THIAMINE INTAKE OF HEALTHY PRESCHOOL CHILDREN AS AN INDICATION OF REQUIREMENT

by

CAMILLE PALMER HAWKINS

A THESIS

submitted to the

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF SCIENCE

June 1945

APPROVED:

Professor of Foods and Nutrition and Head of the Department in Charge of Major

Chairman of School Graduate Committee

Chairman of State College Graduate Council

ACKNOWLEDGEMENT

Grateful acknowledgement is here made to Dr. Margaret L. Fincke, Professor of Foods and Nutrition, for her unfailing kindness and assistance in the research and preparation of this thesis; to Dr. Josephine Gardner, Assistant Professor of Foods and Nutrition, for her interest and encouragement; to Bessie L. Davey, Graduate Assistant in Nutrition, for advice and assistance during the course of the chemical analysis; and to Mrs. Vernon H. Cheldelin and Mrs. Elmer Hansen, the mothers who cooperated so willingly and made this study possible.

TABLE OF CONTENTS

CHAPTER I

PURPOSE OF THE INVESTIGATION

The purpose of this study was to determine by dietary analysis the thiamine intake of three preschool children as an indication of the amount of this vitamin which normal, healthy children under favorable circumstances ordinarily consume. Comparison with recommendations for thiamine requirement should give an indication of how close these standards are to what a young child will normally eat.

CHAPTER II

REVIEW OF LITERATURE

THIAMINE REQUIREMENT

A determination of the adequacy of a diet is dependent on the standard used. The recommended daily allowances for specific nutrients as adopted by the Food and Nutrition Board of the National Research Council (14) have been, since 1941, the yardstick for the estimation of the prevalence of dietary inadequacies. These figures were based on the results of scientific investigations of the human requirement for the various nutrients, as far as they were available, with a margin of safety allowed to insure good nutrition.

For children, the recommended allowance for thiamine as given by the National Research Council amounts to 0.5 mg. per 1000 calories.

There have been few experiments with preschool children to determine the thiamine requirement of that age. Knott in 1936 (22) studied the requirements of eight children, ranging in age from four to seven years, by placing them successively on three different levels of thiamine intake. Food and excreta were analyzed by the rat growth method and results were given in terms of a unit which is approximately equal to two Chase-Sherman units. They

noted a trend toward higher retentions of vitamin B_1 accompanied by higher levels of intake, with the highest retentions occurring on the highest intakes. They concluded that the optimum requirement for vitamin B_1 was similar to the largest amount of the vitamin used in these balance studies, which in terms of body weight, was stated to be 20 Units per kilogram. According to a generally accepted equivalent of thiamine unitage (37) this would mean, for optimum nutrition, a requirement of 60 micrograms per kilogram, or for an average four year old of forty pounds (29), a daily requirement of 1.088 milligrams.

Benson et al (5) carried out a study with children ranging in age from four to eleven years. The thiamine intake of this group of 22 children was estimated from tables and averaged 990 mcg., which resulted in an average excretion of 27.2% of the total. They concluded that the average thiamine intake in this group seemed adequate to provide for excellent health and that an optimum of 450 mcg. of thiamine per 1000 calories would contribute to maximum health.

In 1944 Oldham and co-workers studied the riboflavin and thiamine requirements of children of preschool age (33). Their subjects were two normal 5 year old boys who had previously been on a good diet. By analysis of food and urine they found that when the thiamine intake averaged

600 mcg. there was a daily excretion of 18% of intake and test dose returns showed a marked increase over those on lower levels of thiamine intake. At 700 mcg. the thiamine excretion averaged 23% of the intake and the one hour fasting excretions showed the first significant increase over those on lower levels of intake. In terms of calorie intake this level of 0.50 mg. per 1000 calories is sufficient to maintain tissue saturation. This amount agrees well with Benson's (5) recommendation of 0.45 mg. per 1000 Calories and the National Research Council's standard of 0.5 mg. per 1000 calories (14).

These studies recommend levels of intake which are compatible with good health but do not state what would be a minimum protective allowance.

Infants are apparently protected against thiamine deficiency when the milk contains at least 10 mcg. of thiamine per 100 ml., that is, 0.15 mg. per 1000 calories (20).

Studies of adult requirement have given a range of values for minimum and recommended intake. Melnick (27) suggests the reasons for this variance to be due to the nutritional status of the experimental subjects prior to the depletion periods, the length of the experimental periods, the criteria of the state of nutrition and the expression of thiamine requirements in terms of milligrams per day rather than per 1000 calories.

Williams, Mason, Smith and Wilder (45) recommend comparatively high minimal and optimal standards for thiamine. This is probably because of the criterion used--the disappearance of clinical signs of deficiency after a prolonged depletion of six months. In this study the minimal daily requirement of thiamine was found to be between 0.22 mg. and 0.50 mg. for each 1,000 calories of a diet providing carbohydrates and fat in conventional proportions. Optimal intake was from 0.5 mg. to 1.0 mg. per 1000 calories.

Elsom et al (11) recommend the minimal absolute intake to prevent symptoms of deficiency as 0.35 mg. per 1000 calories. Their six subjects were on a diet deficient in other factors besides thiamine and the findings may not have given a true picture of thiamine requirement but would perhaps more nearly have represented requirement under conditions when more than one vitamin was low in a poor diet.

Melnick (26) studied thiamine requirement with 60 normal and 56 thiamine deficient subjects in which the criterion was "the critical level of dietary intake associated with a precipitous decrease in the urinary excretion values, indicating an active attempt on the part of the organism to conserve thiamine." It was concluded that the minimal thiamine intake should be no less than 0.35 mg. per 1000

calories and the recommendation for safety would be 0.50 mg. per 1000 calories.

Holt, as cited by Melnick (27), kept 12 subjects on a synthetic diet and gradually lowered the thiamine intake until the thiamine excretion in a morning hour sample was zero. The amount required to give a perceptible excretion of thiamine was considered the minimal requirement. This would obviously give a much lower standard than a determination of the level at which the body rapidly begins to conserve the vitamin as in Melnick's experiment (26.) Holt recommends a minimal range of 0.128 to 0.178 mg. per 1000 calories.

Keys et al (21) used a much different method of determining thiamine requirement. Their estimation was based upon the amount needed "to allow maximal and most efficient performance of the body." On levels of intake from 0.63 mg. per 1000 calories to 0.23 mg., for periods of 10 to 12 weeks each, observations were made of the effect of severe work, sustained work and activities involving speed and coordination upon psychomotor performance and blood lactate, pyruvate, glucose and hemoglobin values. For periods studied no benefit of any kind was observed to be produced by an intake of more than 0.23 mg. of thiamine per 1000 calories. This study did not have the long depletion period as used by Williams (45) and conclusions

were not drawn as to requirements of men during more prolonged periods.

These adult studies, then, give as a recommended minimal allowance a range of 0.128 to 0.50 mg. per 1000 calories. The National Research Council's (14) recommendation is 0.6 mg. per 1000 calories, intended to give a safe allowance for individual variation and factors which increase this vitamin requirement.

There is a considerable difference of opinion as to the minimum requirement of thiamine, with few suggestions as to an optimal amount. Holt (20) in 1944 reviewed the literature on minimum requirement and concluded that on a constant diet the standard thiamine intake should be from 0.13 to 0.17 mg. per 1000 calories and on a varied diet 0.17 to 0.23 mg. per 1000 calories. He states that as this is close to Knott's observations of normal intake for infants of 0.15 mg. per 1000 calories the minimal level for children should probably be close to the same figure.

Melnick (27) contends the minimal requirement of the "sedentary adult" is approximatoly 0.35 mg. per 1000 calories and that the National Research Council's recommended intake for adults of 0.6 mg. offers a liberal but necessary margin for safety.

The studies of child requirement are not strictly comparable with adult studies but the results of Knott

(22), Benson (3) and Oldham's (33) research indicate that to maintain normal body processes a level of intake of approximating 0.5 mg. per 1000 calories is required for the young child.

METHODS OF DETERMINING NUTRITIONAL STATUS

As thiamine pyrophosphate (cocarboxylase) (2), thiamine is essential in the oxidative enzyme system of carbohydrate metabolism and is concerned primarily with the metabolism of the intermediary product, pyruvic acid (32, 34). "It would seem that di-phospho-thiamine is primarily concerned with the decarboxylation of alpha-ketonic acids in all living cells." (12). Thiamine is carried by the plasma of the blood stream to the liver and kidneys where phosphorylation occurs. Other tissues phosphorylate it more slowly (32). There is very little storage of thiamine in the body and any excess of intake immediately causes increased excretion (7).

The successive stages of nutritional inadequacy are given by Joliffe (12) as tissue depletion, biochemical lesions, altered function and anatomical lesions. The metabolic changes which occur in thiamine deficiency were used in the requirement experiments to determine nutritional status. In clinical practice it is important that early deficiencies be recognized but the evaluation depends on

what criterion is used.

Tissue Depletion

Since thiamine is not stored to any extent in the organism and all excess is excreted and to a small extent destroyed (7), low excretion in the urine values would point to a diet recently deficient in the essential.

Total daily excretion of thiamine in the urine in terms of percent of intake has been used as a criterion for determining nutritional status. An excretion of 20% of the intake is recognized by Benson (5,6) and by Oldham (33) as indicating adequate nutrition in children.

Healthy humans on an adequate diet have been found to excrete between 50 and 150 mcg. a day (3). Levels of 15 to 30 mcg. are reported for deficient subjects (45). Averages of 150 mcg. (6) and 268 mcg. (5) are reported for children. These figures give too wide a range for use in clinical diagnosis of deficiency.

Test dose returns are not considered a satisfactory index of nutritional status (3). Mason and Williams (25) observed an excretion of 1 to 6% of the test doses in well developed deficiency and 20% excretion when nutrition was adequate but concluded that total daily excretion affords as much information as to the physiologic state as does the test dose procedure.

Biochemical Lesions

The amount of thiamine in the blood plasma does not fall until the stores of the vitamin in the tissues are low (12). The daily variations in blood thiamine do not appear to follow the daily urinary output (4,33). An average blood level of 7.8 mcg. per 100 ml. of blood was found by Benson (4) in 45 healthy children while Oldham (33) reports levels of 7.0 mcg. per 100 ml. in children on intakes of 700 to 750 mcg. Estimation of thiamine, or of cocarboxylase, in whole blood is not considered by Goodhart (15) to be a reliable means of detecting possible deficiency of thiamine.

The range of values of cocarboxylase, which occurs in the blood exclusively in the cells (15), has been stated by Wortis (49) to be 4 to 13 mcg. with an average of 7.5 mcg. per 100 ml. for 50 healthy children four to fifteen years of age. Schlutz (39) reports an average of 10.0 mcg. per 100 ml. for infants and children. Blood of healthy adults contains about 7 mcg. per 100 ml. while a value below 3 mcg. indicates deficiency (37).

The amount of pyruvic acid in the blood would theoretically be influenced by the thiamine intake, as cocarboxylase is necessary for catabolism of pyruvate (2). A range of 0.71 to 1.21 mg. with an average of 0.86 mg. of pyruvate per 100 ml. has been suggested for children seven

to sixteen years of age (47). In 39 normal adults the range was 0.77 to 1.23 mg. per 100 ml. with an average of 1.0 mg. (8). Following the ingestion of glucose there is a rise in blood pyruvic acid and in normal subjects the curve follows a fairly characteristic pattern, generally returning to normal in three hours. In cases associated with thiamine deficiency the pyruvic acid curve following thiamine ingestion is abnormally elevated and fails to return to fasting level until thiamine is administered (8).

Disturbances in Function and Anatomical Lesions

Biophysical methods have been designed to measure functional or structural impairments attributed to avitaminosis (1). Keys (21) attempted to determine objectively the effect of thiamine deficiency in developing weakness, fatigue, neuro-muscular incoordination and anorexia, but found no apparent change in efficiency when thiamine was reduced to the level of 0.23 mg. per 1000 calories for 10 weeks.

The results from electrocardiographic records, which indicate circulatory disturbances, are not uniform. Abnormalities were found by Williams et al (45) in only 3 of 11 cases of mild deficiency and Keys (21) observed no changes in the heart rhythm in his subjects.

Early thiamine deficiency symptoms which should be

recognized by the diagnostician are outlined by Joliffe (12). "This syndrome consists of tension and irritable-weakness states. It is manifested in complaints of fatigability, weakness, and exhaustibility, head pressures, poor sleep, irritability, feeling of tenseness, various aches and pains, subjectively poor memory, and difficulty in concentration. . . . anorexia, fatigability and disturbances of sleep are the fundamental symptoms."

Williams' (45) eleven women on a diet of 0.45 mg. per day for six months showed mental and physical inefficiency weeks or months before more objective manifestations of nutritional status. These symptoms and the more easily recognizable ones of beriberi cannot be accepted as diagnostic of early nutritional failure (31).

The syndrome of beriberi can be determined by a diagnostician. It is characterized by

a) Polyneuropathy: Plantar dysesthesia and calf-muscle tenderness are the earliest objective signs (12,48,45). The vibratory sensation in the toes is diminished and ankle jerk disappears. These symptoms travel up the legs and an abnormal gait appears. With continuance of the deficiency the arms are involved. (12).

b) Ophthalmoplegia of Wernicke's syndrome (12) is usually preceded by a condition which increases metabolism and consequently thiamine requirement. The syndrome is

characterized by degenerative changes in the eyes and clouding of consciousness.

c) Circulatory disturbances (12) are characterized by edema with or without enlargement of the heart.

Factors Affecting Requirement

Activity, age, weight, sex, pregnancy and lactation are considered separately by the National Research Council (14) in setting up standards.

Exercise, although causing an increase in total calorie requirement and in the absolute requirement for thiamine does not cause any increase in the requirement per calorie (21).

Increases in the metabolic activities of the body as in pregnancy, lactation, fever (3), febrile infections and toxic goiter (44) cause a higher requirement for thiamine.

The composition of the diet, particularly the fat content, may affect the requirement (46,13,20) but requirement is more often stated for Americans in terms of calorie intake (14); however, it may be more nearly related to calories metabolized than to calories consumed (20).

Holt (20) believes that one of the reasons for the differences in the literature of recommendations on thiamine requirement is due to the lack of uniformity of the diet; the more uniform the diet the smaller the requirement.

This may be a result of biosynthesis which is apparently facilitated on constant diets (30).

The question of human adaptation to low levels of vitamin supply has received some attention in the literature. Mitchell (28) recounts the work of a physician in Java who determined the thiamine output in the urine of 15 Javanese subsisting upon their native diets and in apparently a normal state of health. He found the output was low in comparison with the values found in this country. He stated that with test doses the percentage recovered in the urine was not subnormal so apparently the saturation level of the tissues was low.

ADVANTAGE OF INCREASED INTAKE OVER RECOMMENDED ALLOWANCES

Animal experiments show that at a certain point a plateau is reached in growth beyond which there is no further increase with increased ingestion of thiamine. Addition of thiamine to infants and children's diets have given inconclusive results but it is apparent that increasing thiamine in an otherwise normal diet results in increased growth and more stabilized rates of growth (40, 41, 9, 35). Large doses are not toxic (37) but are of no advantage as they are poorly absorbed and rapidly excreted.

Increased thiamine has a beneficial effect on the

appetite. Schlutz (38) reports that with 52 children ranging in age from 4 to 11 years there was an increase in food consumption of 17 to 25% when the thiamine in the diet was increased 50%.

Harrell (18) describes an interesting study of the effect of added thiamine on learning. She divided 104 children of average age of 13 into two well matched groups, the only difference being the addition of 2 mg. of thiamine to the diet of one group and placebos to the control group. Learning was measured by 18 activities, both mental and physical, which were selected for objectivity and scoring. The thiamine group was consistently superior in making gains of 7 to 87% over the controls; showing an average improvement on all tasks of 27%. Although many of the individual scores for thiamine-treated and control groups were not significantly different, the trend was entirely towards better scores for the thiamine-treated group.

NUTRITION SURVEYS

Dietary studies do not directly measure the incidence of malnutrition (existence of body abnormalities as a result of nutritional deficiency) but they serve as an indication of its likely occurrence or absence. When clinical determinations of malnutrition are made in connection with

dietary surveys a much better idea of the health of the group is obtained. The estimates of various investigators, working with similar population groups, may range from an incidence of almost 100% to practically no malnutrition (10). This is due to the lack of uniformity in the methods of study and the different criteria used in evaluating deficiency.

The thiamine content of American diets, obtained from food consumption records, was estimated in 1939 by the Bureau of Home Economics of the Department of Agriculture (43). Seventy-six percent of the families failed to receive 500 International Units of thiamine (1.5 mg.) per person. The average American diet, prior to the enrichment of bread and flour was estimated by Lane, Johnson and Williams (1942) (23) to be 0.8 mg. per 2500 calories. They estimated that with enrichment of flour and bread the intake should be increased to 1.3 mg. per 2500 calories. This would be approximately 0.5 mg. per 1000 calories, so, the average population should now be receiving close to an adequate amount of this vitamin.

Chemical analysis for three week periods of the diet of 15 women in a housing project in Texas (48) showed a range of intake of 0.27 to 0.92 mg. of thiamine daily with an average of 0.51 mg. The National Research Council (14) recommendation for sedentary women is 1.2 mg. Of the 15

women examined none showed diagnosable polyneuritis but two showed plantar dysaesthesia.

Canadian studies by Ferguson, Leeson and McHenry (13) illustrate the great difference in interpretation of the adequacy of a diet according to the standard used. From one week food records of high school students thiamine intake was calculated. Only 44% of the girls and 30% of the boys had an intake of 70% of the National Research Council's standard of 0.6 mg. per 1000 calories, whereas 99% of the girls and 98.7% of the boys were above 70% of Keys' (21) recommendation of 0.22 mg. per 1000 calories. According to physical examinations 78% of the girls and 85% of the boys had excellent or good health.

An example of the use of blood tests in determining nutritional status is reported by Wilson (47). The blood pyruvic acid level of a group of hospitalized children in England averaged 0.99 mg. per 100 ml. Since this result is similar to the average figure given by Wortis et al (49) for a group of American children, the English investigators concluded that there was no deficiency in their diets.

Estimates of the thiamine intake of children four to twenty years of age in an orphan home (18) gave for 9 days a range of 0.6 to 1.3 mg. with an average intake of 0.9 mg. per day. The mean age of this group was 13 years 8

months, and to meet the recommended standard the intake should have been nearer 1.3 mg. per day.

Studies of the food consumption of preschool children are limited. Four boys ranging in age from 40 to 55 months (36) received respectively 376, 568, 606, and 611 Sherman-Chase units of thiamine on the basis of analysis of one day's food. According to Rosenberg's (37) statement of equivalence i.e. 2 Sherman-Chase units ≡ 1 I.U. ≡ 3 mcg., the average day's total was 810 mcg. of thiamine. Per 1000 calories they received an average of 506 mcg.

The 22 children, four to 10 years of age, reported in Benson's study (5) chose diets containing an average of 990 mcg. or 450 mcg. per 1000 calories.

From these studies it can be seen that recommendations for minimal adult requirement vary from 0.128 to 0.50 mg. per 1000 calories and the National Research Council has set its standard to give a margin of safety over the highest minimum requirement. Studies of preschool children are limited, but indicate that a recommended allowance of 0.5 mg. per 1000 calories is none too high.

Methods of determining early nutritional deficiencies are still in the experimental stage but a daily excretion of thiamine of 20% of the intake is considered an indication that the recent diet has been adequate.

Dietary surveys generally show a deficiency in thiamine when the National Research Council's recommendation is taken as a standard. The two studies reported here of thiamine in children's diets describe an intake close to the recommended allowance.

Further study of thiamine in the normal diet of healthy preschool children would give an indication of the requirement for this age.

CHAPTER III

EXPERIMENTAL

Duplicates of all food eaten by three preschool children were analyzed for total thiamine by the thiochrome method. Collections of food were made for seven days for two children and fourteen days for the third child during the months of February and March.

The children were chosen for their apparent health and good appetite and the willingness of the mothers to assist in food collections. Two were the children of college professors and one was the child of the author. The one girl in the study, V.C., was 48 months old, weighed forty pounds and was forty-four inches tall. During the preceding year she had gained six pounds in weight and four inches in height. J.H., a boy, age 45 months, weighed fifty-one pounds and was forty-five inches tall. Previous weight records were not available. The third child B.H., a boy, age 35 months, weighed thirty-six pounds and was forty inches tall. All three of these children are well above the average in height and weight for their age. (29). Within the previous year the children had been examined by a physician and were found to be in very good health. None of the children had dental caries.

The collection of food was interrupted in the three

cases due to illness (colds and chicken pox). Collections were not continued until the children were well and eating normally.

V.C. and J.H. attended the College Nursery School for four morning hours and B.H. the Corvallis Nursery School for the full day. They ate their noon meals at school.

The food given to each child to eat was first weighed on a dietetic balance or measured in cups and spoonfuls and the amount recorded. Any food not eaten or spilled by the child was subtracted from the total and a duplicate of the food eaten was taken for analysis. At the nursery school the weighing of the food and the collection of duplicates was done by the author or by an assistant. Duplicates of food eaten at home were collected by the mothers who were careful that measures and weights were exact and records complete.

The duplicate samples of food were stored in covered fruit jars in a refrigerator overnight and the following day the day's total was mixed. The solid food was ground twice through a food grinder and utensils were washed with distilled water. The liquids were added and food was weighed. This mixture was thoroughly blended and sampled for thiamine analysis. Vitamin preparations taken by the children were not included in the food analyzed.

Total thiamine in the food was calculated and the

thiamine/calorie ratio determined. Calories were estimated using Taylor's table of food values (42).

A simple score card based on the "seven basic" food groups was drawn up to evaluate the diet as a whole (p. 23). Sizes of servings used in the score card which children of this age could be expected to take were based on Lowenberg's (24) report of food intake of preschool children. On this scale 100 percent signified that the child is getting a good diet which presumably meets his needs. It would be possible to meet the requirements by other food patterns, but this score card is an attempt to provide a simple quick method of assessing the quality of the diet eaten by American children.

Thiamine Analysis

A modified Hennessey and Cerecedo (19) thiochrome method was used for determination of total thiamine. The basis of this method is the oxidation of thiamine to the fluorescent compound, thiochrome. The intensity of this fluorescence, which is proportional to the concentration of thiamine, can be measured by an electronic photofluorometer. To obtain free thiamine for analysis the samples of food in dilute acid must first be incubated with enzymes which will hydrolyze the compounds of thiamine and phosphate, carbohydrate and protein.

Duplicate one hundred or two hundred-gram samples of

SCORE CARD

To Evaluate the Adequacy of Diets of Children Three to Four Years of Age

	Food Group	Amount for the Day	Score Half	Score Complete
1.	Milk	3 cups		20
		2-3 cups	15	
		1-2 cups	10	
		served	5	
2.	Butter	1 T		10
		served	5	
3.	Leafy or green or yellow vegetables	1/4 cup		10
		served	5	
4.	Any other vegetable	1/4 cup		5
		served	2	
5.	Orange, grapefruit or tomato	1/3 cup		10
		served	5	
6.	Other fruit	1/3 cup		5
		served	2	
7.	Meat, fish, poultry, cheese, or dried beans	1/4 cup		10
		served	5	
8.	Eggs	1		10
		served	5	
9.	Whole grain cereals or enriched	2 servings		10
	a) Bread, 1 slice	1 serving	5	
	b) Cooked cereal 1/3 cup			
10.	Vitamin D concentrates	400 I.U.		10
				100%

the food mixture were weighed and ground in a Waring Blendor for five minutes with an equal volume of 2% acetic acid. One hundred grams of the resulting mixture were transferred to a 125 ml. Erlenmeyer flask and 10 ml. 3% Polidase solution, made up in a buffer at pH 4.5, added. Flasks were corked and kept in an oven at 37° to 40°C. for at least fourteen hours. Contents of the flasks were then filtered by suction, the first few millilitere of the filtrate being discarded.

Two ml. aliquots of the extract were pipetted into glass stoppered cylinders and contents made up to 5 ml. with distilled water. Four drops of the oxidizing agent, one percent potassium ferricyanide solution, were added to each cylinder followed by three ml. of fifteen percent sodium hydroxide and thirteen ml. of isobutanol. For each sample a blank determination was made by the omission of the ferricyanide. The purpose of this blank analysis was to measure fluorescence not due to the oxidation of thiamine to thiochrome. The cylinders were shaken for one and a half minutes and the contents poured into separatory funnels. The alkaline aqueous layer was drawn off and discarded and the top isobutanol layer, containing the thiochrome, was poured off into centrifuge tubes. Two to 4 gms. of anhydrous sodium sulfate, a drying agent to remove the last traces of water, were added to each tube.

Tubes were centrifuged and solutions poured into dry cuvettes and read immediately in a Coleman electronic photo fluorometer. As the instrument sensitivity varies with the intensity of the mercury vapor lamp the sensitivity was checked immediately before each test by inserting a cuvette of the stable reference solution quinine sulfate and the instrument adjusted to read 50 on the galvanometer.

To standardize the fluorometer the instrument was set at 50 with the standard quinine sulfate solution. The deflections of the galvanometer caused by thiamine solutions of known strength oxidized to thiochrome in the usual way were measured. The strength of the thiamine solution is directly proportional to the deflection of the galvanometer reading. A curve of reference was constructed from these data. From this curve the number of micrograms of thiamine in each aliquot could be calculated and consequently the number of micrograms in the total day's food.

Recovery of thiamine was tested at the beginning of the experiment by treating a sample of the food in the same way using 2 ml. of thiamine standard solution, containing 5 mcg. thiamine per ml. for each 98 ml. of 2% acetic acid used. Within the limits of experimental error, which in this case was about 15 percent, all thiamine was recovered.

Solutions for Thiamine Analysis

Standard Solutions

Quinine Sulfate

Solution A: 0.0108 gms. of quinine sulfate in one liter of 0.1 N sulfuric acid.

Working standard: 8 ml. solution A in 500 ml. 0.1 N sulfuric acid.

Thiamine Hydrochloride

Solution A: 5 mg. Thiamine in 100 ml. 20 percent ethanol which has been brought to approximately pH 4.0 with 0.1 N hydrochloric acid.

Working standard: 10 ml. solution A diluted to 100 ml. with water brought to pH 4.0

Reagents

Sodium hydroxide 15 percent: 75 gms. sodium hydroxide in 500 ml. distilled water plus 5 gms. barium hydroxide.

Potassium Ferricyanide solution: 1%.

Sodium acetate-acetic acid buffer: 55 ml. glacial acetic acid, 110.5 gms. $NaC_2H_3O_2.3H_2O$ made up to one liter with distilled water (pH 4.5).

Acetic acid 2%: made frequently from 20% stock solution.

Isobutanol: which shows a fluorescence not greater than distilled water.

Sodium sulfate: anhydrous.

CHAPTER IV

RESULTS AND DISCUSSION

As shown in Table I the average daily thiamine intake of the three children in this study was 560 mcg; calories averaged 1286 and the average thiamine/calorie ratio was 435 mcg. per 1000 calories. This figure is well above the minimum intake recommended by Holt (20) of 0.17 to 0.23 mg. per 1000 calories for adults and above Melnick's (29) minimum of 0.35 mg. per 1000 calories , but 13% lower than the National Research Council's recommendation for children of 0.5 mg. per 1000 calories.

The girl, V.C., age 49 months, had a range of 425 to 863 mcg. of thiamine and 1216 to 1668 calories in her diet during the seven days of analysis. This averaged 666 mcg. thiamine and 1434 calories which is a ratio of 464 mcg. per 1000 calories. Her diet for the seven days was scored 84% according to the scale used.

There were 486 to 667 mcg. of thiamine, averaging 562 mcg, and 815 to 1714 calories averaging 1231 calories in the diet of J.H. age 43 months. His diet for the seven days was rated as 78% and the average thiamine intake per 1000 calories was 456 mcg.

The duplicate lots of food eaten by B.H. age 35-36 months were collected for 14 days. Thiamine intake in the first 7 days ranged from 294 to 714 mcg. and averaged

TABLE 1

Thiamine, Calories and Diet Score of the Three Children

	V.C.			J.H.			B.H. 1st. week			B.H. 2nd. week		
Day	Thia. mcg.	Cal.	Diet Score %	Thia. mcg.	Cal.	Diet Score %	Thia. mcg.	Cal.	Diet Score %	Thia. mcg.	Cal.	Diet Score %
1	752	1228	70	667	1714	85	497	1261	75	456	1452	60
2	515	1427	85	532	1473	85	586	1391	75	545	1443	80
3	672	1216	80	643	1549	80	714	1093	75	467	1451	70
4	756	1635	90	486	956	75	294	772	65	519	1322	75
5	425	1568	70	587	936	70	402	1003	60	771	1406	75
6	679	1668	95	492	815	75	391	884	70	559	1108	80
7	863	1301	95	526	1174	75	543	1493	65	354	1268	75
Aver.	666	1434	84	562	1231	78	490	1128	69	524	1350	73
Thiamine	464 mcg. per 1000 cal.			456 mcg. per 1000 cal.			434 mcg. per 1000 cal.			388 mcg. per 1000 cal.		

Average Thiamine 560 mcg.

Average Calories 1286

Average Thiamine per 1000 calories 435 mcg. per 1000 cals.

490 mcg., and the diet contained 884 to 1493 calories with an average of 1128 calories. This represents 434 mcg. per 1000 calories. The diet score for this week was 69%. The second week showed thiamine as varying from 354 to 771 mcg. with a mean of 524 mcg. and a caloric variation of 1108 to 1452 averaging 1350 calories. This amounted to 388 mcg. per 1000 calories and the diet was scored as 73%.

The food eaten by each child during the period of collection is given in the appendix.

J.H.'s nursery school food was analyzed separately from the home collection. This was done to give an indication of the amount of thiamine supplied by the nursery school meals. Table II reports the data which shows that for this child the nursery school was supplying 35 percent of the thiamine he obtained during the seven days of analysis. There was little difference in the average amount of thiamine for the five school days as compared with the two days when all meals were eaten at home.

The average thiamine intake of 560 mcg. obtained by these children in the seven days of study is lower than the 810 mcg. (estimated from Sherman-Chase Units (37)) reported by Robb, Vahlteich and Rose (36) for 4 preschool boys. Per 1000 calories these 4 boys received an average

TABLE II

Comparison of Thiamine in diet of Home and School Meals as Eaten by J.H.

Day	Thiamine in home collection		Thiamine in school collection		Total Thiamine	
	mcg.	% of total	mcg.	% of total	mcg.	
1	373	56	294	44	667	
3	493	76	149	24	643	
4	345	71	141	29	486	
6	291	59	200	41	492	
7	323	61	203	39	526	
Ave.	365	65%	198	35%	563	100%
2					532	
5					587	
Ave.					559	

of 506 mcg. as compared with 435 mcg. in this study. Their analysis was of only one day's food and was stated in terms of Sherman-Chase Units, so little comparison is possible between these two studies.

The caloric intake of these three children 35-48 months old, as estimated from tables (42) averaged 1286 calories with a range of 815 to 1714 calories. This is similar to amounts reported by Hann and Stiebeling (16) of 1288 calories for 24-35 months old children and 1255 calories for 36 to 47 months.

The scoring of the diet as a whole was used as a simple method of evaluation. (see score card, p. 23). However, the fact is appreciated that even a perfect score does not necessarily guarantee a diet adequate in all essentials. The seven basic foods made up the total score the basis of which was 20% for milk, 10% for butter and fortified margarine, 15% for vegetables, 15% for citrus fruits, tomatoes and other fruits, 10% for meat, fish, poultry, cheese or dried peas or beans, 10% for eggs, 10% for whole grain cereals and in addition 10% for vitamin D concentrates or fish liver oils.

The diets of V.C., J.H. and B.N. scored 84%, 78%, and 71% respectively. A study made by Hardy and coworkers (17) of 7363 city children whose diet was scored on the basis of food groups indicated that the "diet patterns of 72% of the

children failed to meet even a low standard." Since the children in this study of thiamine intake were the children of college professors and a college student and were taking a meal a day at nursery school it is to be expected that their diets would be good.

A comparison of the diet scores for the week show that all three children tended to be low in the amount of leafy or green or yellow vegetables which they ate. Butter rarely reached the amount of one tablespoon but this is not serious in children's diets if they are drinking recommended amounts of whole milk and taking fish liver oil regularly.

V.C. and J.H. ate at least four eggs a week but B.H. had them served to him but seldom and then would eat only a small amount. Milk to drink averaged between two and three cups a day for all three children, being least for B.H. Whole grain or enriched cereals were adequate for V.C. and J.H. but were very low in B.H.'s diet during the first seven days and slightly low during the second period.

The three children drank fruit juices well. J.H. was the only child whose diet had a smaller amount of meat, fish or cheese than recommended. His diet was also lower than recommended in the amount of fruit eaten.

There is only slight relationship from day to day

between thiamine and calorie intake or thiamine and dietary adequacy as judged by the score card, but the diets which are high in thiamine are those which contain a very good source of this essential nutrient e.g. wheat germ, liver, pork or a larger than recommended amount of whole grain or enriched cereal or of milk (see menus in appendix). The diet scores however tend to be higher as the calories are higher indicating that the quantity of protective foods as well as quality of the diets affects the score.

The score card is made up to give half score when the food recommended is at least served, even though the child does not eat the recommended amount. The frequency of the occurrence of half scores, especially for vegetables, eggs and whole grain cereals shows the importance of training in food likes as well as planning and preparation of adequate meals.

When the average of the seven days' food consumption for each child (Table I) is considered the highest diet score and calorie intake (V.C.) gave the largest average amount of thiamine with the best thiamine/calorie ratio. However, the second week's record of B.H.'s food intake had a slightly increased diet score, increased calories and an increase in thiamine intake but the increase in thiamine was not proportional to the calories and there

were only 388 mcg/1000 calories as compared with 434 mcg/1000 calories for the first week. This might be a further indication that besides planning for a well balanced diet containing the seven basic foods the foods important for thiamine content must be emphasized.

As a result of this study it is apparent that the diets of these three preschool children, under normal but favorable conditions, did not quite meet the recommended level of intake for thiamine made by the National Research Council. Either these standards are too liberal or it requires good planning to supply a well balanced diet and care in regularly choosing food which is a good source of thiamine.

CHAPTER V

SUMMARY AND CONCLUSIONS

The food consumed by three children, 35 to 49 months of age, was analyzed for total thiamine and calculated for total calories for seven day periods for two of the children and 14 days for the third. The average thiamine/calorie ratio was 435 mcg. per 1000 calories. The ratio was 464 mcg. and 456 mcg. per 1000 calories respectively for two children and 434 mcg. and 388 mcg. per 1000 calories for the third child for two seven-day periods.

An evaluation by means of a score card based on the seven basic food groups indicated that in general leafy or green or yellow vegetables represented the food group which was most often low in the three children's diets. The child who had the lowest thiamine intake was particularly low in eggs and whole grain or enriched cereals. The children averaged between two and three cups of milk daily. Thiamine intake was higher on days when good sources of thiamine, such as wheat germ, pork, liver, or good quantities of milk and whole grain or enriched cereals were included in the diet. It is evident that it

requires care and good planning to obtain the recommended amount of thiamine in each day's diet.

These results show that three normal, healthy children under favorable circumstances had a thiamine intake thirteen percent lower on the average than the National Research Council's (14) recommendation of 0.5 mg. per 1000 calories.

BIBLIOGRAPHY

1. American Medical Association. Handbook of nutrition. American Medical Association, Chicago, 1943.

2. Bango, I., Ochoa, S., Peters, R.A. Pyruvate oxidation in brain. VI. The active form of vitamin B_1 and the role of C_4 dicarboxylic acids. Biochem. J. 33:1109-1121, 1939.

3. Benson, R.A., Lawrence, B., Slobody, M.D., Witzberger, C.M., Lewis, L., Urinary excretion of thiamine in children. J. Pediatrics 20:454-465, 1942.

4. Benson, R.A., Witzberger, C.M., Slobody, L.B., Lewis, L. The blood level of vitamin B_1 in healthy children and its relation to the urinary thiamine. J. Pediatrics 21:659-664, 1942.

5. Benson, R.A., Witzberger, C.M., and Slobody, L. The urinary excretion of thiamine in normal children. J. Pediatrics 18:617-620, 1941.

6. Benson, R.A., Witzberger, C.M., and Slobody, L. An evaluation of the blood and urinary thiamine determinations in vitamin B_1 subnutrition. J. Pediatrics 23: 437-445, 1943.

7. Borsook, H., Buchman, E.R., Hatcher, J.B., Yost, D.M. and McMillan, E. The course of thiamine metabolism in man as indicated by the use of radioactive sulfur. Proc. Nat. Acad. Sci. 26:412-418, 1940.

8. Bueding, E., Wortis, H., Stein, M.H., and Jolliffe, N. Pathological variations in blood pyruvic acid. J. Clin. Invest. 20:441-442, 1941.

9. Colby, M.G., Macy, I.G., Poole, M.W., Hamel, B.M., Cooley, T.B. Relation of increased vitamin B_1 intake to mental and physical growth of infants. Am. J. Dis. Child. 54:750-756, 1937.

10. Editorial. The evaluation of nutrition surveys. Nut. Rev. 1:72-76, 1943.

11. Elsom, K.O., Reinhold, J.C., Nicholson, J.T.L., Chornoch, C. Studies of the B vitamins in human subjects. V. Normal requirement of thiamine. Am. J. Med. Sci. 203:569-577, 1942.

12. Evans, E.A. The biological action of the vitamins. Univ. of Chicago Press, Chicago, Ill., 1942.

13. Ferguson, H.P., Leeson, H.J., and McHenry, E.W. A nutrition survey in east York township. II The influence of the choice of dietary standards upon interpretation of data. Canadian J. Pub. Health 35:66-70, 1944.

14. Food and Nutrition Board, National Research Council. Recommended dietary allowances. Nat. Research Council Circ. Series 115, Jan., 1943.

15. Goodhart, R.S. and Sinclair, H.M. The estimation of cocarboxylase in blood. Biochem. J. 33:1099-1108, 1939.

16. Hann, H.N., and Stiebeling H.K. Food consumption of children at the national child research center. U.S. Department of Agriculture Circular No. 481, 1938.

17. Hardy, M.C., Spohn, A., Austin, C., McGiffert, S., Mohr, E., and Peterson, A.B. Nutritional and dietary inadequacies among children from different socio-economic groups. J. Am. Dietetic Assoc. 19:173-181, 1943.

18. Harrell, R.F. Effect of added thiamine on learning. Teacher's College, Columbia University Contributions to Education No. 877. Bureau of Publications Teacher's College, Columbia University N.Y., 1943.

19. Hennessey, D.J. and Cerecedo, L.R. Determination of free and phosphorylated thiamine by a modified thiochrome assay. J. Am. Chem. Soc. 61:179-183, 1939.

20. Holt, L.E. The thiamine requirement of man. Federation Proceedings 3:171-177, 1944.

21. Keys, A., Henschel, A.F., Mickelson, O., and Brozek, J.M. The performance of normal young men on controlled thiamine intakes. J. Nutrition 26:399-415 1943.

22. Knott, E.M. A quantitative study of the utilization and retention of vitamin B by young children. J. Nutrition 12:597-611, 1936.

23. Lane, R.L., Johnson, E., and Williams, R.R. Studies of the average American diet I. Thiamine content. J. Nutrition 24:613-624, 1942

24. Lowenberg, M.E. Food for young children in group care. Dept. of Labor, Children's Bureau Publication No. 285, 1942.

25. Mason, H.L., and Williams, R.D. The urinary excretion of thiamine as an index of the nutritional level: assessment of the value of a test dose. J. Clin. Invest. 21:247-255, 1942.

26. Melnick, D. Vitamin B_1 (Thiamine) requirement of man. J. Nutrition 24:139-151, 1942.

27. Melnick, D. A critique of values suggested as the thiamine requirement of man. Am. Dietetic Assoc. 20: 516-520, 1944.

28. Mitchell, H.H. Adaptation to undernutrition. J. Am. Dietetic Assoc. 20:511-515, 1944.

29. Monsch, H., and Harper, M.K. Feeding babies and their families. John Wiley and Sons, Inc., New York, N.Y. 1943.

30. Najjar, V.A., and Holt, L.E. The biosynthesis of thiamine in man. J. Am. Med. Assoc. 123:683-684, 1943.

31. National Research Council. Recognition of early nutritional failure in infants and children. J. Am. Med. Assoc. 118:615-616, 1942.

32. Ochoa, S., and Peters, R.A. Vitamin B_1 and cocarboxylase in animal tissues. Biochem. J. 32:1501-1515, 1939.

33. Oldham, H., Johnston, S.K., and Herman, H.S. A study of the riboflavin and thiamine requirements of children of pre-school age. J. Nutrition 27:435-446, 1944.

34. Peters, R.A. The biochemical lesion in vitamin B_1 deficiency. Lancet 230:1161-1164, 1936.

35. Poole, M.W., Hamel, B.M., Cooley, T.B., and Macy, I.G. Stabilizing effect of increased vitamin B_1 intake on growth and nutrition of infants. Am. J. Dis. Child. 54:726-749, 1937.

36. Robb, E., Vahlteich, E.M., and Rowe, M.S. Vitamin B_1 intake of nursery school children. Am. J. Dis. Child. 55:544-552, 1938.

37. Rosenberg, H.R. Chemistry and physiology of the vitamins. Interscience Publishers, Inc., New York, N.Y., 1942.

38. Schlutz, F.W. and Knott, E.M. The effect of varied vitamin B_1 ingestion on appetite of children. J. Nutrition 15:411-427, 1938.

39. Schlutz, F. W. and Knott, E.M. Cocarboxylase content of blood of infants and children. Am. J. Dis. Child. 41:231-236, 1941.

40. Summerfeldt, P., and Ross, J.R. Value of an increased supply of B_1 and iron in the diet of children. II. Am. J. Dis. Child. 49:1185-1189, 1935.

41. Summerfeldt, P., and Ross, J.R. Value of an increased supply of B_1 and iron in the diet of children. III. Am. J. Dis. Child. 56:985-988, 1938.

42. Taylor, C.M. Food values in shares and weights. The Macmillan Company, New York, N.Y. 1942.

43. U.S. Department of Agriculture. Food and life. Yearbook of Agriculture. pp. 296-320. Washington, D.C. 1939.

44. Wilder, R.M. Types of nutritional deficiency. Vitamin B_1. Annals Am. Acad. Pol. Science 225:229-231, 1943.

45. Williams, R.D., Mason, H.L., Smith, B.F., and Wilder, R.M. Induced thiamine (Vitamin B_1) deficiency and thiamine requirement of man. Archives Int. Med. 69: 721-738, 1942.

46. Williams, R.R. and Spies, T.D. Vitamin B_1 (Thiamin) and its use in medicine. Macmillan Co. New York, N.Y. 1938.

47. Wilson, H.E.C. Pyruvic acid test for Vitamin B_1 deficiency in children. Lancet 242:199, 1942.

48. Winters, J.C., and Leslie, R.E. A study of the diet and nutritional status of women in a low income population group. J. Nutrition 26:443-457, 1943.

49. Wortis, H., Goodhart, R.S. and Bueding, E. Cocarboxylase, pyruvic acid and bisulfite-binding substances in children. Am. J. Dis. Child. 61:226-236, 1941.

APPENDIX

FOOD CONSUMPTION RECORDS

AND

DIET SCORES

V.C. No. 1, Feb. 3, 1945

Breakfast	
Fablum	3 T
Bone phosphate	1 t.
Milk	3/4 c.
Egg, fried	1/2
Graham cracker	1
Bacon	1/2 slice
Lunch Home	
Milk	1/2 c.
Bean soup, canned	1/4 c.
Rolls, sweet	2
Honey	2 t.
Butter	1 t.
Dinner	
Milk	1 c.
Smelt, fried	4 medium
Potato	1/2 small
Carrot	1/3 medium
Jello	2 T
Jelly Roll	3"diam.x 1"
Creamed cabbage	1 T
Between meals	
Nuts	1 T
Apple	1/2
Vitamin preparations*	
20 drops oleum perc.	
1 capsule calcium & viosterol	

Thiamine: 752 mcg.

Calories: 1228

Score

1. Milk	15
2. Butter	5
3. L.g.y. veg.**	5
4. Other veg.	5
5. Citrus	0
6. Other fruit	5
7. Meat, etc.	10
8. Eggs	5
9. Whole Grains	10
10. Vitamin D	10
	70%

*Not included in analysis
**Leafy or green or yellow vegetables

V.C. No. 2, Feb. 5, 1945 42

Breakfast	
Fablum	3 T
Bone phosphate	1 t.
Milk	3/4 c.
Egg, fried	1/2
Bacon	1/2 slice
Toast	1/2
Butter	1 t.
Lunch School	
Meat loaf	35 gms.
Baked potato	42
Carrots, cooked	30
Cauliflower, raw	4
Toast, w.w. & butter	4
Milk	232
Fruit gelatin	76
Mid-morning School	
Tomato juice	86 gms.
Dinner	
Beef, roast	2"x4"x1/2"
Potato	1/2 medium
Creamed corn	2 T
Carrots	1/2 medium
Peaches	3 halves
	1/4 c.juice
Gravy	2 T
Milk	1/2 c.
Between meals	
Graham crackers	3
Vitamin preparations	
20 drops oleum perc.	
1 capsule calcium & viosterol	

Thiamine: 515 mcg.

Calories: 1427

Score

1. Milk	15
2. Butter	5
3. L.g.y. veg.	10
4. Other veg.	5
5. Citrus	10
6. Other fruit	5
7. Meat, etc.	10
8. Eggs	5
9. Whole grains	10
10. Vitamin D	10
	85%

V.C. No. 3, Feb. 7, 1945

Breakfast

Oranges slices	2/3 orange
Pablum	4 T
Bone phosphate	1 t.
Scrambled egg	1 T
Toast	1/2 slice
Butter	1/2 t.
Milk	2/3 c.
Cheese	1 t.

Lunch School

Milk	241 gms.
Liver, baked	25
Red beets	22
Peas	30
Toast & butter	5
Carrot strip	1
Ice cream	45
Cake	28

Mid-morning School

Orange juice	89 gms.

Dinner

Chicken	1 leg
Creamed celery	1 T
Potato	1/4 small
Cake, gold	1 wedge
Milk	1,2/3 c.

Between meals

Animal crackers	4

Vitamin preparations*

20 drops oleum perc.
1 wafer calcium & viosterol

Thiamine: 672 mcg.

Calories: 1216

Score

1.	Milk	20
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	0
7.	Meat, etc.	10
8.	Eggs	5
9.	Whole grains	10
10.	Vitamin D	10
		80%

*Not included in analysis

V.C. No. 4, Feb. 9, 1945

Breakfast

Egg	1 large
Pablum	3 T
Milk	1 1/3 c.
Toast	1/2 slice
Butter	1 t.
Blackberry jam	1 t.

Lunch School

Salmon	62 gms.
Potatoes, mashed	47 gms.
Broccoli	24
Toast & butter	5
Celery	1
Milk	249
Tapioca custard	81
Cake	14

Mid-morning School

Tomato juice	70

Dinner

Hamburger patty	1 medium
Potato	1 t.
Cauliflower	1 t.
Broccoli	2 T
Pudding, cornstarch	3 T
Orange	1/3
Doughnuts	1 1/2
Bread, plain	1 slice
Roll, sweet	1/2

Between meals

Orange	2/3
Cheese spread	1 t.

Vitamin preparations*

Oleum perc.
1 calcium capsule & viosterol

Thiamine: 756 mcg.

Calories: 1635

Score

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	10
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	10
9.	Whole grains	10
10.	Vitamin D	10
		90%

V.C. No. 5, Feb. 11, 1945

Breakfast	
Cream of wheat	2 T
Milk	1 1/4 c.
Egg, fried	1/2
Bread (garlic)	1 slice
Butter	1/2 t.
Lunch Home	
Salami sausage	2 slices
Milk	1 c.
Strained peas	1 t.
Apple sauce	1 c.
Dinner	
Fish - Salmon	3 T
Green beans	2 1/2 T
Butter	1 t.
Custard pudding	1/3 c.
Milk	1 c.
Graham cracker	1
Between meals	
5 olives - ripe	
2 chocolate candies	
1 slice w.w. bread, dry	

Vitamin preparations*
1 ascorbic acid tablet
1 calcium wafer

Thiamine: 425 mcg.

Calories: 1568

Score

1.	Milk	20
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	0
5.	Citrus	0
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	5
9.	Whole grains	10
10.	Vitamin D	10
		70%

*Not included in analysis

V.C. No. 6, Feb. 26, 1945

Breakfast	
Pablum	4 T
Milk	1 1/3 c.
Toast w.w.	1/4 slice
Peaches, canned	1/2 c.
Butter	1/2 t.
Lunch School	
Milk	254 gms.
Scrambled egg	52
Baked potato	43
Spinach	33
Carrot strip	7
Toast & butter	6
Applesauce	77
Mid-morning School	
Tomato juice	74 gms.
Dinner	
Chicken	3"x1"x1/4"
Beets	2 T
Potato, baked	1/2
Milk	2 c.
Prunes	6
	1/3c. juice
Cookies, arrowroot	2
Between meals	
Nut bread	1 1/2 slices
Brownie	1

Vitamin preparations*
Super D, 20 drops
1 calcium wafer

Thiamine: 679 mcg.

Calories: 1668

Score

1.	Milk	20
2.	Butter	5
3.	L.g.y. veg.	10
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	10
9.	Whole grains	10
10.	Vitamin D	10
		95%

V.C. No. 7, Feb. 27, 1945

Breakfast	
Pablum	4 T
Milk	1 1/3 c.
Egg, fried in butter	1/2
Bread, w.w.	1/2 slice
Butter	1 t.
Lunch School	
Milk	226 gms.
Bacon	10
Liver	6
Cabbage in milk	18
Celery	8
Toast and butter	5
Potato, boiled	21
Butter	2
Tapioca Custard	46
Mid-morning School	
Orange juice	67 gms.
Dinner	
Creamed chicken & veal	2 T
Broccoli	3 T
Potato	1/2 medium
Corn, cream style	3 T
Milk	1 c.
Strawberry	6
	2 T juice
Biscuit, baking powder	1
Between meals	
Arrow root cookies	4
Vitamin preparations*	
Super D 20 drops	
1 wafer calcium & viosterol	

Thiamine: 863 mcg.

Calories: 1301

Score:

1.	Milk	20
2.	Butter	10
3.	L.g.y. veg.	10
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	5
9.	Whole grains	10
10.	Vitamin D	10
		70%

*Not included in analysis

J.H. No. 1, Feb. 15, 1945

Breakfast	
Orange j. strained	60 gms.
Wheatsworth cereal	68
Cream and sugar	18
French toast	94
Syrup	30
Milk	186
Lunch School	
Beef & Liver loaf	62 gms.
Baked potato	32
Peas, buttered	16
Carrot stick	1
Toast	8
Milk	277
Ice Cream, vanilla	91
Dinner	
Salad, lettuce, carrot whipped cream	10 gms.
Deviled eggs	108
Potato & butter, baked	30
Sandwich, peanut butter & jelly	20
Milk	190
Apricot & juice, home canned	86
Between meals School (analysed with home meal	
Tomato juice	89

Vitamin preparations*

1 t. Squibbs A & D Haliver Oil
1 tab. B_1 containing 1 mg. thiamine chloride

Thiamine: 667 mcg.

Calories: 1714

Score

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	10
9.	Whole grains	10
10.	Vitamin D	10
		85%

*Not included in analysis

J.H. No. 2, Feb. 17, 1945

Breakfast	
Tomato juice	100 gms.
Milk	200
Wheatsworth cereal	82
Egg	44
Toast w.w.	28
Butter	2
Lunch Home	
Milk	200 gms.
Meat, pork patty	52
Potato, boiled	36
Broccoli	26
Turnip, raw strip	6
Apple sauce	74
Cookies	12
Dinner	
Milk	220 gms.
Soup, veg.	50
& crackers	8
Liver sausage	17
Doughnut	26
Bear claw, sweet roll	45
Berries	90

Vitamin preparations*

1 t. Squibbs A & D Haliver Oil
1 tablet B_1

Thiamine: 532 mcg.

Calories: 1473

Score

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruits	5
7.	Meat etc.	10
8.	Eggs	10
9.	Whole grains	10
10.	Vitamin D	10
		85%

J.H. No. 3, Feb. 19, 1945

Breakfast

Orange juice	64	gms.
Wheatsworth cereal	60	
Scrambled egg	70	
Toast w.w.	16	
Cocoa	168	
Milk	170	
Butter	4	
Lunch School milk	189	
Scrambled egg & bacon	7	gms.
Buttered peas	2	
Carrot stick	2	
Brown rice	30	
Toast w.w.	4	
Butter	2	
Mid-morning School		
Orange & grapefruit j.	78	gms.
Dinner		
Milk	200	
Brown rice & cheese sauce	90	
Hamburger patty	20	
Spinach & egg	60	
1/2 sweet roll	16	
1/2 doughnut	12	
Ice Cream, vanilla	45	
Between meals Home		
Cooky	12	gms.
Wheaties	10	
Milk	52	
Vitamin Preparations*		
Squibbs C.L.O.	1	t.
1 B_1 tablet		

Thiamine: 663 mcg.

Calories: 1549

Score

1. Milk	20	
2. Butter	5	
3. L.g.y. veg.	10	
4. Other veg.	0	
5. Citrus	10	
6. Other fruits	0	
7. Meat etc.	5	
8. Eggs	10	
9. Whole grains	10	
	80%	

*Not included in analysis

J.H. No. 4, Feb. 21, 1945

Breakfast

Fresh grapefruit j.	60	gms.
Cereal, w.w.	64	
Egg, soft boiled	16	
Bacon	5	
Toast w.w.	20	
Butter	8	
Jam	7	
Mid-morning School		
Tomato juice	5	gms.
Lunch School		
Milk	62	gms.
Applesauce	34	
Beef patties	33	
Gravy	15	
Mashed potato	56	
Broccoli	4	
Cabbage leaf	3	
Toast & butter	7	
Dinner		
Milk	200	gms.
Lettuce	6	
Salmon loaf	40	
Canned peaches	45	
Bread w.w.	21	
Butter	6	
Jelly	2	
Cooky	12	
Vitamin preparations*		
Squibbs Haliver Oil	1	t.
1 B_1 tablet		

Thiamine: 486 mcg.

Calories: 956

Score

1. Milk	5	
2. Butter	10	
3. L.g.y. veg.	5	
4. Other veg.	5	
5. Citrus	10	
6. Other fruit	5	
7. Meat etc.	10	
8. Eggs	5	
9. Whole grains	10	
10. Vitamin D	10	
	75%	

J.H. No. 5, March 5, 1945

Breakfast		
Orange juice	50	gms.
Milk	185	
Cereal, wheatsworth	60	
Toast & milk	40	
Egg, poached	20	
Lunch Home		
Baked potato	58	gms.
Butter	4	
Sausage patty	28	
Cauliflower	6	
Milk	200	
Pie, apple	14	
Dinner		
Milk	85	gms.
Tomato soup (cream)	50	
Roll, white	22	
Butter	2	
Green beans	4	
Spam meat	10	
Between meals		
Candy	8	gms.
Cracker, soda,	4	
peanut butter	½	
jam	1	
Vitamin preparations*		
Squibbs Haliver Oil	1	t.
1 B_1 tablet		

Thiamine: 587 mcg.

Calories: 936

Score

1. Milk	15	
2. Butter	5	
3. L.g.y. veg.	5	
4. Other veg.	5	
5. Citrus	10	
6. Other fruit	0	
7. Meat etc.	5	
8. Eggs	5	
9. Whole grains	10	
10. Vitamin D	10	
	70%	

* Not included in analysis

J.H. No. 6, March 13, 1945

Breakfast		
Orange juice	70	gms.
Milk	200	
Cereal, Wheatsworth & Farina	80	
Egg, medium boiled	23	
Toast w.w.	12	
Butter	2	
Lunch School		
Roast Loin of Pork lean	14	gms.
Mashed potatoes	35	
Buttered spinach	27	
Butter 1 gm.		
Carrot sticks	2	
Milk	161	
Prune whip	36	
Mid-morning School		
Tomato juice	94	
Supper		
Milk	200	gms.
Rice, white	10	
cheese sauce	4	
Fresh tomatoes	2	
Celery	18	
Between meals		
Crackers, graham	10	
Vitamin Preparations*		
Squibbs Haliver Oil	1	t.
1 B_1 tablet		

Thiamine: 492 mcg.

Calories: 815

Score

1. Milk	15	
2. Butter	5	
3. L.g.y. veg.	10	
4. Other veg.	5	
5. Citrus	10	
6. Other fruits	0	
7. Meat etc.	5	
8. Eggs	5	
9. Whole grains	10	
10. Vitamin D	10	
	75%	

J.H. No. 7, March 15, 1945

Breakfast		
Orange juice	70	gms.
Oatmeal	70	
Milk	200	
Hot cakes	40	
Sirup	15	
Lunch School		
Beef & Kidney Stew (potato, carrot, peas)	60	gms.
Raw cauliflower buds	6	
Toast w.w.	10	
Butter	1	
Fruit cup (apricots (orange, banana, apple)	48	
Milk	182	
Mid-morning School		
Tomato Juice	98	gms.
Dinner		
Milk	150	gms.
Sandwich, white	22	
Salmon loaf	45	
Bacon	5	
Spinach, fresh	25	
Ice Cream	33	
Vitamin preparations*		
Squibbs Haliver Oil	1	t.
1 B_1 tablet		

Thiamine: 526 mcg.

Calories: 1174

Score	
1. Milk	15
2. Butter	5
3. L.g.y. veg.	10
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	0
9. Whole grains	5
10. Vitamin D	10
	75%

* Not included in analysis

B.H. I. No. 1, Feb. 3, 1945

Breakfast milk	1/2 c.
Shredded wheat	1/2 bisc.
Toast strip w.w. & butter	1/2" strip
Canned prune plumes	1/4 c.
Grapefruit juice, canned	1/2 c.
Lunch School	
Milk	190 gms.
Buttered beets	30
Stew: potatoes, carrots, peas, beef, br. gravy	66
Buttered toast	1 strip
Celery	2 x 1"
Fruit jello (whipped cream) peach, banana	135 gms.
Between meals School	
Orange & grapefruit j.	3/4 c.
Chocolate milk	1/2 c.
Dinner	
Milk, skim	1 c.
Macaroni, tomato sauce hamburger	1/4 c.
Fried potatoes	1/4 c.
Sauerkraut	1 T
Biscuit w.w.	1/2
Butter	1 t.
Apple roll, white bread & applesauce	1/2 c.
Between meals	
Yeast tablets* (0.06 mg. of thiamine per tablet)	
Super D C.L.O.*	1 t.
Raisins	

Thiamine: 497 meg.

Calories: 1261

Score:

1. Milk	15
2. Butter	10
3. L.g.y. veg.	5
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	0
9. Whole grains	5
10. Vitamin D	10
	75%

*Not included in analysis

B.H. I. No. 2, Feb. 5

Breakfast	
Baked apple	1
French toast	1/2 slice
Syrup	1 t.
Milk, skim	1/2 c.
Juice, grapefruit	1/4 c.
Lunch School	
Meat loaf, beef	32 gms.
Buttered carrots	30
Potatoes (boiled with skins)	36
Toast w.w. &butter	1 strip
Cauliflower	1 bud
Jello, fruit	44 gms.
Milk	136
Between meals, School	
Orange juice	2/3 c.
Milk	2/3 c.
Graham cracker	1
Dinner	
Potato, boiled	1/2 c.
Meat, pork roast	3 T
Gravy	3 T
Applesauce	1 T
Gingerbread	2"x3"x1"
Whipped cream	1 T
Milk, skim	1/2 c.
Between meals Home	
Raisins	1 T
Yeast tablets*	5 tab.
Lemon drop	1
Super D C.L.O.*	1 t.

Thiamine: 586 meg.

Calories: 1391

Score:

1. Milk	20
2. Butter	5
3. L.g.y. veg.	5
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	0
9. Whole grains	5
10. Vitamin D	10
	75%

B.H. I. No. 3, Feb. 7

Breakfast

Tomato juice	4 ozs.
Bread w.w. & butter	1/2 slice
Apple sauce	1/3 c.
Milk, skim	1/2 c.

Lunch School

Milk	160 gms.
Liver (with gravy)	56
Potato, baked	84
Peas, frozen	48
Carrots	2 strip
Ice Cream	8 gms.
Cake	18

Between meals School

1/2 Grapefruit juice	1/2 c.
Milk	1/3 c.
Graham crackers	2

Dinner

Potato, baked & skin	1/4 c.
Peas	1 T
Carrots	1 T
Ham, boiled (2"x1"x1/8")	1 slice
Lettuce	small piece
Beef, roast	1 T
Gravy, brown	2 T
Gingerbread	1 1/2"x2"x1"
Whipped cream	1 T
Peach	1 T
Milk, skim	3/4 c.

Between meals Home

Cod liver oil*	1 t.
Yeast tablets*	5

Thiamine: 714 mcg.

Calories: 1093

Score

1. Milk	15
2. Butter	5
3. L.g.y. veg.	10
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	0
9. Whole grains	5
10. Vitamin D	10
	75%

B.H. I. No. 4, Feb. 9

Breakfast

Egg Souffle	1/3 c.
Toast w.w. & but.	1/4 slice
Prune plums	2 T
Grapefruit juice	1/2 c.

Lunch School

Milk	158 gms.
Salmon loaf	52
Mashed potatoes	46
Broccoli	4
Celery	1 stick
Toast w.w. & but	1 stick
Tapioca, whipped cream	26 gms.

Between meals School

Tomato juice	1/2 c.
Milk	1/2 c.
Graham cracker	1

Dinner

Applesauce	2 T
Milk, skim	1/2 c.

Between meals Home

Cod liver oil*	1 t.
Yeast tablets*	5

Thiamine: 294 mcg.

Calories: 772

Score

1. Milk	10
2. Butter	5
3. L.g.y. veg.	5
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	5
9. Whole grains	5
10. Vitamin D	10
	65%

B.H. I. No. 5, Feb. 11

Breakfast	
Egg, fried	1/2
Bacon	1"x2"
Cinnamon roll w.w.	1
Milk, skim	1/2 c.
Pineapple juice	1/4 c.
Dinner Home	
Beef roast	1/4 c.
Tomato sauce	1 T
Beans, string	1/3 c.
Bread, white en. & butter	1/2 slice
Milk, skim	1/4 c.
Lunch	
Applesauce	3/4 c.
Milk, skim	1/2 c.
Cookie, w.w.	1
Bread & butter	1/4 slice
Cheese spread	1/2 T
Between meals	
Apple, peeled	1
Cookie, w.w.	2
Yeast tablets*	5
Cod Liver Oil*	1 t.

Thiamine: 402 mcg.

Calories: 1003

Score

1.	Milk	5
2.	Butter	5
3.	L.g.y. veg.	10
4.	Other veg.	0
5.	Citrus	0
6.	Other fruits	5
7.	Meat etc.	10
8.	Eggs	5
9.	Whole grains	10
10.	Vitamin D	10
		60%

B.H. I. No. 6, Feb. 13

Breakfast	
Applesauce	2 T
White bread en.	1 bite
Milk, skim	1/2 c.
Lunch School	
Milk	210 gms.
Egg souffle	30
Tomatoes & bread	21
Raw apple	33
Toast & butter	3 strips
Spinach	11 gms.
Prunes	110
Between meals School	
Orange juice	1/3 c.
Milk	1/2 c.
Arrow root cracker	1
Dinner	
Potato, baked	1/2 med.
Beets	1 T
Macaroni, meat, tomato	2 T
Bread, white en.	1/2 slice
Butter	1/2 t.
Milk, skim	1/2 c.
Jello (fruit juice)	1/3 c.
Whipped cream	1 T
Peach	1/2
Between meals Home	
Cod liver oil*	1 t.
Brewer's Yeast*	6

Thiamine: 391 mcg.

Calories: 884

Score:

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	5
8.	Eggs	5
9.	Whole grains	5
10.	Vitamin D	10
		70%

D.H. I. No. 7, Feb. 15

Breakfast		
Lemon, pear & grapefruit juice	109	gms.
Egg, fried	23	
Bacon	3	
Milk, skim	126	
Bread w.w.	16	
Butter	3	
Jam	4	
Applesauce	47	
Lunch Home		
Milk	132	gms.
Beans, navy	46	
Meat, beef roast	50	
Corn bread	56	
Butter	4	
Corn syrup	2	
Dinner		
Milk, skim	132	gms.
Pea soup	146	
Salt crackers	21	
Macaroni & tomato	32	
Apple Dumpling	52	
Applesauce	70	
Between meals		
Apple	24	gms.
Stuffed date	1/2	
Yeast tablets*	5	
Raisins	1	T
Cod liver oil*	1	t.

Thiamine: 543 mcg.

Calories: 1493

Score		
1. Milk	10	
2. Butter	5	
3. L.g.y. veg.	0	
4. Other veg.	5	
5. Citrus	10	
6. Other fruits	5	
7. Meat etc.	10	
8. Eggs	5	
9. Whole grains	5	
10. Vitamin D	10	
	65%	

B.H. II. No. 1, March 3

Breakfast

Milk, skim	133 gms.
Cereal, cream of wheat with germ added	58 gms.
Top milk	28
Toast w.w.	10
Butter	2
Jam	4
Applesauce	92

Lunch Home

Milk, skim	120 gms.
Cod fish	94
Potatoes, fried	22
Gravy, milk	38
Bread w.w.	24
Butter	4
Applesauce	116
Sugar cookie	11

Dinner

Milk, skim	222 gms.
Cherries	126
Apple, pear, cream salad	24
Cauliflower	1
Macaroni & cheese	33
Pork & beef stew	20
Roll, w.w.	20
Cinnamon roll	30
Butter	3

Between meals

Apple, no peeling	76 gms.
Candy, 1 lemon drop 1 caramel	
Cod liver oil*	1 t.
Squibbs, yeast* tabs.	6

Thiamine: 456 mcg.

Calories: 1452

Score:

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	0
4.	Other veg.	5
5.	Citrus	0
6.	Other fruits	5
7.	Meat etc.	10
8.	Eggs	0
9.	Whole grains	10
10.	Vitamin D	10
		60%

B.H. II. No. 2, March 4

Breakfast

Milk, skim	118 gms.
Tomato juice	120
Egg, fried	23
Bacon	9
Cinnamon roll	56

Lunch Home

Salad, orange, apple & banana	28 gms.
Milk, skim	252
Beef roast	21
Peas, buttered	24
Potatoes, mashed	50
Gravy, brown	24
Bread, w.w.	21
Butter	2
Jam	4
Jello (apricot juice)	61
Banana	12
Chocolate Cake	21

Dinner

Salad, orange etc.	30 gms.
Milk, skim	130
Pears	114
Bread w.w.	28
Butter	4
Jam	12
Cookie, sugar	2
Tomatoes & crackers	20
Cottage cheese	20

Between meals

Apple	66
Graham cracker	11
Cod liver oil	1 t.

Thiamine: 545 mcg.

Calories: 1443

Score:

1.	Milk	15
2.	Butter	5
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruits	5
7.	Meat etc.	10
8.	Eggs	5
9.	Whole grains	10
10.	Vitamin D	10
		80%

B.H. II. No. 3, March 5

Breakfast

Milk, skim	121	gms.
Prune plums	155	
Oatmeal cereal	52	
Top milk	31	
Cinnamon roll	52	

Lunch School

Tomato, scalloped	30	
Macaroni & cheese	26	
Spinach	26	
Sandwich (raw carrot) butter	1/2	sandwich
Milk	130	
Gingerbread	26	
Whipped cream	16	

Mid-morning School

Orange juice	1/3	c.
Milk	1/3	c.

Dinner

Milk, skim	260	gms.
Bread w.w.	21	
Butter	5	
Jam	6	
Rice, white	43	
Gravy, brown	14	
Beef boil	24	
Jello, apricot juice	63	
Banana	44	
Cake	30	

Between meals Home

Cod liver oil*	1	t.
Yeast tablets*	6	

Thiamine: 467 mcg.

Calories: 1451

Score:

1. Milk	15
2. Butter	5
3. L.g.y. veg.	5
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	5
8. Eggs	0
9. Whole grains	10
10. Vitamin D	10
	70%

B.H. II. No. 4, March 6

Breakfast

Milk, skim	69	gms.
Toast w.w.	13	
Butter	2	
Jam	2	
Tomato juice	119	

Lunch School

Milk	200	gms.
Beef roast	26	
Potatoes, boiled	28	
Carrots	16	
Cauliflower bud	12	
Toast w.w.	6	
Milk sherbet	58	
Cake	50	

Between meals School

Tomato juice	1/2	c.
Graham cracker	1	
Milk	1/2	c.

Dinner

Milk, skim	118	gms.
Pear	22	
Lettuce	1	
Bread w.w.	17	
Butter	2	
Jam	2	
Potatoes, mashed	45	
Pork & brown gravy	40	
Creamed peas	30	
Apple dumpling, biscuit	70	

Between meals Home

Cod liver oil*	1	t.
Yeast tablets*	6	

Thiamine: 519 mcg.

Calories: 1322

Score:

1. Milk	15
2. Butter	5
3. L.g.y. veg.	10
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	0
9. Whole grains	5
10. Vitamin D	10
	75%

B.H. II. No. 5, March 7

Breakfast		
Grapefruit juice	110	gms.
Milk, skim	135	
Bread w.w.	16	
Butter	2	
Jam	10	
Corn meal & wheat germ cereal	50	
Cream, top	24	
Applesauce	68	
Lunch School		
Beef & tomato sauce	56	gms.
Potatoes, baked	84	
Peas	32	
Apples	30	
Toast & butter	6	
Milk	150	
Custard	10	
Between meals School		
Tomato juice	1/2	c.
Chocolate milk	1/2	c.
Dinner		
Milk, skim	240	gms.
Bread w.w.	18	
Butter	2	
Potato, boiled	75	
Gravy, brown	25	
Beets	35	
Beef steak	48	
Apple dumpling	40	
Lettuce	1	
Between meals Home		
Cod liver oil*	1	t.
Yeast tablets*	5	

Thiamine: 771 mcg.

Calories: 1406

Score:

1. Milk	15	
2. Butter	5	
3. L.g.y. veg.	10	
4. Other veg.	5	
5. Citrus	10	
6. Other fruits	5	
7. Meat etc.	10	
8. Eggs	0	
9. Whole grains	10	
10. Vitamin D	10	75%

B.H. II. No. 6, March 8

Breakfast		
Tomato juice (thin)	120	gms.
Milk, skim	133	
Egg, fried	4	
Bacon	24	
Lunch School		
Milk	150	gms.
Toast w.w. & butter	8	
Turnip stick	2	
Stew, carrot, peas, beef	66	
Potatoes, parsley	52	
String beans	42	
Apricots	118	
Between meals School		
Grapefruit juice	1/2	c.
Milk	1/2	c.
Dinner		
Milk, skim	138	gms.
Celery	14	
Beef steak	26	
Carrots	4	
Rice patties (brown)	34	
Bread w.w.	22	
Butter	9	
Gravy, brown	6	
Bananas	28	
Cookie, sugar	10	
Between meals Home		
Cod liver oil*	1	t.
Yeast tablets*	10	

Thiamine: 559 mcg.

Calories: 1108

Score:

1. Milk	15
2. Butter	5
3. L.g.y. veg.	10
4. Other veg.	5
5. Citrus	10
6. Other fruits	5
7. Meat etc.	10
8. Eggs	5
9. Whole grains	5
10. Vitamin D	10
	80%

B.H. II, No. 7, March 9

Breakfast		
Milk, skim	133	gms.
Prunes	191	
Pancake, w.w.	26	
Butter	4	
Syrup	6	
Lunch School		
Milk	148	gms.
Tuna fish-applesauce loaf	30	
Brown rice	24	
Broccoli	16	
Orange wedges	1	sec.
Toast w.w.	6	
Floating island	6	
Between meals School		
Tomato juice	1/3	c.
Milk	1/2	c.
Graham cracker	1	
Dinner		
Milk, skim	124	
Potatoes, mashed	106	
Gravy	36	
Hash, beef	54	
Bread w.w.	20	
Butter	4	
Jam	6	
Applesauce	38	
Pears	56	
Bananas	36	
Between meals Home		
Cod liver oil*	1	t.
Yeast tablets*	5	

Thiamine: 354 mcg.

Calories: 1268

Score:

1.	Milk	15
2.	Butter	10
3.	L.g.y. veg.	5
4.	Other veg.	5
5.	Citrus	10
6.	Other fruit	5
7.	Meat etc.	10
8.	Eggs	0
9.	Whole grains	5
10.	Vitamin D	10
		75%