 ± 0.39
Iron - mg.	7.4 ± 3.1	9.3 ± 3.0
Vitamin A - I.U.	7253 ± 5086	7355 ± 6669
Thiamine** - mg.	0.68 ± 0.28	0.89 ± 0.25
Riboflavin - mg.	1.40 ± 0.58	1.48 ± 0.44
Niacin - mg.	9.6 ± 4.2	10.1 ± 3.7
Ascorbic Acid - mg.	50 ± 35	49 ± 40

* Standard deviation

** Difference between 1963 and 1965 mean intakes significant at 95% confidence level but not at 97.5% level.

Comparison of Data from Twenty-Four Hour Recall Records with
Data from Three Day Food Records

Twenty-one individuals in Group A, seven men and fourteen women, kept a three day record. The average age was seventy-one.

Comparison of the mean intake showed the levels from twenty-four hour recall records to be fairly close to, but in all cases higher than, those from three day records (Table II). It is possible that, in some cases, the interviewer obtained a more complete record of intake than was recorded by the individual who may have forgotten some items. In one case where a considerable decrease in finances occurred between the taking of the twenty-four hour recall and the three day record, a parallel decrease in food intake was observed.

The application of the t test failed to show any significant differences at the 95 per cent confidence level between the two sets of data. This might be due to the limited number of cases and the considerable variance. But the fact that there seemed to be no significant differences between the data obtained by the two methods would appear to justify the use of the time-saving twenty-four hour recall method in place of a record kept for a longer period of time. Young et al (60) found that similar group means were obtained with twenty-four hour recall and seven day records but suggested a small pilot study be done with each population to be studied prior to using the recall method. The similarity between the findings



TABLE II

COMPARISON OF DAILY INTAKE FROM TWENTY-
FOUR HOUR RECALL RECORD WITH DAILY INTAKE
FROM THREE DAY RECORD FOR TWENTY-ONE
ELDERLY INDIVIDUALS

Nutrient	Mean Daily Intake	
	24 Hour Recall	Three Day Record
Calories	1855 ± 346*	1725 ± 281
Protein - gm.	62.5 ± 17.7	58.2 ± 12.6
Fat - gm.	79 ± 22	70 ± 15
Calcium - gm.	0.75 ± 0.24	0.70 ± 0.23
Iron - mg.	10.9 ± 2.6	10.0 ± 2.8
Vitamin A - I.U.	14652 ± 14047	9093 ± 4863
Thiamine - mg.	1.04 ± 0.33	0.91 ± 0.22
Riboflavin - mg	1.56 ± 0.80	1.26 ± 0.38
Niacin - mg.	11.5 ± 4.0	10.3 ± 2.6
Ascorbic Acid - mg.	74 ± 42	67 ± 46

* Standard deviation

of the two methods would seem to indicate that the elderly people in this study have well established food patterns with nutrient intake fairly similar from day to day.

Data on Nutritional Status of Group A and B

Description of Group A

The number of persons comprising Group A is shown in Table III. Thirty-seven individuals were interviewed at the Day Center and nineteen individuals were interviewed at home. Eighty-three per cent of the men and fifty-three per cent of the women were interviewed at the Day Center. It was fairly easy to find men willing to volunteer for the survey at the Day Center while difficulty was experienced in finding other suitable male subjects willing to participate. This was probably due to the fact that the members of the Day Center have participated in other studies and have received considerable encouragement from their director to take part in such projects. More men than women were sought for interviews at the Day Center to balance the greater proportion of women than men interviewed at home.

Blood samples were obtained from sixty-two per cent of the subjects at the Day Center and eighty-four per cent of the subjects interviewed at home. Only eleven per cent of the subjects at the Day Center and sixteen per cent of the subjects interviewed at home did not wish to give a blood sample. Twenty-seven per cent of the subjects at the Day Center were

TABLE III

THE NUMBER OF PERSONS SUPPLYING DATA IN
GROUP A

	Interviewed at the Notre Dame Day Center			Interviewed at Home		
	Men	Women	Entire Group	Men	Women	Entire Group
Number of persons interviewed	20	17	37	5	15	19
Number of dependable meal patters obtained	20	14	34	4	15	19
Number of blood samples	14	9	23	3	13	16
Number of urine samples	14	8	22	3	13	16

willing to give blood samples but were not at the Day Center at the times the technician was there. Blood samples were collected from all subjects interviewed at home who were willing to give blood since the technician collected samples at their homes at arranged times.

The range in age of the men was 64 to 101 years with a mean of 75 years. The age of the women ranged from 62 to 90 years with a mean of 74 years. The weight of the men ranged from 105 to 194 pounds with a mean of 159 pounds while that of the women ranged from 93 to 181 pounds with a mean of 137 pounds.

Sixty-seven per cent of the individuals in Group A had an income under \$1,500, twenty-five per cent had an income of \$1,500 to \$3,000, and thirteen per cent had an income of over \$3,000. Eleven per cent of the group ate frequently in restaurants. This included twenty-one per cent of the men and three per cent of the women. The difference between the sexes might be due to the fact that women generally are more experienced in food preparation than men. All fifty-three individuals in the group did their own food shopping, although two of the group received some help from others.

Description of Group B

The number of persons in Group B is shown in Table IV. The total number was considerably less than anticipated. While the Meals Delivery Service has expanded, fewer elderly individuals living on their own have become clients than expected. Up to

TABLE IV

THE NUMBER OF PERSONS SUPPLYING DATA IN
GROUP B

	Prior to Beginning Meals Delivery			After Ten Weeks on Meals Delivery		
	Men	Women	Entire Group	Men	Women	Entire Group
Number of persons interviewed	9	12	21	6	8	14
Number of dependable meal patterns obtained	6	10	16	5	7	12
Number of blood samples	6	13*	19	6	7	13
Number of urine samples	7	13*	20	4	6	10

* includes samples from two individuals
not interviewed

the present, the program has found its greatest demand among post-hospitalization cases. The high turnover rate among the clients of the Winnipeg Meals Delivery Service is similar to that experienced by the Rochester meals delivery program (20) where the greatest demand for the service also tended to be for short periods following hospitalization.

Blood samples were obtained from eighty-one per cent of the individuals prior to starting on the meals delivery program. Blood and urine samples were obtained from two women who were not interviewed. Sixty-six per cent of the group interviewed prior to starting the meals delivery program were interviewed again ten weeks later. During the ten week interval, four who had been interviewed initially went off the program. Three who had been interviewed the first time were not interviewed again for various reasons. One person did not fit the requirements of the study, another was senile and the third started the program too late to allow for a ten week follow-up. One man who could not give a dependable meal pattern prior to going on the meals delivery program because of great irregularity in food intake was able to give reliable information ten weeks later. This was partly due to the fact that the meals delivery program had considerably stabilized his food intake, and, because of his gratefulness for the service, he was much more willing to co-operate. Thirteen of the fourteen individuals interviewed after ten weeks of meals delivery gave blood samples for a second time. The one individual who did not wish to

give a second sample had experienced considerable discomfort in her arm for a week after the first sample was taken.

Data on weight, height and age were obtained for individuals from whom meal patterns were obtained. The weight of six men prior to going on the meals delivery program ranged from 107 to 160 pounds with a mean of 138 pounds, while that of ten women ranged from 90 to 140 pounds with a mean of 113 pounds. It may be noted that the mean weight of members of Group B is considerably lower than for members of Group A, although mean heights were identical, 68 and 63 inches for men and women respectively. The age of the six men ranged 80 to 90 years with a mean of 85 years and that of the ten women ranged from 65 to 89 years with a mean of 78 years.

After ten weeks on the meals delivery program, the five men supplying data for meal patterns ranged in weight from 124 to 150 pounds with a mean of 140 pounds. During the interval, two had retained their previous weight, two had gained weight and one had lost weight under the guidance of a doctor to relieve a physical disorder. The seven women supplying data for meal patterns ranged in weight from 86 to 139 pounds with a mean of 117 pounds. During the interval, three had gained weight and four had decreased in weight. The two who had lost weight were on reducing programs. The weight loss experienced by the other two women may have been due to physical disorders.

Fifty-six per cent of Group B had incomes under \$1,500, forty-four per cent had incomes of \$1,500 to \$3,000 and none

had incomes over \$3,000. Two of the six men supplying data during the first interview ate frequently in nearby restaurants and two of the women sometimes ate in restaurants. However, seventy-five per cent of the group, twelve individuals, never ate in restaurants. This was mainly the result of the home-bound condition of most members of Group B. Fifty per cent of the group had to rely completely on others for food shopping, thirty-eight per cent did their own food shopping with help from others, and thirteen per cent of the group, two individuals, did their own food shopping. This contrasts with Group A, ninety-six per cent of whom did all their own food shopping, and four per cent had some help from others.

Food Intake

Dietary intake by food groups is summarized in Table V. In Group A, the majority of individuals consumed a satisfactory number of servings of most food groups. A greater percentage of women than men consumed fruits and green or yellow vegetables daily while a greater percentage of men than women consumed potatoes and two servings of meat daily. These differences in intake are probably, at least in part, due to the fact that, in Western society, meat and potatoes are considered masculine foods, and fruit and vegetables, feminine (31). A greater preference among women than men for fruits and vegetables, and among men than women for potatoes and meat was also found in the Moose Jaw survey (36).

TABLE V

PERCENTAGE OF BOTH GROUPS OF SUBJECTS CONSUMING CERTAIN FOODS DAILY

Number of Daily Servings	Group A			Group B					
	Men N=24	Women N=29	Entire Group N=53	Prior to Meals Delivery		After 10 Weeks on Meals Delivery			
				Men N=6	Women N=10	Men N=5	Women N=7	Entire Group N=12	
Bread and Cereal									
- 4 or more	88	76	81	67	50	56	20	43	42
- 2 or 3	13	24	19	33	40	38	60	57	50
- 1	-	-	-	-	10	6	20	-	8
Citrus Fruit or Tomato									
- ½ serving or more	63	76	70	33	60	50	80	100	92
Other Fruit									
- ½ serving or more	54	83	70	50	50	50	60	71	67
Potatoes									
- ½ serving or more	79	66	72	67	40	50	100	100	100
Green or Yellow Veg.									
- ½ serving or more	58	79	70	33	40	38	80	100	92
Milk									
- 1½ cups or more	67	48	57	67	80	75	60	71	67
- 1 - 1½ cups	8	21	15	17	10	13	-	-	-
- less than 1 cup	21	28	25	17	10	13	40	29	33
Cheese									
- ½ serving or more	17	28	23	-	20	13	40	29	33
Meat									
- 2 servings or more	33	14	23	17	-	6	20	-	8
- 1 serving	58	79	70	50	80	69	80	100	92
Eggs									
- 1 or more	54	52	53	33	60	50	20	29	25

The numbers in Group B are unfortunately too low for valid comparison. It appears, comparing data from Group A with that from Group B, that Group A had higher intakes of all food groups except milk. Seventy-five per cent of Group B had one and a half cups or more of milk daily compared with fifty-seven per cent of Group A. Ninety-three per cent of Group A, and seventy-five per cent of Group B, received at least one serving of meat per day. It appeared, from a study of the twenty-four hour records, that cream soups frequently replaced meat in the meals of subjects in Group B.

Food intake of Group B after ten weeks of meals delivery showed considerable increase of fruit, potatoes, green and yellow vegetables and meat. Most of these foods are provided in the delivered meal. A tendency towards decreased milk and egg consumption appeared. Increased meat consumption may have replaced some of the milk and eggs previously consumed as main course items.

Nutrient Intake

Comparison of the daily nutrient intake of the fourteen women of Group A interviewed at the Day Center with that of the fifteen women interviewed at home indicated mean intake levels of both groups to be fairly similar although the women interviewed at home appeared to have higher intakes of all nutrients except calcium, vitamin A and riboflavin (Table VI). However, results of the t test showed no significant differences

TABLE VI

COMPARISON OF THE DAILY NUTRIENT INTAKE OF FOURTEEN WOMEN INTERVIEWED AT THE NOTRE DAME DAY CENTER WITH THAT OF FIFTEEN WOMEN INTERVIEWED AT HOME AS CALCULATED FROM TWENTY-FOUR HOUR RECALL RECORDS

	Mean Daily Intake	
	14 Women Interviewed at Day Center	15 Women Interviewed at Home
Calories	1619 ± 261*	1825 ± 288
Protein - gm.	57.7 ± 12.0	60.9 ± 12.9
Fat - gm.	74 ± 20	82 ± 23
Calcium - gm.	0.78 ± 0.21	0.73 ± 0.22
Iron - mg.	8.7 ± 2.4	9.9 ± 1.9
Vitamin A - I.U.	9340 ± 12998	8860 ± 7473
Thiamine - mg.	0.89 ± 0.24	0.94 ± 0.21
Riboflavin - mg.	1.49 ± 0.81	1.31 ± 0.23
Niacin - mg.	9.3 ± 2.8	10.6 ± 3.7
Ascorbic Acid - mg.	57 ± 35	73 ± 29

* Standard deviation

at the ninety-five per cent confidence level between the two groups. Thus it appears justified to combine the two groups of women. The number of men interviewed at home was too low to allow any comparison of their nutrient intake with that of the men interviewed at the Day Center. It is probable that, if comparison were possible, results would be similar to those obtained with the women. In following discussion the subjects interviewed at the Day Center and those interviewed at home are treated as one group.

Table VII shows the daily nutrient intake of Group A. The range in intake for each nutrient was considerable. This was especially true of the daily intakes of ascorbic acid and vitamin A which ranged from 0 to 172 milligrams and from 1240 to 51,022 I.U. respectively. Fluctuations in intake of these two vitamins are frequently large because of variation in occurrence among fruits and vegetables.

The men of Group A had higher mean intake levels than the women of all nutrients except ascorbic acid. This reflects the generally higher food consumption of men than women. The men were considerably taller and heavier than the women. The trend to slightly higher ascorbic acid intake among women than men parallels the fact that seventy-six per cent of the women compared with sixty-three per cent of the men had a daily serving of citrus fruit or tomato. However, this difference was not statistically significant. The application of the t test indicated that, at the ninety-five per cent confidence

TABLE VII

DAILY NUTRIENT INTAKE OF TWENTY-FOUR MEN AND TWENTY-NINE WOMEN
IN GROUP A AS CALCULATED FROM TWENTY-FOUR HOUR RECALL RECORDS

Nutrient	Men N=24			Women N=29		
	Mean	Low	High	Mean	Low	High
Calories**	1958 ± 419*	1233	2988	1725 ± 290	1149	2292
Protein** - gm.	69.3 ± 19.1	45.0	115.8	59.3 ± 12.4	33.3	85.5
Fat - gm.	85 ± 24	33	139	78 ± 22	44	128
Calcium - gm	0.79 ± 0.37	0.21	1.87	0.75 ± 0.22	0.38	1.08
Iron** - mg.	11.2 ± 3.3	6.4	19.9	9.3 ± 2.2	5.2	14.0
Vitamin A - I.U.	11942 ± 14454	1298	50098	9092 ± 10316	1240	51022
Thiamine** - mg.	1.14 ± 0.33	0.59	1.80	0.88 ± 0.23	0.44	1.23
Riboflavin - mg.	1.73 ± 0.89	0.70	3.87	1.40 ± 0.58	0.85	3.96
Niacin - mg.	11.8 ± 3.9	6.3	20.7	9.9 ± 3.2	4.4	16.6
Ascorbic Acid - mg.	61 ± 45	0	172	65 ± 32	3	135

* Standard deviation

** Mean intake level of men significantly higher at the 95% confidence level than that of women

level, the men had significantly higher intakes of Calories, protein, iron and thiamine than the women. Higher consumption of bread, cereal and meat among the men than women may account for this difference.

Table VIII shows the daily nutrient intake of Group B. It appears that the mean daily nutrient intake of Group B was considerably lower than that of Group A. The one exception was calcium for which the mean daily intake was higher among both men and women in Group B immediately prior to the meals delivery program and among the women ten weeks after starting the program than among the men and women in Group A. This was directly related to higher milk consumption of individuals in Group B than those in Group A. The generally lower nutrient intake of Group B than Group A may result from differences in weight and age and also from the fact that members of Group B were mainly home-bound and quite inactive whereas those of Group A were somewhat active. The mean age of Group B was considerably greater than that of Group A. An overall decrease in calories with aging has been noted in other studies such as the San Mateo (46) and the North Central States (48) studies.

The numbers of men and women comprising Group B were too low for comparison in nutrient intake between the sexes. However, as with Group A, men had a higher mean caloric intake than women, and women had a higher mean intake of ascorbic acid.

TABLE VIII A

DAILY NUTRIENT INTAKE OF GROUP B IMMEDIATELY PRIOR TO
MEALS DELIVERY AS CALCULATED FROM TWENTY-FOUR HOUR RECALL RECORDS

	Daily Intake Immediately Prior to Meals Delivery				Entire Group Mean	Entire Group N=16 Range
	Men Mean	Men N=6 Range	Women Mean	Women N=10 Range		
Calories	1513	994 - 1870	1375	524 - 2035	1427	524 - 2035
Protein - gm.	55.7	33.6 - 74.7	47.4	14.9 - 67.9	50.5	14.9 - 74.7
Fat - gm.	62	35 - 90	62	27 - 102	62	27 - 102
Calcium - gm.	0.88	0.32 - 1.44	0.81	0.36 - 1.28	0.83	0.32 - 1.44
Iron* - mg.	7.2	5.1 - 12.1	6.6	2.2 - 12.2	6.8	2.2 - 12.2
Vitamin A - I.U.	3545	1155 - 9808	4559	792 - 15324	4179	792 - 15324
Thiamine - mg.	0.68	0.37 - 0.80	0.76	0.27 - 1.26	0.73	0.27 - 1.26
Riboflavin - mg.	1.46	0.70 - 2.18	1.35	0.54 - 2.01	1.39	0.54 - 2.18
Niacin* - mg.	8.0	4.4 - 12.5	6.4	2.2 - 9.1	7.0	2.2 - 12.5
Ascorbic Acid* - mg.	29	6 - 55	40	3 - 95	38	3 - 95

* Mean level of intake of entire group prior to Meals Delivery Service significantly lower at the 95% confidence level than that 10 weeks later

TABLE VIII B

DAILY NUTRIENT INTAKE OF GROUP B AFTER TEN WEEKS OF MEALS
DELIVERY AS CALCULATED FROM TWENTY-FOUR HOUR RECALL RECORDS

	Daily Intake after Ten Weeks on Meals Delivery				Entire Group Mean	N=12 Range
	Men Mean	N=5 Range	Women Mean	N=7 Range		
Calories	1682	1251 - 2029	1561	978 - 1970	1611	978 - 2029
Protein - gm.	55.1	37.8 - 72.1	61.3	45.7 - 79.6	58.7	37.8 - 79.6
Fat - gm.	67	41 - 79	65	36 - 82	66	36 - 82
Calcium - gm.	0.69	0.16 - 1.38	0.78	0.37 - 1.30	0.74	0.16 - 1.38
Iron* - mg.	9.5	7.1 - 13.0	9.3	6.9 - 12.8	9.4	6.9 - 13.0
Vitamin A - I.U.	4097	2307 - 7392	5112	999 - 11130	4689	999 - 11130
Thiamine - mg.	0.89	0.70 - 1.20	0.91	0.80 - 1.07	0.90	0.70 - 1.20
Riboflavin - mg.	1.27	0.59 - 2.11	1.44	0.85 - 2.07	1.37	0.59 - 2.11
Niacin* - mg.	11.7	7.7 - 20.3	10.4	8.8 - 11.8	11.0	7.7 - 11.8
Ascorbic Acid* - mg.	60	32 - 89	96	66 - 116	81	32 - 116

* Mean level of intake of entire group prior to Meals Delivery Service significantly lower at the 95% confidence level than that 10 weeks later

A comparison of the mean intake level of Group B prior to the meals delivery program and ten weeks later indicates that, with the meals delivery, mean levels of intake increased for all nutrients except calcium and riboflavin. This resulted from increased consumption of fruit, potatoes, green and yellow vegetables and meat, and a decreased consumption of milk (Table V). Application of the t test showed the mean daily nutrient intake of iron, niacin and ascorbic acid to be significantly higher at the ninety-five per cent confidence level after ten weeks on the meals delivery program than immediately prior to the program. No significant difference in intake was found for the other nutrients. This may be due to the small numbers comprising Group B.

The percentage of individuals in both groups with daily nutrient intake below the recommended level is shown in Table IX. The percentage of individuals with daily caloric level below recommended was lower when caloric needs were calculated on the basis of the FAO Standard (13) than on the Canadian Dietary Standard (8). The reason for this is the greater decrement in Calories with age in the FAO Standard than in the Canadian Standard. Since the majority of individuals interviewed had been maintaining a fairly constant weight for some time, it appears that the FAO recommendations with the greater decrement for age gave the more accurate estimate of the calorie requirements of these elderly individuals.

TABLE IX

PERCENTAGE OF INDIVIDUALS IN GROUPS A AND B WITH
DAILY NUTRIENT INTAKE BELOW RECOMMENDED LEVEL *

Nutrient	Group A			Group B				
	Entire Group N=53			Prior to Meals Delivery		After 10 Weeks on Meals Delivery		
	Men N=24	Women N=29	Entire Group N=53	Men N=6	Women N=10	Men N=5	Women N=7	Entire Group N=12
Calories (Canadian Standard)	25	31	28	67	40	60	43	50
Calories (FAO Standard)	13	7	9	36	40	20	29	25
Protein	4	3	4	33	30	20	0	8
Fat	4	0	2	0	0	0	0	0
Calcium	13	10	11	17	10	20	29	25
Iron	0	3	2	17	50	0	0	0
Vitamin A	25	28	26	83	60	60	43	50
Thiamine	0	0	0	0	0	0	0	0
Riboflavin	4	3	4	0	0	0	0	0
Niacin	0	0	0	0	0	0	0	0
Ascorbic Acid	25	14	19	50	49	0	0	0

* Recommended level for Calories and protein based on ideal weight

The nutrients most frequently consumed daily in less than recommended levels were vitamin A and ascorbic acid. This was due to the limited consumption of green and leafy vegetables and of citrus fruits and tomatoes (Table V). The percentage with levels below recommended intakes for these two vitamins was much greater for Group B prior to the meals delivery program than for Group A. This reflects the much lower consumption of vegetables and fruits among Group B prior meals delivery than among Group A (Table V).

Comparison of the percentage falling below recommended intake in Group B prior to the meals delivery program with the group studied by Johnson (24) is valid since both groups were of similar age, home-bound and living on their own either singly or as couples. On the whole, the percentage of cases in Group B falling below recommended intake levels for each nutrient paralleled that found in the Johnson study. The twenty-eight per cent of Group B with below recommended protein intake is quite close to the thirty-one per cent reported by Johnson. Thirty-eight per cent of Group B had below recommended intake of iron compared with thirty-nine per cent in the Johnson study. Differences that did occur may, at least in part, be due to differences in numbers comprising the two groups. Group B contained only sixteen individuals whereas Johnson reported on seventy-four individuals.

A comparison of the percentage of individuals in Group B with below recommended intake prior to meals delivery and ten

weeks later showed a definite decrease in the percentage of cases with intake below recommended levels for Calories, protein, vitamin A and ascorbic acid. The most noticeable change occurred with ascorbic acid. Prior to receiving the delivered meals, forty-four per cent of Group B failed to meet the recommended level of intake for ascorbic acid. This percentage fell to zero with meals delivery.

Biochemical Data

Blood sera values are recorded in Table X for Group A and in Tables XIA and XIB for Group B. The mean levels of all components analyzed were higher for Group A than for Group B both prior to meals delivery and ten weeks later. This corresponds with the generally lower percentage of individuals in Group A than in Group B with daily nutrient intake below recommended levels (Table IX). Poorer physical condition of members in Group B than in Group A may also have contributed to differences in serum nutrient levels.

Blood data were interpreted according to the ranges suggested as guides by the Interdepartmental Committee on Nutrition for National Defense (22). The categorized levels of this guide are arbitrary but "reflect the best judgment which can be reached on the basis of data available". The table used for interpretation of blood data is included as Appendix C.

For Group A, the mean sera levels of all components analyzed were in the high range. The exception was hemoglobin,

TABLE X

LEVEL OF SIX COMPONENTS IN BLOOD SAMPLES FROM GROUP A

No. of Samples	Component	Lower Limits of		Group A		No. Below Lower Limits of		
		Low Category*	Acceptable Category*	Mean	Low	High	Low Category	Acceptable Category
MEN								
per 100 ml.								
16	Total Protein - gm.	6.0	6.5	7.5	6.4	10.3	0	1
15	Albumin - gm.	2.8	3.5	4.6	3.3	6.4	0	1
15	Cholesterol - mg.	-	-	242	135	350	-	-
17	Hemoglobin - gm.	12.0	14.0	14.4	11.8	16.2	1	6
16	Vitamin A - mcg.	10	20	58	30	91	0	0
16	Carotene - mcg.	20	40	88	22	217	0	2
WOMEN								
17	Total Protein - gm.	6.0	6.5	7.3	6.0	10.2	0	2
17	Albumin - gm.	2.8	3.5	4.4	3.8	4.9	0	0
16	Cholesterol - mg.	-	-	288	200	445	-	-
22	Hemoglobin - gm.	10.0	11.0	13.7	11.2	15.5	0	0
16	Vitamin A - mcg.	10	20	68	34	110	0	0
17	Carotene - mcg.	20	40	112	58	192	0	0

* From : Interdepartmental Committee on Nutrition for National Defense. Suggested Guide to Interpretation of Blood Data, p 235, Manual for Nutrition Surveys (2nd ed.), 1963

the mean serum level of which was in the acceptable range. In no cases did total protein or albumin levels fall in the deficient range although, in three cases, the total protein and, in one case, the albumin levels were in the low range. These few occurrences of low protein levels related to the fairly low percentage of individuals in Group A with daily protein intake below the recommended level (Table IX). Cholesterol levels were higher in women of Group A than men. This is similar to findings of the San Mateo study (15) where, among 573 subjects, significantly higher serum cholesterol levels were found in women than men over sixty years of age.

Five men of Group A had hemoglobin levels in the low range, and one man had a level in the deficient range. These occurrences of low hemoglobin levels probably do not result from low iron intake since none of the men had a calculated intake of iron below the recommended level. The low levels may reflect other physical disorders, and may also reflect the age of the men. The suggested levels used apply to a reference man, twenty-five years of age and physically active (22).

Levels of serum vitamin A were acceptable to high in both men and women of Group A. Levels of serum carotene were acceptable to high for both sexes except for two men with levels in the low range. The generally high levels are not consistent with the twenty-six per cent of Group A with calculated dietary intakes of vitamin A below the recommended level. This may reflect some discrepancy between recorded and actual intake of

fruits and vegetables rich in carotene, and, in some cases, the consumption of vitamin preparations.

No values of serum ascorbic acid levels were available due to technical errors. This is very regrettable. Nineteen per cent of Group A had calculated daily intakes of ascorbic acid below the recommended value, and it would have been helpful to have data on sera levels to compare with the data on dietary intake.

The number of blood samples collected from Group B is far too small to make any definite statements on findings although trends will be noted. Group B had a mean total serum protein level in the high range and a mean albumin serum level in the acceptable range (Table IXA). Albumin levels are considered a better indication of nutritional status than total protein levels (22). Two members of Group B had total protein and albumin levels in the deficient range. Two others had total protein levels and one other had an albumin level in the low range. The apparently higher occurrence of protein deficiency in Group B than in Group A as shown by biochemical results would seem to parallel the finding from dietary analysis that protein and calories were consumed in less than recommended levels more frequently among individuals in Group B than Group A. Because of the high percentage of Group B with caloric intakes below recommended levels it is probable that, in some cases, glycoenic amino acids are deaminated and metabolized for calories (2).

TABLE XI A

LEVEL OF SIX COMPONENTS IN BLOOD SAMPLES FROM GROUP B PRIOR MEALS DELIVERY

No. of Samples	Component	Lower Limits of		Group B			No. Below Lower Limits of	
		Low Category*	Acceptable Category*	Prior Meals Delivery		Low Category	Acceptable Category	
				Mean	High			
MEN								
6	Total Protein - gm.	6.0	6.5	7.2	5.9	9.0	1	1
6	Albumin - gm.	2.8	3.5	4.1	1.7	4.9	1	1
6	Cholesterol - mg.	-	-	235	120	330	-	-
6	Hemoglobin - gm.	12.0	14.0	13.0	9.1	15.4	1	5
6	Vitamin A - mcg.	10	20	56	32	71	0	0
6	Carotene - mcg.	20	40	62	31	92	0	1
WOMEN								
13	Total Protein - gm.	6.0	6.5	7.0	5.4	8.7	1	3
13	Albumin - gm.	2.8	3.5	4.2	1.7	5.3	1	2
13	Cholesterol - mg.	-	-	225	170	365	-	-
12	Hemoglobin - mg.	10.0	11.0	12.7	10.4	14.6	0	2
12	Vitamin A - mcg.	10	20	52	19	130	0	1
12	Carotene - mcg.	20	40	65	12	159	2	4

* From : Interdepartmental Committee on Nutrition for National Defense. Suggested Guide to Interpretation of Blood Data, p. 235, Manual for Nutrition Surveys (2nd ed.), 1963

The mean total serum protein level of individuals in Johnson's study (24) was 6.4 grams per cent for both men and women whereas it was 7.2 and 7.0 grams per cent for men and women respectively of Group B. A similar difference in the two studies was noted in the percentage of cases with intakes falling below recommended levels for calories and protein.

One man in Group B had a hemoglobin level in the deficient range and four men and two women had hemoglobin levels in the low range. Prior to meals delivery thirty-eight per cent of Group B had calculated daily intakes of iron below the recommended level. More women than men consumed below recommended levels of iron (Table IX) and, yet, more men than women had hemoglobins in the deficient and low ranges. Higher values are used in assessing hemoglobin adequacy for men than women. Gillum (14) found that in the group seventy-five year and older hemoglobin values declined and differences between the sexes became insignificant.

The low levels of carotene in five of eighteen cases in Group B reflect, to some extent, low consumption of green and yellow vegetables (Table V). While carotene levels do reflect recent dietary intake, they may not give a true indication of vitamin A status (22). People consuming adequate intakes of preformed vitamin A may have little or no carotene in the blood. Only one of eighteen individuals of Group B had serum vitamin A level in the low range. As in Group A, the serum levels of vitamin A are not consistent with dietary data and

this may be due to the consumption of vitamin preparations by some individuals.

Mean levels of blood components were in the same ranges prior to meals delivery and ten weeks later (Table XIB). Of the two individuals with total serum protein and serum albumin levels in the deficient range, one went off the meals delivery program within a month and the other still had levels in the deficient range although they were slightly higher after ten weeks of meals delivery. There appeared little or no change in the mean values of components analyzed except for carotene. The increase in carotene levels reflects the increased consumption of green and yellow vegetables with the meals delivery.

It is most regrettable that ascorbic acid values were not available. It is one component for which the mean serum level may have risen within the ten weeks of meals delivery as a result of increased dietary intake (Table VIII).

Meals delivery resulted in increased dietary intake of most nutrients (Table VIII). A longer period of time than ten weeks would be required to raise the sera levels of many nutrients. In some cases, it may be impossible to increase sera levels due to the effects of physical disorders and wasting diseases.

Analysis of thirty-eight urine samples from Group A and thirty from Group B gave "Positive" results in all cases for the presence of thiamine, riboflavin and niacin. This

TABLE XI B

LEVEL OF SIX COMPONENTS IN BLOOD SAMPLES FROM GROUP B TEN WEEKS ON MEALS DELIVERY

No. of Samples	Component	Lower limits of		Group B - 10 weeks on Meals Delivery			No. Below Lower Limits of		
		Low Category*	Acceptable Category*	Mean	Low	High	Low Category	Acceptable Category	
MEN									
		per 100 ml.							
5	Total Protein - gm.	6.0	6.5	7.0	6.3	8.7	0	1	
4	Albumin - gm.	2.8	3.5	3.7	2.6	4.7	1	1	
5	Cholesterol - mg.	-	-	216	170	245	-	-	
6	Hemoglobin - gm.	12.0	14.0	13.0	10.4	14.2	1	5	
5	Vitamin A - mcg.	10	20	56	28	86	0	0	
5	Carotene - mcg.	20	40	81	56	102	0	0	
WOMEN									
7	Total Protein - gm.	6.0	6.5	7.1	6.3	8.8	0	1	
4	Albumin - gm.	2.8	3.5	4.1	3.2	5.5	0	1	
7	Cholesterol - mg.	-	-	221	160	300	-	-	
7	Hemoglobin - gm.	10.0	11.0	12.5	11.5	13.9	0	0	
7	Vitamin A - mcg.	10	20	59	25	89	0	0	
7	Carotene - mcg.	20	40	83	29	180	0	3	

* From : Interdepartmental Committee on Nutrition for National Defense. Suggested Guide to Interpretation of Blood Data, p. 235, Manual for Nutrition Surveys (2nd ed.), 1963

would indicate these nutrients were present in acceptable quantities in those individuals from whom urine samples were collected. This finding corresponds to the finding from nutrient analysis that all of Group B and almost all of Group A had daily intakes of thiamine, riboflavin and niacin meeting or exceeding the recommended levels. It also parallels the generally high consumption of cereal products among this age group.

Nutrient Contribution of Noon Meal Supplied by the Meals
Delivery Service

The noon meal delivered to clients of the Meals Delivery Service consists of a juice, often citrus or tomato, buttered roll, meat, potato, other vegetable, usually green or yellow, and dessert. Clients provide their own beverage.

The levels of nutrients supplied by the noon meal during the period under study made a very valuable contribution to the average daily recommended intake of the representative person (Table XII). In fact, half of the nutrients studied were supplied, on the average, in quantities sufficient to meet in full, or exceed, the daily recommended intake for the representative person. Even the lowest levels of ascorbic acid and niacin exceeded the daily recommended level. The high level of ascorbic acid provided is of value since many aged individuals have shown a low intake of this vitamin (36, 25, 27, 24). Fifty per cent of the individuals in the Group B did not have a daily serving of citrus fruit prior to receiving delivered meals.

TABLE XII

THE MEAN NUTRIENT CONTENT OF TEN MEALS SUPPLIED BY THE MEALS DELIVERY SERVICE, NOVEMBER, 1965, AND COMPARISON WITH DAILY INTAKE RECOMMENDED FOR A REPRESENTATIVE PERSON

Nutrient	Level in Noon Meal			Recommended Daily Intake For Representative Person*	Percentage of Recommended Daily Intake in Mean of Noon Meal
	Mean	Low	High		
Calories	885	769	1081	1832	48
Protein - gm.	35	31	42	48	73
Fat - gm.	42	36	49	-	-
Calcium - gm.	0.19	.10	0.27	0.50	38
Iron - mg.	6	4	8	6	100
Vitamin A - I.U.	4981	685	10772	3700	135
Thiamine - mg.	0.6	0.4	0.9	0.5	120
Riboflavin - mg.	0.6	0.4	0.8	0.9	66
Niacin - mg.	7.7	6.7	8.4	5.0	154
Ascorbic Acid - mg.	66	44	96	30	220

* Representative person taken as a man of sedentary activity, aged 75 years, and weighing 150 pounds.

The mean level of vitamin A in the delivered meals was 135 per cent of the recommended daily intake. The range in vitamin A was greater than that of any other nutrient studied. This is to be expected in view of the wide variation in vitamin A content among foods.

The nutrient for which the meals made the least contribution to the daily recommended intake was calcium. This nutrient is supplied chiefly by milk and milk products. No milk as a beverage is provided with a meal although at least one milk pudding is served per week.

Examination of menus supplied for other periods during the winter months of 1965-66 showed a continuation of the basic menu pattern. Thus, the nutritive value of the meals provided remained relatively constant. It was found that the delivered meals were generally well received. In some cases, not all of the meal was consumed at noon due to the size of dinner and the fact that many in Group B were not used to large meals. The bun and dessert were often kept for the evening meal. In some instances, part of the meat was kept and used for a sandwich later.

Table XIII shows the mean percentage of daily nutrient intake provided by the noon meal in twenty records obtained on re-visits to twelve members of Group B. It is evident that, on the average, the delivered meal provided a good part of the daily intake of each nutrient studied. The only nutrients

TABLE XIII

MEAN PERCENTAGE OF DAILY NUTRIENT INTAKE PROVIDED BY
NOON MEAL IN TWENTY RECORDS FROM TWELVE INDIVIDUALS
ON THE MEALS DELIVERY PROGRAM

Nutrient	Percentage in Noon Meal		
	Mean	Range	
		Low	High
Calories	51	31	82
Protein	59	36	97
Fat	55	31	100
Calcium	35	8	88
Iron	68	52	91
Vitamin A	72	30	99
Thiamine	58	41	89
Riboflavin	46	13	90
Niacin	76	48	96
Ascorbic Acid	90	51	100

in the noon meal supplying on the average less than half of the daily total daily intake were calcium and riboflavin. This is due to the high milk consumption at other meals among members of Group B and the relatively low levels of these two vitamins supplied, by the delivered meal (Table XII). The nutrient in the noon meal supplying the highest percentage of the daily intake was ascorbic acid.

The range in mean percentage of daily intake provided by the noon meal indicates variation of nutrient levels provided in the meal and also differences in intake among individuals. Cases occurred where daily nutrient intake depended entirely, or almost entirely, on the delivered meal.

Better morale and increased interest in life were noted among the majority of individuals in Group B on re-visits. The meals delivery has enabled some elderly individuals to remain in their own homes longer than their physical condition would otherwise have permitted.

SUMMARY AND CONCLUSIONS

Two groups of elderly individuals living alone, except for two couples, were interviewed regarding food intake. The experimental group was, for the most part, home-bound, and associated with the Winnipeg Meals Delivery Service. The comparison group was not home-bound. The members of the comparison group did their own food shopping while the majority of the home-bound group had to rely on others for food shopping.

Evaluation of the dietary histories on the basis of nutrient intake showed vitamin A and ascorbic acid to be the nutrients most frequently consumed in less than recommended levels among individuals of both groups. Among the home-bound, calories and protein were also frequently consumed in less than recommended levels. The comparison group had a better intake of food both in quantity and quality than the home-bound group.

Clinical data tended to confirm this finding. Few in the comparison group had blood levels of components below the acceptable range. The one exception was hemoglobin for which, six of seventeen men had levels in the deficient or low ranges. A greater percentage of home-bound individuals appeared to have blood levels of components in the deficient and low ranges. Five of six men in this group had hemoglobin levels in the deficient or low ranges. There seemed to be no relationship between dietary intake and blood levels of vitamin A. Urine

analysis showed thiamine, riboflavin and niacin to be present in adequate amounts.

Comparison of the nutrient intake of the home-bound group prior to meals delivery and ten weeks later showed increased food intake both in quantity and quality. The percentage of the group with below recommended intakes of iron and ascorbic acid dropped to zero, and there was a lower percentage of the group with intakes of calories and protein below recommended levels, although there appeared to be some increase in the percentage with below recommended intake of calcium. Blood analysis showed some rise in carotene levels which corresponded with increased consumption of green and yellow vegetables. No noticeable differences were observed in the blood levels of other components analyzed. Ten weeks is too brief a period of time to increase blood levels of most nutrients by dietary means alone. The physical condition of each subject is also a factor influencing nutritional status. A study comprising a larger group of individuals over an extended period of time will be necessary for adequate appraisal of the effect of this meals delivery program on nutritional status of elderly individuals.

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APPENDIX A

APPENDIX B

TEN DAY MEAL PLAN
"Meals Delivery Service"

Tomato Juice
Roast Veal and Dressing
Gravy
Mashed Potato
Buttered Parsnips
Sago Pudding
Roll and Butter

Fruit Juice
Roast Beef and Gravy
Franconia Potato
French Cut Green Beans
Pineapple Upside down Cake
Roll and Butter

Tomato Juice
Braised Lamb
Parsley Potato
Buttered Carrots
Creamy Rice Pudding
Roll and Butter

Fruit Juice
Chicken Quarters
Mashed Potato
Green Peas
Raisin Bread Pudding
Roll and Butter

Tomato Juice
Batter Fried Cod
Tartar Sauce
Mashed Potato
Savory Beets
Fruit Pie
Roll and Butter

Tomato Juice
Roast Pork
Applesauce
Mashed Potato
Julienne Carrots
Caramel Bread Pudding
Roll and Butter

Fruit Juice
Spanish Steaks
Parsley Potato
Green Peas
Apple Betty
Roll and Butter

Tomato Juice
Roast Veal
Gravy
Dressing
Mashed Potato
Spinach
Cottage Cheese Pie
Roll and Butter

Fruit Juice
Italian Pot Roast
Mashed Potato
Vegetable Marrow
Rice and Raisin Pudding
Roll and Butter

Tomato Juice
Batter Fried Cod
Tartar Sauce
Mashed Potato
Glazed Carrots
Fruit Pie
Roll and Butter

APPENDIX C

Biochemical Data

Suggested guide to interpretation of blood data

	Deficient	Low	Acceptable	High
Total plasma protein: mg/100 ml.	<6.0	6.0-6.4	6.5-6.9	≥7.0
Serum albumin (electrophoretic method): gm/100 ml.	<2.80	2.80-3.51	3.52-4.24	≥4.25
Serum globulin (percent of serum protein):				
Alpha			4-7	
Alpha ₂			9-11	
Beta			11-15	
Gamma			12-16	
Hemoglobin, gm/100 ml:				
Men	<12.0	12.0-13.9	14.0-14.9	≥15.0
Women (nonpregnant, nonlactating; 13 years)	<10.0	10.0-10.9	11.0-14.4	≥14.5
Children (3 - 12 years)	<10.0	10.0-10.9	11.0-12.4	≥12.5
Hematocrit (PCV), percent:				
Men	<36	36-41	42-44	≥45
Women (nonpregnant, nonlactating; 13 years)	<30	30-37	38-42	≥43
Children (3 - 12 years)	<30.0	30.0-33.9	34.0-36.9	≥37.0
Plasma ascorbic acid: mg/100 ml.	<0.10	0.10-0.19	0.20-0.39	≥0.40
Plasma vitamin A: μg/100 ml.	<10	10-19	20-49	≥50
Plasma carotene: μg/100 ml.	(3)	20-39	40-99	≥100
Red cell riboflavin: μg/100 ml.-red blood cells	<10.0	10.0-14.9	15.0-19.9	≥20

From : Interdepartmental Committee on Nutrition for National Defense. Suggested Guide to Interpretation of Blood Data, p. 235 Manual for Nutrition Surveys (2nd ed.), 1963

NUTRITION OF TWO GROUPS OF INDEPENDENT ELDERLY INDIVIDUALS

as determined by dietary history

and biochemical data with a

PRELIMINARY ASSESSMENT OF A MEALS DELIVERY PROGRAM

by

C.M. Moore

May, 1966.

Two groups of elderly individuals living alone were interviewed regarding food intake. The experimental group was mainly home-bound and associated with the Winnipeg Meals Delivery Service. The comparison group was not home-bound. Sixteen and twelve dependable meal patterns were obtained from the experimental group prior to meals delivery and after ten weeks of meals delivery respectively. Fifty-three dependable meal patterns were obtained from the comparison group.

Evaluation of nutrient intake showed vitamin A and ascorbic acid to be the nutrients most frequently consumed in less than recommended levels among both groups. Calories and protein were also frequently consumed in less than recommended levels among the home-bound group. The comparison group had a better intake of food both in quantity and quality than the home-bound group.

The biochemical data tended to confirm this finding. Few in the comparison group had blood levels of components below an acceptable range. A greater percentage of the experimental group appeared to have blood levels of components in a deficient or low range. Five of six men in this group had hemoglobin levels below the acceptable range. Urine analysis together with data on nutrient intake showed thiamine, riboflavin and niacin were consumed in adequate amounts among subjects in both groups.

The food intake of the experimental group had improved both in quantity and quality after ten weeks of meals delivery. The percentages with intakes below recommended levels of ascorbic acid and iron dropped from forty-four and thirty-eight respectively to zero with meals delivery. Blood levels of components were similar prior to meals delivery and ten weeks later. A study comprising larger numbers over an extended period of time will be required for a more adequate assessment of the value of a meals delivery program on the nutritional status of home-bound elderly individuals.

URINARY RIBOFLAVIN EXCRETIONS AND TEST DOSE RETURNS OF
HEALTHY WOMEN AS AFFECTED BY DIETARY NITROGEN

by

Gail S. Nakka

May, 1966.

Five healthy women were maintained for two consecutive 10-day periods on a controlled intake of 1.4 mg. of riboflavin. For the first period, the nitrogen intake was 3.5 gm. and, for the second, 15.4 gm. Twenty-four hour urine and fecal samples were collected. Riboflavin was determined in food and urine samples by a modification of the fluorometric method of Slater and Morell, and nitrogen in food urine and fecal samples by the Macro-Kjeldahl method.

A 5.0 mg. oral test dose of riboflavin was administered on the morning following each experimental period. Complete urinary collections were then made at 30 min. intervals over a 4-hour fasting period.

All subjects were in negative nitrogen balance on an intake of 3.5 gm. nitrogen and in positive nitrogen balance on 15.4 gm. Riboflavin excretion levels showed large inter-individual variation although day-to-day values for individuals were quite constant. The three heavier older subjects excreted less riboflavin than the two lighter, younger subjects. Riboflavin excretion for the group averaged 14% of the intake during the period of positive nitrogen balance and 34% during the period of negative nitrogen balance. The drop in riboflavin excretion in the second period was highly significant according to the t test. The inverse relationship between nitrogen balance and urinary riboflavin excretion was reflected by high correlation coefficients of $-.81$, $-.66$, $-.70$, $-.88$ and $-.93$.

Mean percentage test dose excretions were very similar, 31 and 36% respectively, for the two periods. Individuals, however, varied in their response. No conclusions could be drawn as to the effect of nitrogen balance on the 4-hour return of a 5.0 mg. test dose of riboflavin. Three subjects showed a lower percentage return, one a higher, and one no change in the period of negative balance than in the period of positive balance.

LOW PROTEIN DIET

<u>Breakfast</u>	<u>Amount (gm)</u>
pineapple juice	125
applesauce	240
bread	20
butter	5
apple jelly	20
<u>Lunch</u>	
apple juice	250
boiled potato	100
celery	60
can. green beans	60
lettuce	20
French dressing	20
butter	10
can cherries (2 T. jce)	120
sugar cookie	20
<u>Dinner</u>	
grapefruit-orange jce.	125
ground beef	30
can. yellow beans	60
cabbage	30
mayonnaise	20
carrot	25
onion	3
butter	5
can. pears (2 T. jce)	230
<u>Bedtime Snack</u>	
pineapple juice	250
bread	20
butter	5
apple jelly	20

HIGH PROTEIN DIET

<u>Breakfast</u>	<u>Amount (gm)</u>
orange juice	125
soft boiled eggs	100
bread	20
butter	5
<u>Lunch</u>	
turkey	90
celery	30
mayonnaise	30
tomato-raw	50
bread	20
butter	5
lettuce	15
can. peaches (2 T. Jce)	110
plain cookie	8
<u>Dinner</u>	
round steak	90
tomato (canned)	60
onion	3
frozen peas	60
potato	50
lettuce	15
French dressing	10
butter	10
butter tart	40
<u>Evening</u>	
bread	40
butter	10
apple jelly	30
milk	240