

DIETARY-MEDICAL-PSYCHOLOGICAL IMPLICATIONS  
OF KETOGENIC DIET

by 6721

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**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH DIAGRAMS  
THAT ARE CROOKED  
COMPARED TO THE  
REST OF THE  
INFORMATION ON  
THE PAGE.**

**THIS IS AS  
RECEIVED FROM  
CUSTOMER.**

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## INTRODUCTION

Epilepsy is a symptom complex, characterized by recurrent paroxymal aberrations of brain functions, usually brief and self limiting. This symptom manifests itself as petit mal and/or grand mal seizures. Petit mal is defined as a transient loss of consciousness without conspicuous convulsions (1). However, a myoclonic seizure, which is a form of petit mal, consists of sudden involuntary contractions of muscle of the limb, trunk, or head or neck without apparent loss of consciousness. The attack may develop into grand mal seizures (2). In the broad sense, grand mal is an attack which is convulsive. The present treatments for control of epilepsy are drug and dietary therapy. Anticonvulsive medication is the most widespread method of treatment of convulsive disorders, and from many viewpoints it is the most satisfactory method. The number of new drugs has increased rapidly and several major categories are barbiturates, hydantoins, oxazolidinediones, succinimides, and miscellaneous drugs including phenacemide, primidone, and acetazolamide (3).

The Ketogenic diet can control both grand mal and petit mal disorders. This diet management is most often used to control children with epilepsy throughout their adolescent years (3).

The Ketogenic diet has proved its value in the treatment of idiopathic epilepsy with certain limitations. Limitations present themselves with respect to the physician's justification of use of the diet when compared to drug therapy, to the dietitian's ability to implement the diet, and to the parents' and childrens' cooperation in adhering to the regimen.

The methods of implementation of the Ketogenic diet among dietitians are different (4-8). The techniques for calculating the Ketogenic diet differ in respect to the principle behind this calculation. The rationale of the dietitian's standards for nutritional requirements is not explicit if it is based on requirements of a normal child or of the child while on the Ketogenic diet. Additional research has been conducted by physicians and dietitians to achieve a more palatable and more liberalized diet (9,10).

The cooperation of parent and child is a factor necessary to maintenance on this regimen (2). This aspect has been presented by physicians and dietitians treating these patients. The contrast of the Ketogenic diet to a normal diet of a child is a change in his mode of eating and alters the kinds and amounts of food normally eaten. The parent is responsible for the accuracy of the diet which is served at home to the child. Each meal is calculated in terms of gram nutrient portions and foods are weighed in gram portions. The effect of diet and its relationship to social aspects of family living is a second factor involved in the management of the regimen. Integration of the diet into the patient's environment for home and school is the desired effect.

Researchers to date have not been able to demonstrate or agree on how or why the patient is benefited by the Ketogenic diet. Water balance, acid base, ketone level, and negative sodium balance are proposed theories of mechanism by which the diet assists in the control of seizures. The diet was first

developed in 1920 (11). The majority of this research was in the following 20 years (12-14). Currently, there has been an increase of interest and research, because the diet has shown its effectiveness when drug therapy has not been satisfactory.

However, these existing ramifications of the Ketogenic diet inhibit the greater use of this diet therapy. This study will attempt to offer a method which presents the diet in perspective, minimizing these limiting ramifications. The use of a drug in the acetazolamide family, Diamox, as a synergistic effect in order to liberalize the diet will be considered. The incorporation of foods previously limited in quantity to unlimited amounts, and the regrouping on a broader scale of foods for meal planning, will be offered. The elucidation of information concerning the use of food as a reward, its role in a specific family, and its restricting effects on family social interactions will be discussed. This paper proposes that with a liberalized Ketogenic diet, the social-psychological aspect will be easier to overcome and the use of this therapy will be more acceptable by parent and child, and by physician and dietitian.

## REVIEW OF LITERATURE

### Evolution of Ketogenic Diet

The Ketogenic diet evolved by observations made in connection with the reduced number of attacks occurring in fasting patients. Wilder, in 1921, recognizing the therapeutic impracticability of prolonged starvation, inaugurated a dietetic method of producing ketones (11). Peterman (15), and Hemlholz

(16) in earlier works, studied their patients for as long as a decade on this treatment, both observing favorable results.

The dietetic method of producing ketone bodies (betaoxy-butyric acid, acetoacetic acid, and acetone) from imperfect combustion of fat yielded the desired effect. This effect was produced by an insufficient amount of carbohydrate (1).

Since 1940, the Food and Nutrition Board has developed formulations of daily nutrient intakes which were judged to be adequate for maintenance of good nutrition in population of the United States. The allowances are designed to afford a margin of sufficiency above average physiological requirements to cover variations among essentially all individuals in the general population. They provide a buffer against the increased needs during common stresses and permit full realization of growth and productive potential, but they are not to be considered adequate to meet additional requirements of persons depleted by disease or traumatic stresses. The margin of sufficiency above normal physiological requirements is different in body storage capacity, in the range of individual requirements, and in the possible hazard of excessive intake of certain nutrients. The recommended dietary allowances therefore provide guidelines for evaluation and development of diets for people in the United States (17). The selected nutrient requirements of the Recommended Daily Dietary Allowances, revised in 1968 for children from six months through age fourteen, can be found in Table 1.

Table 1. Recommended daily dietary allowances.

Grouping	Age	Weight	Kcal	Protein	Vita- min A	Ascor- bic acid	Nia- cin	Ribo- flavin	Thia- min	Cal- cium	Iron
	yr	kg		g	IU	mg	mg. equiv.	mg	mg	g	mg
Infants	1/2-1	9	Kgx100	Kgx1.8	1,500	35	8	0.6	0.5	0.6	15
Children	1-2	12	1,100	25	2,000	40	8	0.6	0.6	0.7	15
	2-3	14	1,250	25	2,000	40	8	0.7	0.6	0.8	15
	3-4	16	1,400	30	2,500	40	9	0.8	0.7	0.8	10
	4-6	19	1,600	30	2,500	40	11	0.9	0.8	0.8	10
	6-8	23	2,000	35	3,500	40	13	1.1	1.0	0.9	10
	8-10	28	2,200	40	3,500	40	15	1.2	1.1	1.0	10
Males	10-12	35	2,500	45	4,500	40	17	1.3	1.3	1.2	10
	12-14	43	2,700	50	5,000	45	18	1.4	1.4	1.4	18
Females	10-12	35	2,500	50	4,500	40	15	1.3	1.1	1.2	18
	12-14	44	2,300	50	5,000	45	15	1.4	1.2	1.3	18

(17) Recommended Dietary Allowances, ed. 7, NAS-NRC Publication 1694, Washington, D. C., 1968.

Calcium is administered according to age as a supplement; this is due to both lack of dietary calcium which can be supplied by the food eaten together with evidence that the output of this mineral exceeds intake while on the Ketogenic diet (18). An iron supplement is needed due to the small amount which the diet can provide. Vitamin requirements are not met by the Ketogenic diet and a supplement with a noncarbohydrate coating should be prescribed. Caloric needs of a child with epilepsy are the same for a healthy average child, and yet will produce a Ketogenic with normal growth and development. This can be achieved by 55 calories per kilogram for children under 12 and a 3 to 1 ratio of Ketogenic material to antiketogenic material calculated according to Woodyatt's formula. The initial regimen gradually reduces the carbohydrate and increases the ketones over a four-day period (4).

The diet procedure of Iowa Medical Center, and also the Mayo Clinic, is planned on a gradual increase over a four-day period to a 3 to 1 ratio of Ketogenic to antiketogenic foods. However, a child of 20 kilograms will receive 2 grams protein and 65 calories per kilogram (5). As given in the text of Proudfit and Robinson, the child is gradually placed on a Ketogenic diet, 55 calories per kilogram of weight, 3 to 1 ratio. However, the protein requirement is increased to 1 to 2 grams per kilogram (6). Mike at Babies Hospital, New York, New York, places the patients on a starvation regimen for approximately 24 to 72 hours in order to reach a 4 to 1 ratio. The calories per kilogram are decreased from 100 to 55 calories for patients

between 2 and 10 years. The protein requirement per kilogram is 1.5 grams for the younger child and 1 gram for the older child (7). Turner ascribed to a Ketogenic to antiketogenic material ratio of approximately 2 to 1, when giving a 1,800-calorie diet. The distribution is carbohydrate 30 grams, protein 75 grams, and fat 160 grams (8). Neither the weight nor age of the patient is given.

### Therapeutic Use

Role of Ketogenic diet in epilepsy. Does this diet have a place in present-day management of a child with seizures? Patients who demonstrate hypersensitivity reactions or other side effects which have necessitated the withdrawal of drugs, or the seizures have become refractory to medications, the patients have a positive effect with the treatment of a Ketogenic diet. Rudis and Millichap concluded that despite the introduction of newer medications the diet has a definite place in therapy (19).

Relationship of Ketogenic diet to epilepsy mechanism. Currently, the majority of the investigations into the mechanism of the Ketogenic diet is being conducted by Millichap, et al., at Children's Memorial Hospital, Chicago (20-24). These studies indicated that the control of seizures is closely correlated with a negative balance of sodium and potassium. The Ketogenic diet had no appreciable effect on the levels of sodium and potassium in the serum. Therefore its anticonvulsive effect might possibly be explained by a reduction of the concentration

of these electrolytes in the tissues. The effects of the diet on the systemic electrolyte balance of patients with petit mal were almost identical to those of acetazolamide, and similar alterations in the distribution of extracellular and intracellular sodium and potassium in the brain might be expected (20). In animals, it could not be shown that the degree of ketosis and the degree of anticonvulsant effect of the diet could be related (21). This is not in agreement with studies by McQuarrie and Keith (12), who showed a direct relationship between a degree of ketosis, high enough to prevent attacks. In a later work, McQuarrie and Keith (13) expressed the opinion that the abnormality in acid-base balance observed in certain cases of epilepsy is probably not the factor of chief importance in the mechanism of seizures, but an incidental accompaniment of a more basic disturbance in the physiology of the nerve cell. This was confirmed by Millichap (24). The mechanism of the diet appears unrelated to diuresis (20). However, in an earlier study by McQuarrie (14), it was reported that when diuresis follows the seizure this favors the prevention of further seizures temporarily. Procedures, such as fasting, the use of Ketogenic diet and stringent restriction of water with nonketogenic, borderline diets, lead to partial dehydration of tissues and prevention of seizures.

The Ketogenic diet represents the same principle as Diamox and has been reported as more effective than the drug (25). The effects of acetazolamide on the cellular electrolyte composition and acid-base status in brains of rats were researched



by Koch and Woodbury (26). This drug decreased intracellular sodium concentration consequent to a reduction of the rate of influx of this ion. Diamox has been shown by Lombroso, et al. (27, 28), to have beneficial effects which were not clearly correlated with either the dosage of the drug or the level of carbonic anhydrase activity in the blood, suggesting that the drug may act directly on the metabolism of cerebral neurones. It was seen to benefit patients with myoclonic and akinetic seizures on a short-term basis. Its effectiveness is decreased under prolonged treatment.

#### Considerations in Feeding the Child

A child's eating pattern usually consists of three meals and two snacks. A third snack for an older child might be included in the evening. A typical day's meal pattern could be: at breakfast fruit, usually citrus; cereal; egg; and milk. The snack at school is milk, which is followed by a lunch of soup, sandwich, raw vegetable, milk, and fruit. After school, a child might have a baked goods or potato chip type snack with soda. The dinner meal would be a meat, starchy vegetable, green or yellow vegetable, and milk (29). Meat, milk, and bread ranked next to fruits in popularity. Only 37 per cent liked vegetables (30). Sweets have a place in a child's daily diet, either during a meal or at the end. Sweets are accepted as part of a normal meal and a child naturally loves candy and sweet things (31). The use of sweets as a reward and the withholding of them as a punishment is common in many households. The top

rewards are desserts and candy, equating food with love (32).

The eating habits and a child's orientation to food must be reformed. The Ketogenic diet is based on a regulated and weighed three-meal pattern with the possibility of a minimal caloric snack for the epileptic child. Milk which is present as an integral part of meals and snacks is now eliminated. The incorporation of breads, cereals, potatoes, rice, noodles, etc., into a normal child's diet is now absent. Desserts as cakes, cookies, pies, ice cream, and candy are now prohibited (4, 5-8).

#### Considerations When Administering the Ketogenic Diet

The Ketogenic diet cannot be undertaken lightly because the difficulty of its administration calls for a high degree of cooperation by the patient and parent as well as the intelligent effort by the parent (33). There are practical problems of keeping the child on the diet for a great length of time (33). Consideration must be given on the effect of the restrictive diet and its effect on the epileptic child.

The human organism is remarkably plastic in its adaptability and is extremely dependent on social interaction for its specifically human qualities. From birth onward it needs a close interrelationship with protective and responsive adults in order to gain the type of maturity of personality for which we all strive. All personality is both genetically and environmentally influenced (34).

Most epileptics are normal in intellect and personality; there is no specific epileptic character, nor are there any physical stigmata of epilepsy. Defects of personality or intellect are due to one or more of the following: (a) structural brain disease, (b) uncontrolled seizures, (c) anticonvulsant drugs, (d) psychological reaction to familial and social isolation and rejection (35).

The average healthy child develops an increasing independence of thought and action during the preschool and school years. The epileptic child is a victim of his environment, because of well-meaning parents and friends who are frequently overprotective (36). A restrictive diet adds to the issue of dependence between the child and his parents and along with his epilepsy makes him unlike his peers. However, when a child is placed on the Ketogenic diet in a medical center much time and effort are spent in helping the child and his family to understand the problem better. This might be an unknown factor in the "control" of these patients (19).

Adolescence presents an additional difficult period of adjustment for many children (36). For the normally developing adolescent, acceptance by the social group in which he lives becomes a very dominant and personal drive. When he is deprived of this acceptance and has not found some measure of success in his group he often withdraws himself (34). Because of restrictions placed on many epileptics in earlier years, they are apt to see themselves set apart and feel shame about their affliction. Many express the feeling that they live in an

atmosphere of repeated "don'ts" (36).

### Considerations in the Medical Management of a Child While on the Ketogenic Diet

There are medical considerations of weight, hunger, ketosis, and medication level which if checked can be overcome easily. Most children lose weight during the first few days that they are on the diet, then over several days or weeks the weight remains constant. If the initial loss continues and the child is constantly hungry, the number of calories should be increased, on condition that the caloric intake is not great enough to eliminate the ketosis or to reduce it to an ineffective level. During the induction of ketosis, a problem is nausea with or without vomiting. This complication appears on about the third day or during the first week and it frequently will cause the child to vomit one or more meals. However, vomiting can be effectively controlled by giving the patient one-half to one ounce of orange juice. No change is made in administration of drug until the effect of ketosis is observed. If treatment is beneficial, it is then possible to reduce the amount of anti-convulsant drug gradually. If the drugs have had a depressing effect, this in itself has been helpful, and the child behaves more normally (3).

## METHODS AND PROCEDURES

### Sample

Thirteen patients of the neurological service of Children's Hospital Medical Center, Boston, Massachusetts were used as subjects. The patients were refractory to various combinations of medications and dosage levels and were not effectively controlled from their seizure disorder. The ages ranged from six months to 14 years. Male and female patients were represented, seven and six, respectively. The children lived at home and had at least one parent present in the household. The length of time on dietary control varied with response to diet and medication. Cases will be identified by initial.

### Method of Securing Data

On the neurological division, the physicians referred the hospitalized patient to the researcher. This was 48 hours in advance of commencement of the diet. At the time of referral, the physician consulted with the researcher regarding the seizure status of the patient, medical and social background of family and patient, and the physician's opinion of the patient's medical prognosis. The medical chart was made available. During this interim, the parents were contacted and briefly introduced to the diet in order to elicit information regarding food allergies, food habits, food likes and dislikes, and chewing or swallowing problems which might exist. The information was then compiled on a fact sheet designed by the researcher (see

Appendix) from which the dietitian could formulate the specific diet for the child. The researcher explained to the child that he was on a diet, it was to help him, and his cooperation was needed so that he would benefit from the diet. As an established format the weight of the child was taken upon admission and this weight in kilograms was used for the basis of nutritional requirements. A review with the nursing staff of the Ketogenic regimen was discussed by the researcher before the patient commenced the diet. The child was then put on a fasting period for 32 hours from 12 midnight to 8 a.m. the following morning. The nursing staff tested the ketone level of the patient and, if positive, breakfast was given to the child. The child was instructed to try to eat all the food offered; however, he was told that if he felt nauseous he was not required to finish. The significant rule was that he did not eat anything that was not given to him.

The length of time for the hospitalization was dependent upon the patient's medical and psychological response to the Ketogenic diet and the parent's ability to implement the diet at home. A questionnaire designed by the researcher was completed with the parent to ascertain a perspective of this response of the child and ability of the parent (Appendix). This questionnaire interview was the second phase of instruction. While the researcher was presenting the questions, the parent answered and this generated feedback from them which led into a further explanation of the Ketogenic diet. At the third interview, the researcher explained gram portions, the use of the

scale, and kinds of foods eaten on the diet. The parents were then asked to purchase a gram scale and become familiar with the food stores which carried the needed food products. If necessary, this gave the parent time to make arrangements for the ordering of a particular item. The researcher visited the patient during meal service to adjust or exchange a food if necessary and to gain a rapport with the patient. The parents usually visited during the supper meal. This gave opportunity for them to see serving sizes, and to become acquainted with the varieties of meals which could be offered.

The instruction for the parent was conducted at their pace including the dietary and behavioral management aspects. The nursing staff taught the parent how to test the urine for ketones and the explanation of prescribed anticonvulsants. The parents were given a phone number of the researcher so they might call if a problem arose. They were instructed to phone the physician weekly for the coming four weeks in order to keep him posted as to the medical status of the child. The researcher followed the patient at their scheduled appointments with the physician. At that time the Ketogenic regimen was evaluated and the patient's mode of treatment concurred upon between the physician and dietitian.

A fact sheet was designed to collect information of the patient: diagnosis, age, weight and height, medication, activities, hours of sleep, caretaking responsibilities, financial matters, and medical-dietary concerns. This data was used to calculate a Ketogenic diet with a period of 32 hours of fasting.

Prior to fasting the following tests were instituted: electroencephalogram (E.E.G.), psychological studies by a psychologist, the completion of a questionnaire designed to gain insight into food and social habits of the patient; biochemical values of sodium and potassium in urine and serum; sugar in urine; and ketones in urine were obtained. The diet commenced with medication; calcium and iron, multi-vitamins for age as a supplement; and medications in such a form that did not contain available carbohydrate. Daily weights of the patient were taken while in the hospital. The weight of the patient was taken before breakfast with the hospital "johnny" or the patient's pajamas on him. The weight was then based on the weight-age curves designed by Reed, R. B., and Stuwart, H. G.; Pediatrics 24:904-1959. There are two sheets--one for boys and the other for girls--from 1 to 18. The infant's weight was based on tables designed from newborn through 27 months.

Daily tests for ketones in the urine were performed in the hospital; diacetic acid was measured. To test for diacetic acid a test of one teaspoon of ferric chloride, 10 per cent watery solution, and a teaspoon of freshly voided urine is mixed in a six-inch test tube. In a few minutes, a clear wine-red color appears if diacetic acid is present.

Other tests might be indicated for the diagnostic evaluation of a patient and included in the hospital work-up. If a test was not conducted during the present admission, the work-up prior to admission was utilized.



## Principle and Considerations of the Ketogenic Diet

The Ketogenic diet, as compared to a normal diet, is proportionally high in fat, low in carbohydrate foods, and meets the requirements of protein and calories for weight. The biochemical effect in the body to this regimen is utilized to control petit and grand mal seizure disorder in epileptic children.

The epileptic child, as the normal, uses carbohydrate foods for energy expenditure when available. However, when carbohydrates are insufficient in the diet, the body uses fats. The imperfect combustion of fat produces ketone bodies (beta-oxybutyric acid, aceto-acetic acid, and acetone), giving reason for the title of this dietetic method. The proportion of grams of fat to the combination of grams of protein and carbohydrate are expressed in ratio form. A ratio of 3:1 has been seen to elicit a desirable effect and is used unless otherwise noted. A palatable diet can be planned from this ratio, whereas a 4:1 ratio would be extremely limiting, reducing the grams of carbohydrate to one-half that of the 3:1 ratio.

Caloric needs of a child can be achieved by giving 55 calories per kilogram body weight which produces a Ketogenic status, yet is sufficient for normal growth and development. The amount of protein is restricted to the amount physiologically necessary (approximately 1 gram protein per kilogram) and to maintain an antiketogenic factor. The technique for calculating the Ketogenic diet is found in the following pages. Vitamin requirements of niacin and riboflavin are not met and the other vitamins

can be supplied if the diet is carefully planned. Iron and calcium are below recommended daily requirements. Table 5, showing a sample day's intake compared to the needed requirements, can be seen in the Appendix. A supplement should be given and the most convenient and practical is a prenatal vitamin with added minerals. A capsule, as Dicaldimin with vitamin C by Abbott, is effective and the concern for a sugar coating is alleviated. Sugar-coated or flavored medications will affect the ketone level. One of the most common medications used is cough syrup which contains carbohydrates. This can be checked with a pharmacist who can suggest a form which is usually used for diabetic patients. (Cetrocirose manufactured by Ives Labs is a nonprescription drug which can be used as a cough medication.)

The formation of a large amount of ketones is beneficial in catalyzing the action of the Ketogenic diet. This can be accomplished by fasting the patient from 12 midnight until 32 hours later at breakfast. Diet Kool-Aid, as a beverage or frozen into popsicles, and artificially sweetened tea can be offered during this fasting period. The diet can commence at breakfast if the child is ketotic; testing the urine for diacetic acid will demonstrate this effect.

A weight loss of 4 to 5 pounds can be expected the first week of the diet and then the child's weight should be maintained. This weight loss is caused by initial dehydration until the body accommodates to the new regimen. If a weight loss continues, the caloric intake should be increased. This may take

place when the child increases his activity due to better seizure control.

A significant side effect to the Ketogenic diet which occurs approximately seven to ten days after the diet has been instituted is a toxic reaction to anticonvulsive medication, especially to Dialantin, Zaronton, and Mysoline. A close observance must be kept and at this point the physician will decrease dosage of these drugs. This side effect is beneficial and one which is desired. It has a dual purpose, lowering dosage level of a drug in the body and lessening the side effects of that particular medication. The latter is demonstrated by an increased alertness in the child.

The cooperation of parent and child with constant support of the physician is not only of extreme value, but is necessary for the success of this dietary therapy. This needs to be emphasized and explained to the parent. This is a difficult management problem and the dietitian and physician can be called on for aid as needed.

#### Important Considerations for Planning the Ketogenic Diet

The important considerations for planning the Ketogenic diet are necessary to adapt the basic principle of this regimen into a working therapy individualized to meet the specific needs of the child. Age, weight, medication, activities, and medical-dietary concerns are factors which influence the planning.

The chronological and mental age are mentioned for a

twofold reason--to adjust caloric intake to parallel growth and development needs, and to introduce and to teach the diet, appreciating the child's comprehension, respectively.

Weight, if observed as normal, needs no adjustments; however, if over or under, it does. An overweight child can be placed on a 2:1 ratio of Ketogenic to antiketogenic material, with a decrease in calories. This will induce ketones while the child is losing weight and once the desired weight is achieved, the diet must be recalculated to a 3:1 and 55 calories per kilogram. When a patient is underweight, 60 calories per kilogram may be used; however, this is an uncommon occurrence.

Medication may be taken between meals. For a child with swallowing problems, the tablet may need to be crushed and added in powdered form to food. A minimum amount of water-packed applesauce can be planned into the meal patterns for this purpose and saved to be mixed with the medication between meals.

### Process for Calculating Nutritional Requirements

Established factors required to commence calculations are weight, calories/kilogram, and ratio.

STEP 1. Multiply weight by calories/kilogram

$$\begin{array}{r}
 40 \text{ kilograms weight} \\
 \times 55 \text{ calories/kilogram} \\
 \hline
 200 \\
 200 \\
 \hline
 2200 \text{ calories/day.}
 \end{array}$$

STEP 2. Calculate ratio-denominator and ratio-unit

- A. 3:1 ratio represents 3 (FAT):1 (PROTEIN + CARBOHYDRATE)  
 3:1 ratio represents 3 (9 calories):1 (4 calories)  
 3:1 ratio-denominator represents total 31 calories of energy.
- B. Divide total calories/day by ratio-denominator to determine ratio-unit.

$$\begin{array}{r} 70.96 \text{ ratio-unit} \\ 31 \overline{) 2200.000} \\ \underline{217} \phantom{000} \\ 300 \phantom{00} \\ \underline{279} \phantom{00} \\ 210 \phantom{00} \\ \underline{186} \phantom{00} \end{array}$$

STEP 3. Multiply ratio-unit by appropriate ratio for FAT

$$\begin{array}{r} 70.96 \text{ ratio-unit} \\ \times \quad 3 \text{ ratio} \\ \hline 212.88 \text{ grams FAT/day.} \end{array}$$

STEP 4. Multiply weight by PROTEIN requirement 1 gram/kilogram

$$\begin{array}{r} 40 \text{ kilograms} \\ \times 1 \text{ gram/kilogram} \\ \hline 40 \text{ grams PROTEIN/day.} \end{array}$$

STEP 5. Subtract grams PROTEIN from ratio-unit

$$\begin{array}{r} 70.96 \text{ ratio-unit} \\ - 40.00 \text{ grams PROTEIN} \\ \hline 30.96 \text{ grams CARBOHYDRATE/day} \end{array}$$

NOTE: 3:1 ratio represents FAT:PROTEIN + CARBOHYDRATE  
 3:1 ratio represents 212.88 grams (FAT):40 grams (PROTEIN) + 30.96 grams (CARBOHYDRATE)  
 3:1 ratio represents 1915.92 calories:160 calories + 123.84 calories  
 3:1 denominator represents total 2199.76 calories of energy.

STEP 6. Divide total grams FAT per day by 3

$$\begin{array}{r} 70.96 \text{ grams of FAT per meal} \\ 3 \overline{)212.88} \end{array}$$

STEP 7. Divide total grams PROTEIN per day by 3 for amount per meal

$$\begin{array}{r} 13.33 \text{ grams of PROTEIN per meal} \\ 3 \overline{)40.000} \\ \underline{3} \phantom{000} \\ 10 \phantom{00} \\ \underline{9} \phantom{00} \\ 1 \phantom{00} \end{array}$$

STEP 8. Divide total grams CARBOHYDRATE per day by 3

$$\begin{array}{r} 10.32 \text{ grams of CARBOHYDRATE per meal} \\ 3 \overline{)30.96} \end{array}$$

STEP 9. Calculate MEAL PATTERNS from grams per meal as in Steps 6-8

70.96 grams FAT  
13.33 grams PROTEIN  
10.32 grams CARBOHYDRATE.

Modified from Mike (7).

#### General Instructions for the Ketogenic Diet

- I. Foods are classified in food groups; only these foods listed are to be given.
- II. Food groups are arranged into a MEAL-PATTERN to meet the required nutritional values and to provide a balanced meal.
- III. There are nine MEAL-PATTERNS which are all equal in nutritional value for one meal. A choice of three is needed to provide one day's intake. The frequency of use of a particular MEAL-PATTERN is not detrimental and may be used

as much as three times per day. However, the repeated use of a specific pattern may not lend to a happy variety.

- IV. An eating schedule should be planned to have meal times approximately the same each day.
- V. Each MEAL-PATTERN is eaten as one complete meal and no part may be saved or used as a snack or used in addition to another MEAL-PATTERN.
- VI. All specified gram portions of food are to be weighed, using a scale which records weight in grams.
- VII. It is necessary to eat all food which are allowed in exact amounts as specified.
- VIII. An excess above the specified gram portion is as harmful as eating a food which is not permitted in the Ketogenic diet.

#### Standard Meal Patterns

<u>PATTERN</u>	<u>AMOUNT</u> g	<u>FOOD</u>
1.	_____	Egg
	_____	Cream, 40 per cent
	_____	Bacon, crisp
	_____	Fruit, 10 per cent
	_____	Fat
2.	_____	Meat
	_____	Vegetable, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
3.	_____	Meat
	_____	Vegetables, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
	_____	Cream, 40 per cent

<u>PATTERN</u>	<u>AMOUNT</u> g	<u>FOOD</u>
4.	_____	Bacon, crisp
	_____	Vegetables, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
5.	_____	Cheese, creamed cottage
	_____	Vegetable, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
6.	_____	Egg
	_____	Vegetable, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
7.	_____	Cheese, cheddar
	_____	Vegetable, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat
8.	_____	Puffed wheat
	_____	Cream, 40 per cent
	_____	Fruit, 10 per cent
9.	_____	Frankfurter, 100 per cent Beef
	_____	Vegetable, 6 per cent
	_____	Fruit, 10 per cent
	_____	Fat

## Calculations for Meal Patterns

PATTERN 1

<u>AMOUNT</u> g	<u>FOOD</u> Total/ meal	<u>PROTEIN</u> (13.33 g)	<u>FAT</u> (70.96 g)	<u>CHO</u> (10.32 g)
One	Egg	6.00	6.00	---
100	Cream, 40%	2.00	40.00	3.00
18	Bacon, crisp	4.50	9.90	0.18
73	Fruit, 10%	0.73	---	7.30
15	Fat	---	15.00	---
		<u>13.23 g</u>	<u>70.90 g</u>	<u>10.48 g</u>



PATTERN 2

<u>AMOUNT</u>	<u>FOOD</u>	<u>PROTEIN</u>	<u>FAT</u>	<u>CHO</u>
g	Total/meal	(13.33 g)	(70.96 g)	(10.32 g)
52	Meat	11.96	8.84	---
50	Vegetable, 6%	0.50	---	3.00
73	Fruit, 10%	0.73	---	7.30
62	Fat	---	62.00	---
		13.19 g	70.84 g	10.30 g

The following PATTERNS are based on gram portions of PATTERN 2.

PATTERN 3

<u>AMOUNT</u>	<u>FOOD</u>	
g		Based upon the use of tool 3 (Appendix)
52	Meat	For each 2 g CREAM, 40% wanted,
30	Vegetable, 6%	<u>OMIT</u> 1 g FAT and 1 g VEGETABLE 6%
73	Fruit, 10%	40 g CREAM, 40% wanted, <u>OMIT</u> 20 g
42	Fat	FAT and 20 g VEGETABLE, 6%
40	Cream, 40%	

PATTERN 4

<u>AMOUNT</u>	<u>FOOD</u>	
g		Based upon the use of tool 2
52	Bacon, crisp	50:50 - 52:x as x is to 52
50	Vegetable, 6%	---
73	Fruit, 10%	---
41	Fat	50:20 - 52:x      x = 20.80 <u>OMIT</u> 21 g

PATTERN 5

<u>AMOUNT</u>	<u>FOOD</u>	
g		Based upon the use of tool 2
94	Cheese, creamed cottage	50:90 - 52:x      x = 93 - 60
3	Vegetable, 6%	2:1 = 94:x      x = 47
73	Fruit, 10%	---
67	Fat	90:5 = 94:x      x = 5.2

NOTE: The amount in gram portion for vegetable, 6%, is a slight 3 g in this case. It might be helpful to exchange this for fruit, 10%, as it is shown in Tool 3.  $5:8 = x:3$      $x = 1.99$   
 $x = 2$  g Fruit, 10%. It would now read:

PATTERN 5AMOUNT      FOOD

g

93 Cheese, creamed cottage  
 None Vegetable, 6%  
 75 Fruit, 10%  
 67 Fat

PATTERN 6AMOUNT      FOOD

g

Based upon the use of Tool 2

2 whole Eggs  
 50 Vegetable, 6%  
 73 Fruit, 10%  
 57 Fat

$$50:2 = 52:x \quad x = 2$$

Omit 5 g

PATTERN 7AMOUNT      FOOD

g

Based upon the use of Tool 2

52 Cheese, cheddar  
 50 Vegetable, 6%  
 73 Fruit, 10%  
 52 Fat

$$50:50 = 52:x \quad x = 52$$

----

----

$$50:10 = 52:x \quad x = 10.40 \quad x = 10$$

PATTERN 8AMOUNT      FOODPROTEINFATCHO

g

(13.33 g)

(70.96 g)

(10.32 g)

12 Puffed wheat  
 175 Cream, 40%  
 35 Fruit, 10%

1.80

0.18

9.36

3.50

70.00

5.25

0.35---3.50

5.65 g

70.18 g

18.11 g

NOTE: The combined total of PROTEIN and CARBOHYDRATE foods are equal as if the PROTEIN:CARBOHYDRATE foods were calculated for the amounts per meal.

PATTERN 9

<u>AMOUNT</u>	<u>FOOD</u>	<u>PROTEIN</u>	<u>FAT</u>	<u>CHO</u>
g		(13.33 g)	(70.96 g)	(10.32 g)
100	Frankfurter	12.00	27.00	2.00
50	Vegetable, 6%	0.50	---	3.00
55	Fruit, 10%	0.55	---	5.50
44	Fat	---	<u>44.00</u>	---
		13.05 g	71.00 g	10.50 g

## Ketogenic Blended Mixture

The Ketogenic blended mixture can be used when the child's neurological problems cause difficulty in chewing or swallowing. Also, it can be used for an infant, especially below the age of five months when meats are not incorporated into his diet. The blended mixture includes three ingredients: lipomul, casec powder, and water-packed pureed fruit. This mixture can be prepared for the total daily use and divided into three equal portions for each meal. Water may be added in desired amounts to adjust the consistency suitable for the child's specific needs. The child's weight is 40 kilograms. The same process for calculating table foods is used.

212.88 grams FAT per day  
 40.00 grams PROTEIN per day  
 30.96 grams CARBOHYDRATE per day are needed.

lipomul - 15 cc = 1 tablespoon  $\approx$  10 grams FAT  
 casec - 4.7 grams - 1 tablespoon  $\approx$  4 grams PROTEIN  
 w/p fruit, 5% - 5 grams CHO; 1 gram PROTEIN

lipomul - 15 cc - 10 grams Fat = x - 212.88 grams FAT  
 x = 319.32 x = 319 cc

w/p Peaches - 100 grams - 5 grams CHO = x grams: 30.96 grams CHO  
 x = 319.32 grams

$$\begin{array}{rcl} 100 \text{ grams} & - & 1 \text{ gram PROTEIN} = 619 \text{ grams} - x \text{ gram} \\ \text{PROTEIN} & & x = 6.19 \end{array}$$

$$\begin{array}{rcl} \text{casec} & - & 4.7 \text{ grams} - 4 \text{ grams PROTEIN} = x : (40 - 6.19 - 33.81) \\ & & x = 39.72 \end{array}$$

Total amount needed per day

lipomul - 319 cc or 21 tablespoons  
w/p peaches - 619 grams - pureed  
casec - 39.72 grams = 8 1/2 tablespoons - (8.49)

Prepare this mixture and divide into three equal portions to be given three times daily as a meal.

## RESULTS AND DISCUSSION

Age is a relative term and may denote mental age or chronological age in years. In this study the patients will be discussed in order of their chronological age, with comment upon mental age. The patients' ages range from 8 months to 13 years. The age, weight, and chief complaint of the respective patients upon admission are given in Table 2.

The first two infants, D. B. and C. Van. M., were below one year of age. Upon admission, both patients were in status epilepsy and after evaluation in reference to mode of treatment, they were placed on the Ketogenic diet by the physician.

The second and third patients were both four years old. However, their mental ages differed greatly; G. F. was retarded and F. B. was of normal intelligence. The patient G. F. was a boy who was below the mean in weight, and the patient F. B. was a girl who was on the mean for weight. Chewing, swallowing, and muscular weakness were part of G. F.'s total seizure disorder. Ataxia was noted with the akinetic disorder of F. B.,

who otherwise appeared as a healthy child.

Petit mal and grand mal seizures, speech, ataxia, foggy state, and a psychologically troubled child was the picture presented by the fifth patient, S. C., a seven-year-old boy. His intelligence was believed to be high normal before his seizure disorder. He was in a status condition and his medication dosage for control needed to be higher; however, the drug side effects would be detrimental.

The two 9-year-old girls, N. C. and M. G., were similar in respect to their diagnosis of myoclonic seizures. N. C. was below her chronological age in intelligence and was in a special class for retarded children. M. G. was in the same kind of class; however, she was higher on the intelligence quotient in the dull normal range. The extent to which her intelligence quotient would improve upon better seizure control and lower medication dosage was considered upon evaluation of this girl. Also, the factors of a hearing problem and psychological problem of tuning out what M. G. did not want to hear were evaluated during this admission.

The eighth patient was a 10-year-old girl, K. K., with uncontrolled seizures. She entered the hospital with a plan for the institution of the Ketogenic diet. The patient was mentally retarded and it was a difficult problem to place her in school because of the inability to control her seizures.

The ninth and tenth patients were J. C., a girl, and R. M., a boy, both eleven years of age. The diagnosis of J. C. was one of focal seizures which were sensitive to direct light.

She wore sunglasses even indoors to help control her seizure disorder. She was mentally retarded. R. M. was not retarded, although his ability level was not high. He had periods of remission when his seizures were not fully controlled by medication and periods when he was relatively stable in his control.

Two twelve-year-old patients, K. W. and D. Mc. G., were the eleventh and twelfth children to be introduced. They were a girl and a boy, respectively.

Psychomotor seizure disorder was the impression given for the girl and akinetic seizure disorder for the boy; both attended a normal public school and were of average intelligence. The patient's seizure disorder was creating a psychological problem for her. She was advised to be under guidance so that she could talk out these problems.

The thirteenth patient was a thirteen-year-old boy, G. C. His diagnosis was generalized seizure disorder and psychological problems which were handicapping the control of this disorder. He was admitted to evaluate the course of his treatment. The effectiveness of the Ketogenic diet and his acceptance of this regimen was a determining factor in the long plan course.

The thirteen patients were presented to the researcher and from these highlighted aspects concerning their respected condition, a diet was planned.

The formulation of the Ketogenic diet was based on a 3 to 1 ratio of grams of fat to the combination of grams of protein and carbohydrate. The calorie per kilogram was planned at

Table 2. Age, weight, and chief complaint upon admission to Children's Hospital Medical Center, Boston, Mass.

Patient	Age	Weight	Chief Complaint
		kg	
1. D. B.	8 months	8.8	Uncontrolled seizures
2. C.Van.M.	9 months	7.1	Uncontrolled seizures
3. G. F.	4 years	14.0	Generalized seizure disorder
4. F. B.	4 years	17.2	Akinetic seizure disorder
5. S. C.	7 years	25.2	Petit mal and grand mal seizures
6. N. C.	9 years	25.1	Myoclonic seizures
7. M. G.	9 years	32.5	Psychomotor and myoclonic seizures
8. K. K.	10 years	51.2	Uncontrolled seizures
9. J. C.	11 years	41.0	Focal seizures
10. R. M.	11 years	35.5	Akinetic seizure disorder
11. K. W.	12 years	39.0	Psychomotor seizures
12. D.Mc.G.	12 years	35.8	Akinetic seizure disorder
13. G. C.	13 years	50.0	Generalized seizure disorder

55 calories per kilogram. However, the diet was adjusted to meet individual needs. Table 3 presents each patient in chronological age, his respective total caloric intake for the day, calories per kilogram, the breakdown of nutrients in grams of protein, fat, and carbohydrate per day.

The first two patients were infants and unable to eat solid table foods. The Ketogenic blended mixture was used. It consists of casec, water-packed pureed fruit, and lipomul as described in the section on Methods and Procedures. The consistency varied because of their respective swallowing reflexes. This was done by adding water after the weighing of the ingredients. D. B. needed no alteration in the basic formulation, while C. Van. M. did. First this patient was underweight, and second the patient was given a liquid form of Zarontin which contained available carbohydrate source. It is important to be familiar with the medications prescribed for the patient while he is on the Ketogenic diet. The liquid form of Zarontin has the advantage of being able to be given in small dosage and varying amounts, which the capsule form cannot offer. The disadvantage in this form is that there is a large amount of available carbohydrate used for flavoring. The flavoring in syrups taken by the patient for nonseizure disorders must also be considered. Part of the carbohydrate level allowed per day on the regimen for this patient was in the liquid Zarontin. Patient D. B. was too young to respond behaviorally to the institution of the diet except for control seizure-wise. His mother did not visit often and she treated the diet as another management



problem for her; her response was passive. Patient C. Van. M. was only on the diet for part of the hospital stay; she too was too young to react. Her parents did not visit during this hospital stay and the researcher was not able to meet them.

The third patient was G. F., who was underweight, so a higher caloric allotment was given. Upon beginning the diet, the patient was unable to swallow or chew. The Ketogenic blended mixture was first designed to meet this patient's needs. His neurological condition improved to the point that he could chew and swallow. A diet with solid table foods was then calculated within the same caloric intake. The mother could not cope with her child's illness and was looking for a miracle as a cure. She expected her child to improve, including his below average mental quotient, on the Ketogenic diet. The patient accepted the diet with no demonstrative behavioral response.

The fourth patient, F. B., was of normal weight and activity for age, and the standard formulation was used. After seven months on this regimen, an additional 250 caloric allotment was given due to normal growth and development. Her mother was highly motivated and responsive to suggestions. The mother's capable attitude was complementary in helping the grandmother learn the diet. The grandmother was responsible for lunch; however, the mother planned and weighed the noon meal. The patient, F. B., was quite stubborn at first and did not want to eat all the foods offered. After a short period of time, however, her seizures were controlled and her attitude paralleled this improvement. She seemed to enjoy feeling better and by

time for discharge from the hospital F. B. was cooperative and a delight. Intermittently, at home, there would be periods of refusal of a food high in fat, but this would soon pass.

The fifth patient was S. C., who at first appeared to need a 4:1 ratio after the 3:1 did not seem to have any effect from the diet. The researcher speculated that the more severe the seizure disorder, the longer it takes to see any appreciable results from the initiation of the diet. It required a degree of patience, because the day the diet was changed, the patient began to improve. It is the opinion of the author that the ratio was not the cause of the improvement. The activity level of the patient was low due to the severity of his seizures. With expectation that this level would improve, if the diet was effective, more than the standard 55 calories were given. The mother was very upset during this admission and even though she had a college education, she required constant review during the instruction. The patient was under psychiatric help and part of his problem was that of mirroring his mother's attitude. Therefore this initial stage was most trying. However, as the patient's medical status improved, the mother's cooperation grew, as well as the patient's. As was F. B., this boy was amenable, once he realized his seizures were under control. Several months later, his diet was changed to a 3:1 ratio to make it more palatable. When the patient was able to go to school, his activity increased and a snack was included to meet his increased appetite.

The sixth patient, N. C., was under the mean in weight; therefore more calories per kilogram were calculated. The mother was overwhelmed at first and the father was of little support to the mother at this time. It was fortunate that the mother's sister was a nurse and capable of filling this supportive role. The patient was docile, yet stubborn, when it came to eating foods high in fat. The house officers who wrote the medical orders did not believe in the use of the diet. They were only complying with the decision of the neurologist. Their visible disbelief in the diet caused an uncooperative state and the family received no support from them. This led the researcher to believe the support by the physician to be of necessitive value. The psychiatrist, who treated the neurological patients, stressed the point by adding that "constant" support is required for cooperation from parent and patient. This patient needed much attention by the researcher until she had accepted the premise that she was on a Ketogenic diet. After that it was easier, with only intermittent periods of refusal to eat high fat foods. After a year, the calories per kilogram were again increased to meet increased activity level.

The seventh patient was M. G., a girl who was of normal weight and activity for her age. The standard formulation was used when calculating her diet. The mother was overwhelmed at first; however, the father's attitude was excellent. This helped the mother and she, too, was calmer. Although the patient was docile, she was very stubborn when she had to eat food high in fat. Sometimes she was uncooperative; however,

her parents were quite good about handling the situation.

The eighth patient was a girl, K. K., who was obese. The researcher calculated a reduced caloric level for her and planned a 2:1 ratio for her diet. The researcher speculated that with a reduced caloric level, she would produce ketones. This, in fact, did work out. A few months after commencing the diet, the patient lost twenty pounds and the diet was recalculated. It was then calculated for 55 calories per kilogram and a 3:1 ratio. Due to an increase in activity, a snack was included. The caloric breakdown was 2/7, 2/7, 1/7, and 2/7 for breakfast, lunch, snack, and dinner, respectively, whereas the normal breakdown is 1/3, 1/3, 1/3, and no snack. The patient's mother was excellent in coping with the situation and her effort to achieve success in the management of the diet was high. The father played a lesser role. The patient was resistant at first. However, when she felt better, she was cooperative. As did other patients, D. D. acted out her dislike for high fat foods and then it would pass.

The ninth patient was a girl, J. C., who was slightly overweight, plus her activity level was low. Less than 55 calories per kilogram was planned. The mother was overwhelmed and the father gave no support, and yet an older sibling was quite receptive in learning the diet. The older daughter helped the mother a great deal in this respect. The patient was stubborn regarding the diet as she was toward another mode of her seizure control. She was instructed to wear sunglasses because her seizure disorder was sensitive to light. However, the patient had to be

frequently reminded to wear them, often refusing.

The tenth patient was a boy, R. M., who was small for his age. A very slight increase in calories was given him. The parents were highly skeptical as to the worth of this regimen. They brought the child to the hospital, went on vacation, and came back for his discharge. They only conceded to this management because it was the neurologist's order. After several months, the mother wrote how hungry the patient was and she thought there was a weight loss. An increase in calories was calculated into the daily intake. The parents' cooperation did not improve and the child remained passive.

The eleventh patient was a girl, K. W., who was normal in weight and in activity. Therefore a diet was calculated from the standard formulation. The mother was very anxious and the father was calm yet supportive. The patient focused entirely on her illness and had no hobbies or outside activities. Even though excellent control was obtained and she did not have to focus on her seizures, she now focused on her diet.

The twelfth patient was a boy, D. Mc. G., who was normal in weight and activity; therefore a standard formulation was used to calculate his diet. His mother was very anxious regarding his diet. The patient reacted passively since it was something he had to do.

The last patient was a boy, G. C., who was within normal weight and activity; hence a standard formulation was utilized in the calculation of his diet. His parents were of very little support in respect to his illness and the diet. Also, his

Table 3. Diet formulation and comments regarding the patients.

Patient	Kcal	Kcal per kg	Ratio	Pro- tein	Fat	Carbo- hydrate	Comments
1. D.B.	484	55	3:1	9	46.8	6.6	1. Patient on Ketogenic blended mixture due to age.
2. C.Van.M.	497	70	3:1	8	48.1	8.0	1. Patient was underweight. 2. Liquid zaronitin contains CHO and this had to be included. 3. Patient on Ketogenic blended mixture due to age.
3. G.F.	1241	88.5	3:1	18.5	120.5	20.7	1. Ketogenic blended mixture first. Due to improvement, changed to a diet including table foods. 2. Below mean in weight; increased the calorie per kilo ratio.
4. F.B. (a)	1000	55	3:1	18	96	15	1. Patient normal weight and normal activity.
(b)	1250	62.5	3:1	19	120	22.5	2. Patient gained weight in 8 months and activity had increased.
5. S.C. (a)	1600	64	4:1	27	213.2	15	1. It first appeared patient required 4:1 ratio. 2. Added calories were given due to an expected gain in activity.

Table 3 (Cont'd.).

Patient	Kcal	Kcal per kg	Ratio	Pro- tein	Fat	Carbo- hydrate	Comments
				g	g	g	
(b)	1603	64	3:1	26.9	155.7	25	3. Ratio changed for more palatable diet. 4. Snack added for increased activity of 6 g Pro, 31 g Fat, 4.4 g CHO.
6. N.C. (a)	1506	60	3:1	27	125.8	21.6	1. Patient is below mean weight; increased to 60 cal/kilo.
(b)	1650	66.6	3:1	30	159	24	2. Patient increased activity; calories per kilo increased the next year.
7. M.G.	1787.5	55	3:1	32.5	172.98	25.16	1. Patient normal weight and normal activity.
8. K.K. (a)	1600	31.4	2:1	50	145.4	22.7	1. Decreased calories due to obesity. 2. Changed ratio due to decreased calories. 3. Maintained high protein level.
(b)	2250	55	3:1	42	217.8	30.6	1. Weight loss of 9.2 kilograms in 3 months. 2. Readjusted cal/kilo and ratio. 3. Continued weight loss of 4.1 kilo for next 1 1/2 months

Table 3 (Cont'd.).

Patient	Kcal	Kcal per kg	Ratio	Pro- tein	Fat	Carbo- hydrate	Comments
				g	g	g	
9. J.C.	2000	48	3:1	42	193.5	22.5	4. due to increased activity and then leveled off. Increased activity caused a readjustment of nutrient breakdown to a 2/7, 2/7, 1/7, 2/7 with the 1/7 as a snack. Normally the breakdown is 1/3, 1/3, 1/3.
10. R.M. (a)	2000	56	3:1	36	193.5	28.5	1. Reduced calories due to overweight and low activity level.
(b)	2300	66	3:1	42	222.6	33	1. Patient small for age. 2. Mother requested increased calories because patient was constantly hungry and had 4 pounds weight loss in 5 weeks.
11. K.W.	2145	55	3:1	31.2	207.3	37.89	1. Patient normal weight and normal activity.
12. D.Mc.G.	1914	55	3:1	36	185	27.7	1. No chewing, swallowing, or allergy problems. 2. No increase in calories needed due to normal activity level.



Table 3 (Concl'd.).

Patient	Kcal	Kcal per kg	Ratio	Pro- tein	Fat	Carbo- hydrate	Comments
13. G.C.	2750	55	3:1	54 g	264 g	33 g	1. Patient within normal weight range and normal activity level.

siblings offered no encouragement. The unfortunate factor was that this boy needed a triple share of support, he was extremely insecure. He enjoyed a home tutor, rather than attending school and he did not want to help himself. When he realized he was seizure free because of the diet, he began to cheat and eat foods high in carbohydrates.

The duration on the Ketogenic diet and the improvement noted by E.E.G., physician, and researcher are presented in Table 4. The patients are kept in chronological order.

The first patient, D. B., was on the diet for two months with an E.E.G. improvement, fewer seizures, alertness, and neurological improvements. However, the diet was discontinued because of the family-home situation. The mother was a young unwed woman who lived with approximately ten other persons in a small apartment. The child improved dramatically during hospitalization, yet at home did not. It is thought that the mother could not handle the diet at home within an unstructured environment.

The second child, C. Van. M., was on the diet for one week with no improvement noted. The researcher could not get the diet regulated with the administration of Zarontin in a liquid form. The patient's dosage of medication changed daily and at the end of a week, it was found that the diet was impractical.

The third patient, G. F., improved by having fewer seizures, improved neurological tone, chewing and swallowing, and medication reduction. However, after five months the diet was discontinued. The mother did not constantly maintain the diet. She expected a miracle and was upset when the diet did not

achieve this state. Her intermittent use of the diet pending her whim was not an effective control.

The fourth patient was F. B., who had an improved E.E.G. reading, marked decrease in number and severity of seizures, alertness, speech, memory, social interaction, neurological responses, and a lowered medication dosage. The patient's improvement was high and she attended a regular nursery school. She had excellent control except when she strayed from the diet. Her mother would call periodically and the researcher was confident of the high level of care the mother gave to this mode of therapy. It was unfortunate that the mother did not feel she had a good rapport with the dietitian who took over while the researcher was on leave of absence. The mother changed to another hospital because of this. The patient is still being followed on the diet and is doing well, according to reports from the other medical staff.

The fifth patient, S. C., has improved with a clearer E.E.G., marked decrease in number and severity of seizures, alertness, speech, memory, social interaction, neurological responses, and a reduced medication dosage. The patient's speech has improved from a slurring of one- to three-word expressions to conversational paragraphs. He is in a special class for the slow learner. He is now able to read, to write, and to learn mathematics. He has been going to day camp since the control of his seizures. The day camps are not special for the handicapped child and the only way in which he is different is that he brings his lunch. This past year he has joined Cub

Scouts and he is an active member. He is still meeting with a psychiatrist and when his emotional periods are high, S. C. wavers slightly from the diet. His seizure activity at this time increases. However, the total effect of the Ketogenic diet on S. C. is a vast improvement and he is still following the regimen.

The sixth patient, N. C., has an improved E.E.G. reading, marked decrease in number and severity of seizures, alertness, speech, memory, social interaction, neurological responses, and reduced medication dosage. She has enjoyed being able to learn to swim and ride a bike. Her school class level has improved from a trainable retarded class to an educable class. She has made friends and been accepted by other peers who do not have epilepsy. She still gets upset and when her father was in the hospital, she needed a small dosage of tranquilizers to offset seizure activity. Some of her seizure activity was set off by emotional upsets. At the time of discharge, the medical officer, who was not in accord with the diet, did check with the researcher for the nutritional supplementation necessary. The patient was sent home without a calcium supplement. The researcher was away for a year and during this time the patient developed an unsteady hand, dizziness which was not demonstrable on an E.E.G. reading. Upon return, the researcher contacted the mother, realized that the patient was taking calcium, and prescribed it in combination with a vitamin and iron capsule. This point is of utmost importance; the doctor and dietitian must work together as a team so that the patient receives total medical

treatment. The patient is still on the diet and doing well.

The seventh patient was M. G., who is still on the diet. She had improved E.E.G. reading, marked decrease in number and severity of seizures, alertness, speech, memory, social interactions, neurological responses, and lowered medication dosage.

The audiologist noted a month after the diet began that her speech discrimination scores were reduced bilaterally. He questioned whether this might be related to her improved neurological status. She is still on the diet; the first few months she cooperated very well and then she became difficult. The patient refused to eat foods high in fat and her seizure control became unsteady. The researcher tried her on MCT oil which is now being researched at Yale New Haven Hospital, New Haven, Connecticut. The research is in the initial stage and an established method of using MCT in the Ketogenic diet has not been evaluated. However, the patient refused the MCT oil in her diet. The MCT oil might liberalize a diet when a patient will accept it. At the time the researcher left, Diamox was to be given together with an increase in grams of protein and carbohydrate. As yet, the physician has not contacted the researcher and it is assumed the adjustment is going smoothly.

The eighth patient was K. K., who had an improved E.E.G. reading, marked decrease in number and severity of seizures, alertness, memory, social interaction, neurological responses, and a lowering of medication. The patient was on the diet for 13 months and then was taken off upon recommendation from both physician and researcher. Family problems became overwhelming

and what started out as an ideal management environment, did not continue to work out in this manner. It began as a family project of meal planning, recipe writing, food preparation, and due to varying family crises this did not continue. At one point when the diet was not strict causing seizure control to be less effective, the dosage of Diamox was increased. This had a beneficial effect for several months and then began to lose its effect. When the diet was discontinued, the patient was of the age for secondary sexual development and this hormonal change could have altered the effect the diet had upon her. The researcher speculates this as a second factor for the lessening of seizure control. It is an example of excellent cooperation and understanding from the attending neurologist.

The ninth patient was J. C., who improved with having fewer seizures, alertness, social interaction, improved neurological responses, medication dosage level was lowered. This patient had seizures which were sensitive to light and her response to the diet was not significant enough to justify its continuance.

The tenth patient was R. M., who improved with fewer seizures, alertness, and a reduced medication level. His parents could not accept the fact that the diet might help and if it did, they wanted total improvement. They would not continue the diet since total improvement was not achieved during the four-month trial. The researcher believed that a greater response to the diet from the child would have come if the parents had not resigned themselves to the fact that their son was status quo. The child would have been more inclined to react positively

to the idea of adhering to the regimen if his parents had.

The eleventh patient was K. W., whose hospitalization was one of complete seizure control. However, at home she improved by having fewer seizures, alertness, improved neurological responses, and a reduced medication dosage. She had met with a psychologist before hospital admission. The patient's entire life as she viewed it, was convulsive disorder. At that time she was not ready for therapy. However, after hospitalization she was amenable to discuss her problem. She felt better, less frightened herself and of what others thought about her. She now felt different because of the diet. School was a problem now because she had to bring lunch. The patient became too upset focusing on the diet, so that it was discontinued after two months.

The twelfth patient was D. Mc. G., who improved with fewer seizures and alertness. His response from the diet was going smoothly until he developed drug toxicity from Dialantin. The drug was not reduced and the diet caused the elevation of the drug in the patient's serum. This elevation could cause seizure activity if not enough medication was prescribed. The parents became very upset and believed the diet caused these seizures. They would not continue the diet.

The last patient was G. C., who had an improved E.E.G. reading, marked decrease in number and severity of seizures, alertness, speech, neurological responses, and a reduced medication level. This boy did not want to get better and when he realized the diet was improving his seizure control, he cheated.

Table 4. Duration on ketogenic diet and improvement noted.

Patient	Duration on Diet	Improvement Noted by E.E.G., Physician and Researcher
1. D. B.	2 months	1, 2, 4, 8.
2. C. Van. M.	1 week	12
3. G. F.	5 months	2, 8, 9 <sup>a</sup> , 10, 11
4. F. B.	24 months to date	1, 3, 4, 5, 6, 7, 8, 10, 13
5. S. C.	36 months to date	1, 3, 4, 5, 6, 7, 8, 10
6. N. C.	24 months to date	1, 3, 4, 5, 6, 7, 8, 10
7. M. G.	5 months	1, 3, 4, 5, 6, 7, 8, 10
8. K. K.	13 months	1, 3, 4, 5, 6, 7, 8, 10
9. J. C.	4 months	2, 4, 7, 8, 10, 11
10. R. M.	4 months	2, 4, 10, 11
11. K. W.	2 months	2, 4, 8, 10, 11
12. D. Mc. G.	3 weeks	2, 4, 11
13. G. C.	1 month	1, 3, 4, 5, 8, 10

1. E.E.G. Clearing
2. Fewer seizures
3. Marked decrease in number and severity of seizure
4. Alertness
5. Speech
6. Memory
7. Social interaction
8. Neurological responses
9. Chewing and swallowing reflexes
10. Medication reduced
11. No E.E.G. during this period
12. None observed.

<sup>a</sup>. Only patient having difficulty.



His parents were nonsupportive and the patient's psychological problems overshadowed any attempts by others to help him. He then was sent to a school in Virginia which is geared for epileptic patients with emotional disorders. He stayed until he hitchhiked back home to Massachusetts. His parents were passive to this act. Presently, he is "searching" for help and he has come back to the outpatient clinic.

### Elements Essential for Effective Utilization of the Ketogenic Diet

The cooperation from the medical team is necessary. The dietitian and physician must work together, each understanding the other's role and informing the other, of their respective plans. The patient and his parent need the physician's constant support and they need to feel the physician believes in this mode of treatment. The nursing staff is instrumental in the management of the diet while the patient is hospitalized. If they understand the diet, they can supplement the work of the dietitian. Also the nurse is effective, because she is with the patient constantly and can communicate to the dietitian a present problem or one that might arise.

The parents and their ability to manage the diet is of utmost importance. The difficulties of administering the diet need to be pointed out in the beginning. However, the parent needs to understand if he cannot manage the diet, he has not failed as a parent. The diet becomes a mode of treatment for which they are responsible and it is more difficult than giving

medication. The parents must be willing to try. The feeling of being overwhelmed is a normal reaction but one which does not continue. The psychological adjustments which take place after the commencement of the diet should be pointed out so that the parents can handle their child. The patient's behavioral change which has been observed is from a very docile, dependent child to one who now acts out his feelings. His feelings can be somewhat stubborn, assertive, and independent. The psychiatrist has noted that this was the same pattern of response seen in drug-controlled therapy. The parent who has resigned himself to have a child with seizures finds it difficult to adjust to the fact the child is controlled and now has different needs. The child who has lived in a world of restrictions, because of protective parents, accepts the fact he cannot have certain foods. He does not complain about this; however, he does complain about what he has to eat. The patient becomes stubborn when he must eat foods high in fats. The parents need to explain these foods will help him and when the child accepts this, his cooperation improves. Parents are often very proud that their child will refuse candy and sweets; however, they need to go one step further. They need to help the child accept the diet as part of their new routine. The parent's ability to be creative is important, especially on birthdays and holidays. The parent's ability to incorporate the child in activities of food preparation and meal planning is valuable. If the parent can prepare food which all siblings can share for a snack, as Diet Kool-Aid pops, the child will not feel left out. The

child's acceptance of new foods is important in the management of this diet. It is suggested that a scrapbook containing "new foods tried" be made by the child to help in this respect.

It is the responsibility of the dietitian to help the parent and child accept this regimen, to give them support, and ideas which will help the parent administer the Ketogenic diet. The ability, skill, and interest of the dietitian is an important factor in the success of this diet. The diet should have foods which are unlimited, such as celery, so that the child can then have this on his own and not be dependent upon his parents' permission. When broad food groups are made, as butter, mayonnaise, oil and shortening, one calculation is used. This is easier for the mother; she is not required to use so much of one item and so much for another. The simpler the dietitian can present the Ketogenic diet to the parent, her overwhelming feeling is sooner to be overcome. The utilization of a questionnaire as the researcher designed is a valuable tool both for the dietitian to gain insight into the food and social aspects of the family. Also, it is a method of presenting to the parent aspects of their family routine which may have to be altered, in order to make the diet a more normal way of life for the child. This is essential for effective administration of the Ketogenic diet and fosters a feeling of cooperation from the child.

When the cooperation of the physician, parent, patient, and dietitian is achieved, effective management and utilization of the Ketogenic diet can be obtained. Future research in this

area of the Ketogenic diet and the epileptic child should include these parameters in its design and in its implementation of the regimen.

#### SUMMARY

Thirteen patients with seizure disorders from Children's Hospital Medical Center were treated with the Ketogenic diet. Four patients are continuing on the diet and doing well. One patient did well on the diet for 13 months; however, home management problems caused discontinuance. Six patients improved moderately; however, the diet was discontinued because of psychological and management difficulties. One patient did not respond significantly to the diet because of the nature of seizure disorder treated. One patient was not on the diet for more than a week because of the inability to create a level of ketosis while the patient was on a high carbohydrate medication.

It is believed that a liberalized diet based on a broader grouping of foods and unlimited food items offered is effective in overcoming part of the management area. Diamox can offer a synergistic effect in the liberalization of the diet by reducing the amount of fat-containing foods and the increase of carbohydrate-containing foods. Cognizant of the fact that the personality of these children is sometimes affected by their seizure disorder, a mode of treatment should not compound the psychological overtone. It was observed that the dietitian, physician, and parent must work together to aid the child to accept the diet and overcome behavior difficulties which might

arise while on the diet. It was found that a liberalized diet and increased insight into the child's personality and family situation caused greater cooperation. Cooperation is essential for the effectiveness of the Ketogenic diet. The researcher believes that if these certain limitations are overcome, the diet will have a greater use. Its value in the treatment of idiopathic epilepsy will be justified by the physician and extended in practice to benefit additional patients.

## ACKNOWLEDGMENT

Appreciative of the guidance, knowledge imparted, and understanding from Dr. L. Wakefield, I extend a sincere thank you. Also, I extend the thought that I am glad to have had the opportunity of being her student and hope to be able to continue as one. For their constructive criticism and their knowledge imparted to me, I recognize both Miss G. Tinklin and Dr. I. McCord. For his medical assistance and concerned interest, a special thank you is offered to Dr. H. Gascon.

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## APPENDIX

Table 5. Calculations for selected nutrients for 2,200 calories--3:1 ratio.

Num- ber	Amt. g	Food	Ca g	Fe mg	Thi mg	Rib mg	Nia mg equiv.	ASD mg	Via IU
968	One	Egg	27.00	1.65	0.05	0.15	0.05	0	590.0
931	100	Cream	75.00	Trace	0.02	0.11	Trace	1.00	1,540.0
126	18	Bacon	2.52	0.59	0.92	0.06	0.94	--	(0)
1437	73	Orange juice	6.57	0.07	0.07	0.01	0.22	32.85	146.0
505	37	Butter (15*-12*)	7.40	0.00	--	--	--	0.00	1,222.0
2324	52	Tuna	4.16	0.99	0.03	0.06	6.19	--	41.6
2282	50	Tomato	6.50	0.25	0.03	0.02	0.35	11.50	445.0
942	50	Cucumber	12.50	0.55	0.02	0.02	0.10	5.50	125.0
1480	146	W/p Peaches	5.84	0.44	0.01	0.04	0.88	4.38	657.0
1938	62	Mayonnaise	11.16	0.31	0.01	0.02	Trace	--	173.6
353	52	Roast beef	6.24	1.82	0.04	0.11	2.91	--	15.6
192	50	Green beans	20.00	0.35	0.04	0.05	0.20	2.50	290.0
1613	73	W/p Pineapple	8.76	0.22	0.06	0.01	0.15	5.11	36.5
1401	40	Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Children 8-10 (RDA)			193.65	7.24	1.30	0.66	11.99	62.84	5,281.3
			1000.00	10.00	1.10	1.20	15.00	40.00	3,500.0

This is based upon a 2,200-calorie diet, 3:1 ratio.

Tool 1

## TABLE OF FOOD VALUES

Expressed in grams  
Average composition of 100 grams

	PROTEIN	FAT	CARBOHYDRATE
Vegetables and Fruits			
6 per cent VEGETABLES	1	0	6
10 per cent FRUIT	1	0	10
Eggs and Dairy Products			
Eggs, each	6	6	0
40 per cent CREAM	2	40	3
Meats			
Meat, fish, fowl (medium fat)	23	17	0
Frankfurter, cooked	12	27	2
Bacon, crisp	25	55	1
Fats			
Butter, mayonnaise, shortening, margarine, vegetable oils	0	100	0
Cereals			
Puffed wheat	15	1.5	78

Modified from Keith (3).

## Tool 2

Foods to be exchanged for 25 or 50 grams of  
Meat, Fish, or Fowl

	25 grams	50 grams
Bacon, crisp	25	50
Omit Fat	10	20
Cheese, cheddar	25	50
Omit Fat	5	10
Cheese, creamed cottage	45	90
Omit Vegetable, 6 per cent	22	45
Add Fat	5	5
Egg, whole	1	2
Omit Fat	-	5

Modified from Keith (3).

## Tool 3

## Exchange Lists

Specific exchanges may be made within a meal pattern to give more variety.

1. When CREAM, 40 per cent, is desired to replace some or all of FAT, the following exchange can be made:

For each two grams of CREAM, 40 per cent wanted, OMIT one gram FAT and one gram VEGETABLE, 6 per cent.

Example: 10 grams CREAM, 40 per cent, OMIT 5 grams FAT and 5 grams VEGETABLE, 6 per cent, from respective gram portion listed within a meal pattern.

2. Vegetables and Fruits can be classified as carbohydrate-containing foods. Exchanges can then be made between the VEGETABLE and FRUIT groups maintaining the same carbohydrate value.

- A. For each 5 grams of VEGETABLE, 6 per cent wanted, OMIT 3 grams FRUIT, 10 per cent.

Example: 25 grams VEGETABLE, 6 per cent, will replace 15 grams of FRUIT, 10 per cent.

- B. For each 5 grams of FRUIT, 10 per cent wanted, OMIT 8 grams VEGETABLE, 6 per cent.

Example: 25 grams FRUIT, 10 per cent will replace 40 grams VEGETABLE, 6 per cent.

3. Ripe olives may be substituted for part of the gram portion listed for the FAT group. Six grams of ripe olives can be substituted for one gram FAT. This is helpful as a garnish for salads.

Modified from Keith (3).



## FOOD GROUPS

### MEAT GROUP

When meat is listed in the pattern, one of the following foods may be selected. Each item in this group is equal in food value.

Beef, veal, lamb, pork, chicken, turkey, fish.

### SPECIFIC ITEMS

If a food is listed specifically, as it is for the following items, then they CANNOT be substituted for either a MEAT or another specific item. These items are not equal in food value.

Bacon, egg, cheese (cheddar), cheese (creamed cottage), frankfurter, puffed wheat.

### FAT GROUP

FAT is included in each pattern except the PUFFED WHEAT pattern. The choice can be made from the following items. They are interchangeable and equal in food value.

Butter, margarine, vegetable oils, lard, vegetable shortening, mayonnaise.

### CREAM, 40 per cent

A meal pattern is specifically calculated for CREAM, 40 per cent. This CREAM CANNOT be substituted for a FAT. You will notice that the amount of FAT and either a FRUIT or a VEGETABLE will be lower than other patterns.

## VEGETABLE GROUP

When VEGETABLE, 6 per cent, is listed in a pattern, a choice can be made from the following foods. The vegetables are equal in food value and a selection of one or a combination of vegetables may be chosen to equal the specific gram portion in the pattern.

Beans, green or wax	Egg plant	Peppers, red
Beets	Kale	Pimento, canned
Brussel sprouts	Kohlrabi	Pumpkin
Carrots	Leeks	Rutabagas
Chives	Okra	Squash, winter
Collards	Onions	Turnips
Dandelion greens	Parsley	

However, a choice may be made from the following VEGETABLE, 3 per cent. In this case, twice the gram portion listed for VEGETABLE, 6 per cent, is given.

Asparagus	Cucumber	Sauerkraut
Bean sprouts	Dill pickle	Spinach
Beet greens	Endive	Squash, summer
Broccoli	Mushrooms	Tomatoes
Cabbage	Mustard	Tomato juice
Cabbage, Chinese	greens	Turnip greens
Cauliflower	Peppers,	Watercress
Chard, Swiss	green	
	Radishes	

Modified from Keith (3).

LETTUCE and CELERY may be eaten at any time or in any amount. They are in addition to a vegetable but lettuce and celery do not substitute for VEGETABLE, 6 per cent, when listed in a pattern.

## FRUIT GROUP

Fruits may be eaten FRESH, FROZEN, or CANNED in a variety of ways. Each of these categories will be listed below and selection can be made when FRUIT, 10 per cent, is listed in the meal pattern.

FRESH or FROZEN

Apricots  
 Blackberries  
 Cranberries  
 Currants  
 Gooseberries  
 Guava  
 Honeydew melon  
 Lemons  
 Limes  
 Oranges  
 Peaches  
 Plums  
 Raspberries  
 Tangerines

JUICE--PACKED

Apricots  
 Cherries, red  
 Fruit cocktail\*  
 Grapefruit  
 Peaches  
 Pears

WATER-PACKED

Applesauce  
 Apricots  
 Blueberries  
 Cherries, red  
 Figs  
 Grapes  
 Pears  
 Pineapple  
 Plums

FRUITS are grouped according to their carbohydrate value.

When fruits are selected from this section, give twice the gram portion listed for FRUIT, 10 per cent.

FRESH or FROZEN

Cantaloupe  
 Rhubarb  
 Strawberries  
 Watermelon

JUICE-PACKED

None

WATER-PACKED

Blackberries  
 Fruit cocktail\*  
 Grapefruit  
 Loganberries  
 Peaches  
 Raspberries  
 Rhubarb  
 Strawberries

\*Note: FRUIT COCKTAIL in the juice-packed form is a FRUIT, 10 per cent. However, when in the water-packed form it is twice the gram portion. This pertains to other fruits, too, which are processed in a fashion producing a different carbohydrate value.

Modified from Keith (3).

## FACT SHEET

1. Name \_\_\_\_\_ 2. Record Number \_\_\_\_\_
3. Doctor \_\_\_\_\_
4. Diagnostic Impression \_\_\_\_\_
5. Age \_\_\_\_\_ A. Chronological Age \_\_\_\_\_ B. Mental Age \_\_\_\_\_
6. Height A. Present Weight \_\_\_\_\_ B. Ideal Weight \_\_\_\_\_  
Weight C. Weight Gain Past 12 Months \_\_\_\_\_ D. Height \_\_\_\_\_
7. Medication A. Anticonvulsive Drug(s) \_\_\_\_\_  
B. Dosage \_\_\_\_\_  
C. Time Medication Given \_\_\_\_\_
8. Activities A. School \_\_\_\_\_ Hours  
B. Play--Active \_\_\_\_\_ hours; Inactive \_\_\_\_\_ hours  
C. Restriction of Activities \_\_\_\_\_
9. Sleep A. Night Sleep \_\_\_\_\_ hours  
B. Nap Sleep \_\_\_\_\_ hours
10. Caretaker A. Morning \_\_\_\_\_ B. Afternoon \_\_\_\_\_  
C. Evening \_\_\_\_\_ D. Night \_\_\_\_\_
11. Financial A. Medical Insurance \_\_\_\_\_  
B. Medical Assistance \_\_\_\_\_  
C. Welfare Assistance \_\_\_\_\_
12. Medical - Dietary Concerns  
A. Food Allergies \_\_\_\_\_  
B. Chewing Difficulties \_\_\_\_\_  
C. Swallowing Difficulties \_\_\_\_\_  
D. Approximate Number of Seizures \_\_\_\_\_  
Time of Day \_\_\_\_\_

FOOD AND SOCIAL HABITS

Patient's Name \_\_\_\_\_

Person Interviewed \_\_\_\_\_

Relationship to Patient \_\_\_\_\_

1. Who plans the meals?

2. Food shopping

A. Who does the shopping?

B. Are food items purchased according to shopping list?

C. Do children help with shopping, if so, do they influence the items purchased?

3. Who prepares the meals?

4. Meal Plan

A. Number of meals per day

B. Time of largest meal each day

C. Number of snacks per day

D. Number of eight ounce glasses of fluid intake per day

5. Food Intake

A. Example of food eaten at meal time, specify the amount

B. Example of food eaten at snack time, specify the amount

6. Meal Time

A. At meal time, do all family members eat together?

B. Do you plan to feed your child on the Ketogenic diet alone or with the family?

C. At snack time, do all siblings have the same snack together?

## 7. Eating away from home

- A. How often does the child eat meals away from home?
- B. Where?
- C. If adult is out with child, for example shopping, do they stop for a snack (ice cream, soda, etc.)?
- D. How often - Sometimes      Often      Never

## 8. Obedience

- A. Does the patient obey readily?
- B. Are sweets used as a reward for being good?
- C. If the patient does not finish his meal, is dessert withheld?

## 9. "Diet" History

- A. Have you or anyone in your family been on a diet?
- B. Has the patient been aware of the diet?
- C. How long was the family member on a diet?
- D. Were special foods purchased or prepared for this diet?

10. Have you had any need to restrict your child's intake in amounts or kinds of food? If so, indicate

11. How do you think the patient will accept the diet?

## 12. Family Involvement

- A. Could you explain the diet to the other children in the family?
- B. Do you think they will cooperate?
- C. How often is there sibling rivalry or teasing?
- D. Do you need to interfere to stop quarreling or teasing?

## 13. New Foods

- A. Does your child try new foods on his - her own?

B. Does the patient need coaxing?

C. Does the patient refuse to try new foods?

14. Does your child help with meal preparation \_\_\_\_\_ table setting \_\_\_\_\_ shopping \_\_\_\_\_ dishes \_\_\_\_\_

15. Emotional involvement with food

A. When your child is angry does he - she refuse to eat?

B. When your child is upset does he - she gorge himself?

16. Fussy eating habits

A. Do you consider your child to be a picky eater?

B. Are there any fussy eaters in the family?

C. Are different foods prepared for family members pending on likes and dislikes at one meal (peas for one - carrots for another)?

D. Do you require your child to eat all foods even if it is not his - her favorite?

17. Does your child eat canned soups \_\_\_\_\_ canned ravioli \_\_\_\_\_ T.V. dinners \_\_\_\_\_ other prepared foods \_\_\_\_\_ how often \_\_\_\_\_

18. Illness's effect upon your child

A. Does your child feel "different" due to his - her illness?

B. Does he feel unlike his friends?

C. Do you think your child is more self conscious?

D. Do you think your child is more dependent upon you than your other children?

E. Do you think his illness has affected his personality?

F. When your child is angry does he - she refuse to take their medication?

G. Does he - she know approximate time to take their medication?

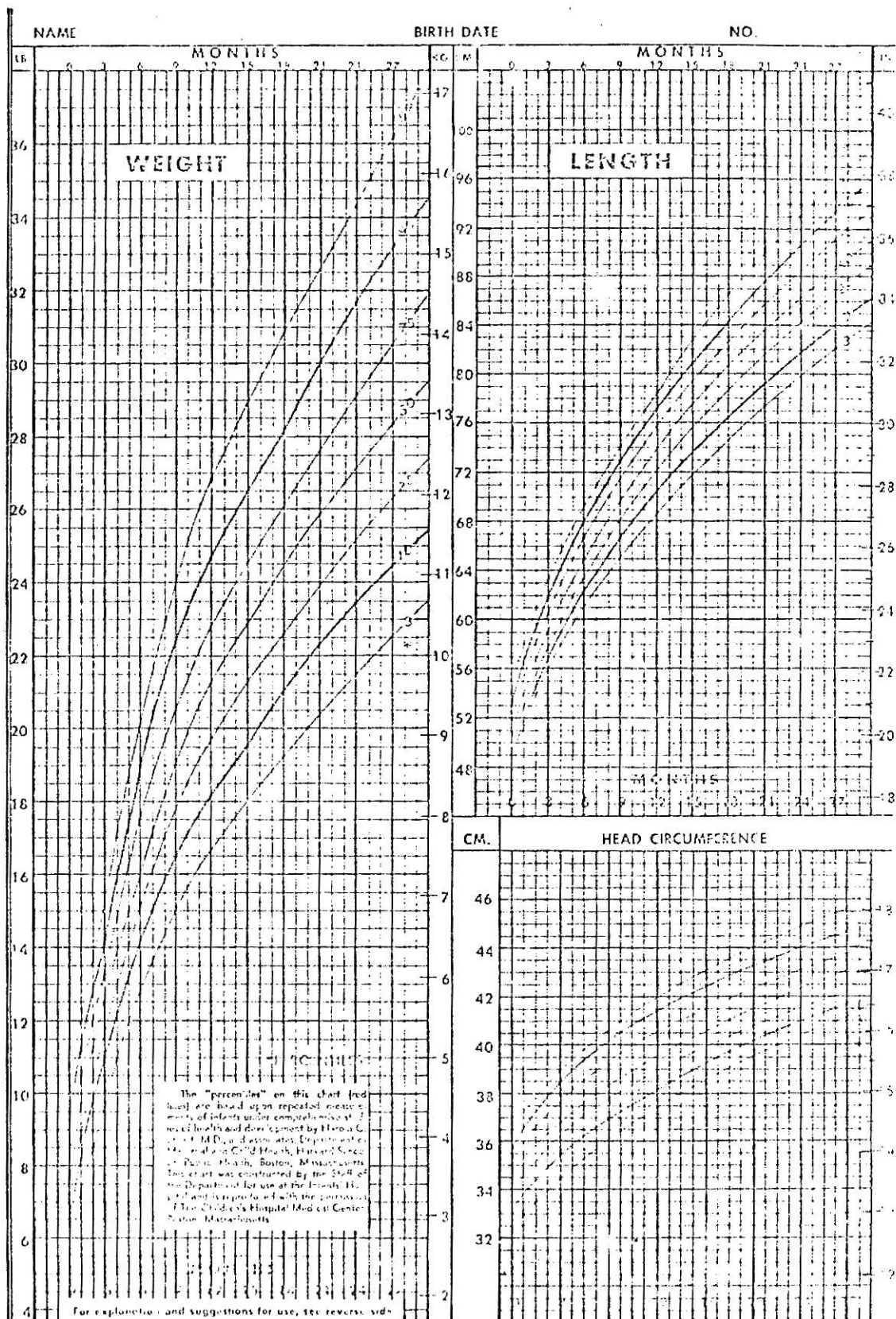
COMMENTS:



## INFANT GIRLS

THE CHILDREN'S MEDICAL CENTER, BOSTON - ANTHROPOMETRIC CHART

03145



## PERCENTILE CHART FOR MEASUREMENTS OF INFANT GIRLS

THIS CHART provides for infant girls standards of reference for body weight and recumbent length by month from birth to 28 months and for head circumference by week from birth to 28 weeks. It is based upon repeated measurements at selected ages of a group of more than 100 white infants of North European ancestry living under normal conditions of health and home life in Boston, Mass. The distribution of the measurements obtained from the infants at each age is expressed in percentiles, each percentile giving a value which represents a particular position in the normal range of occurrences. The number of the percentile refers to the position which a measurement of the given value would hold in any typical series of 100 infants. Thus, the 10th percentile gives the value for the tenth in any hundred; that is, 9 infants of the same sex and age would be expected to be smaller in the measurement under consideration while 90 would be expected to be larger than the figure given. Similarly the 90th percentile would indicate that 89 infants might be expected to be smaller than the figure given while 10 would be larger. The 50th percentile represents the median or midposition in the customary range. Here, the 10th and 90th percentiles are presented in heavy lines to show the limits within which most infants remain. The lighter lines in the graphs divide the distributions into segments for ready recognition and description of individual differences as well as of the "regularity" of progress. The 3rd and 97th percentiles represent unusual though not necessarily abnormal findings.

In line with common usage in the United States, the charts are ruled on a scale in pounds to represent weight. They are ruled, however, in centimeters to represent length and head circumference, because this scale facilitates accuracy in measuring and recording and centimeter rules and tapes are readily available. For the convenience of those preferring them, scales for kilograms and inches are placed outside of the principal scales and paralleling them. Therefore, if weights are taken in kilograms and lengths and head circumferences in inches, they may be plotted directly without conversion by placing a ruler at the appropriate points on the outer scales of the charts.

To determine the percentile position of any measurement at a given age, the vertical age line

is located and a dot is placed where this intersects the horizontal line representing the value obtained from the measurement. Vertical lines give age by one-month intervals for weight and length and one-week intervals for head circumference; horizontal lines give  $\frac{1}{2}$ -pound, 1-cm. and 0.5-cm. intervals respectively. This permits by interpolation accurate placement for age to weeks, for weights to 2 ounces and for centimeters to 0.5 cm. Recognition of the position within or outside of the range held by an infant in respect to each measurement recorded calls attention to the relative size and build of the individual at the time. More importantly, comparisons of percentile positions held by these measurements at repeated periodic examinations indicate adherence to or possibly significant deviation from previous percentile positions. Under normal circumstances, one expects an infant to maintain a similar position from age to age — that is, on or near one percentile line or between the same two lines. Occasional sharp deviations or gradual but continuing shifts from one percentile position to another call for further investigation as to their causes. In all cases, readings of measurements should be checked and care should be taken to secure the same position of the infant at all examinations. The following procedures were used in obtaining these norms and therefore are recommended:

**Body Weight** — The infant is weighed without clothing, preferably on special infant scales.

**Recumbent Length** — The infant lies relaxed on a firm surface parallel to a centimeter rule or on a special infant measuring board which permits the following procedure. The soles of the feet are held firmly against a fixed upright of the zero mark on the rule, and a movable square is brought firmly against the vertex. Care must be taken to secure extension at the knees, and the head should be held so that the eyes face the ceiling.

**Head Circumference** — This measurement is more satisfactory if taken with the infant lying on his back. The tape is passed around the head from above and placed anteriorly over the lower forehead just above the supraorbital ridges. With the position of the tape thus fixed anteriorly, the largest circumference is obtained by passing it posteriorly over the most prominent part of the occiput.

NAME \_\_\_\_\_

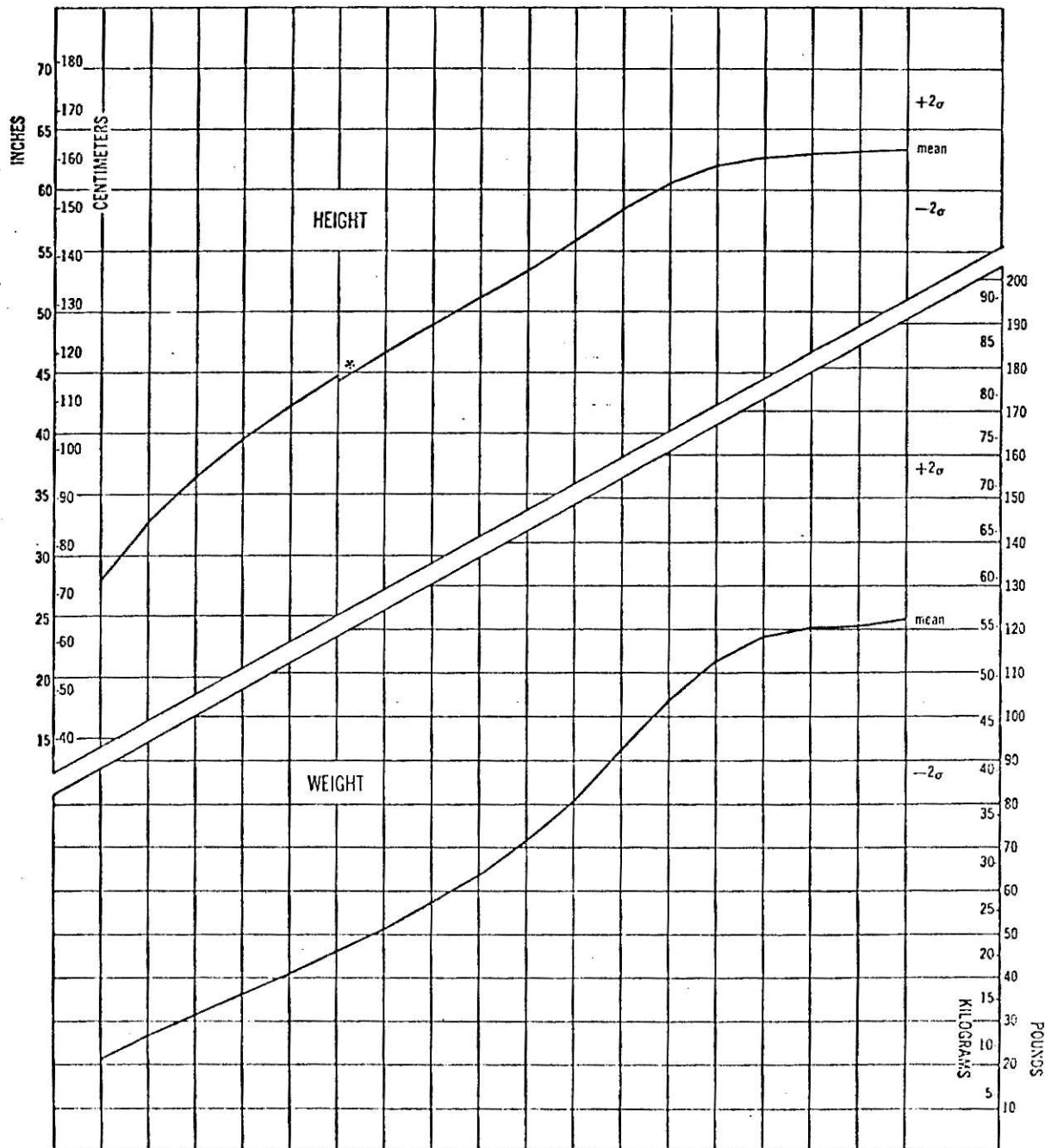
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# GIRLS PHYSICAL DEVELOPMENT 1 to 18 years

THE CHILDREN'S HOSPITAL MEDICAL CENTER

\*supine length to 6 years, standing height from 6 to 18 years





NAME \_\_\_\_\_

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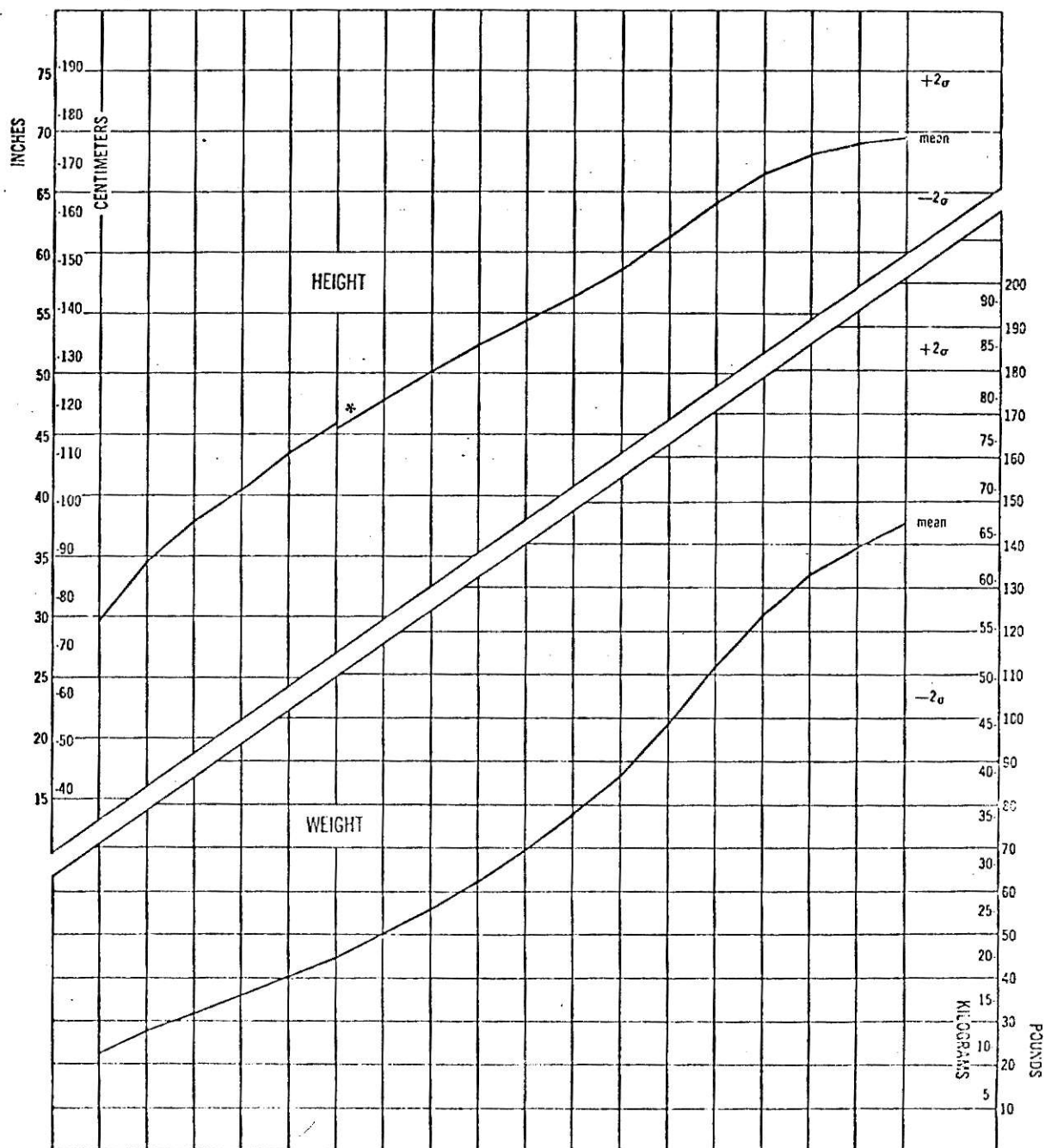
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# BOYS PHYSICAL DEVELOPMENT

## 1 to 18 years.

THE CHILDREN'S HOSPITAL MEDICAL CENTER

\*supine length to 6 years, standing height from 6 to 18 years





FOOD AND SOCIAL HABITSPatient's Name M. G.Person Interviewed Mrs. M. G.Relationship to Patient Mother(Answered before commencement  
of diet)

1. Who plans the meals? Mother
2. Food shopping
  - A. Who does the shopping? Mother
  - B. Are food items purchased according to shopping list? No
  - C. Do children help with shopping, if so, do they influence the items purchased? Occasionally - yes
3. Who prepares the meals? Mother
4. Meal plan
  - A. Number of meals per day 3
  - B. Time of largest meal each day 5:30 p.m.
  - C. Number of snacks per day 2, after school
  - D. Number of eight ounce glasses of fluid intake per day 4
5. Food Intake
  - A. Example of food eaten at meal time, specify the amount  
1 Potato, 1/2 cup vegetable, 2 oz meat
  - B. Example of food eaten at snack time, specify the amount  
1 glass milk, 3 or 4 cookies
6. Meal Time
  - A. At meal time, do all family members eat together? Yes
  - B. Do you plan to feed your child on the Ketogenic diet  
alone or with the family? With family



C. At snack time, do all siblings have the same snack together? No

7. Eating away from home

A. How often does the child eat meals away from home?

Very rarely

B. Where? Neighbors

C. If adult is out with child, for example shopping, do they stop for a snack (ice cream, soda, etc.)? Yes

D. How often - sometimes often never

8. Obedience

A. Does the patient obey readily? Yes

B. Are sweets used as a reward for being good? No

C. If the patient does not finish his meal, is dessert withheld? Yes

9. "Diet" History

A. Have you or anyone in your family been on a diet?

No, not for length of time.

B. Has the patient been aware of the diet? Yes

C. How long was the family member on a diet?

D. Were special foods purchased or prepared for this diet? Yes

10. Have you had any need to restrict your child's intake in amounts or kinds of food, if so indicate No

11. How do you think the patient will accept the diet? Docile

12. Family Involvement

A. Could you explain the diet to the other children in the family? Yes



B. Do you think they will cooperate? Yes

C. How often is there sibling rivalry or teasing?

Occasionally

D. Do you need to interfere to stop quarreling or teasing?

Yes

### 13. New Foods

A. Does your child try new foods on his - her own?

Occasionally, by looks

B. Does the patient need coaxing? Sometimes

C. Does the patient refuse to try new foods? No

14. Does your child help with meal preparation Yes table

setting Yes shopping Yes dishes Yes

### 15. Emotional involvement with food

A. When your child is angry does he - she refuse to eat? No

B. When your child is upset does he - she gorge himself? No

### 16. Fussy eating habits

A. Do you consider your child to be a picky eater? No

B. Are there any fussy eaters in the family? Father

C. Are different foods prepared for family members pending on likes and dislikes at one meal (peas for one - carrots for another)? No, except at breakfast

D. Do you require your child to eat all foods even if it is not his - her favorite? Yes

17. Does your child eat canned soups Yes canned ravioli Yes

T.V. dinners Yes other prepared foods Yes

how often Occasionally on weekend, noon

## 18. Illness's effect upon your child

- A. Does your child feel "different" due to his - her illness? Wears as badge--uses it
- B. Does he feel unlike his friends? Depends on her mood
- C. Do you think your child is more self-conscious?  
Doesn't let on
- D. Do you think your child is more dependent upon you than your other children? Independent when seizures are controlled
- E. Do you think his illness has affected his personality?
- F. When your child is angry does he - she refuse to take their medication? No
- G. Does he - she know approximate time to take their medication? Yes

COMMENTS:

FOOD AND SOCIAL HABITSPatient's Name S. C.Person Interviewed M. C.Relationship to Patient MotherTime Spent on Diet Approx. 3 yrs.

1. Who plans the meals? Mother

2. Food shopping

A. Who does the shopping? Mother

B. Are food items purchased according to shopping list?

Yes, plus sales or new foods of interest

C. Do children help with shopping, if so, do they influence the items purchased? Sometimes

3. Who prepares the meals? Mother

4. Meal Plan

A. Number of meals per day 3

B. Time of largest meal each day Evening meal, 6-7 p.m.

C. Number of snacks per day? 1 or 2

D. Number of eight ounce glasses of fluid intake per day?  
4 or 5

5. Food Intake

A. Example of food eaten at meal time, specify the amount

Meat, 35 gms; vegetable, 40-60 gms; fruit, 40-80 gms; fat 52 gms; beverage

B. Example of food eaten at snack time, specify the amount

Milkshake, jello, crackers, cream cheese

## 6. Meal Time

- A. At meal time, do all family members eat together? Yes
- B. Do you plan to feed your child on the Ketogenic diet alone or with the family? With family
- C. At snack time, do all siblings have the same snack together? No

## 7. Eating away from home

- A. How often does the child eat meals away from home?  
Occasionally
- B. Where? At the homes of friends and at school (every day for lunch).
- C. If adult is out with child, for example shopping, do they stop for a snack (ice cream, soda, etc.)?
- D. How often - sometimes X often never

## 8. Obedience

- A. Does the patient obey readily? Yes
- B. Are sweets used as a reward for being good? No,  
not by mother
- C. If the patient does not finish his meal, is dessert withheld? No, but he does

## 9. "Diet" History

- A. Have you or anyone in your family been on a diet?  
Not formally!
- B. Has the patient been aware of the diet? Aware of attempts.
- C. How long was the family member on a diet?
- D. Were special foods purchased or prepared for this diet?

10. Have you had any need to restrict your child's intake in amounts or kinds of food, if so indicate?

No, he restricts himself.

11. How do you think the patient will accept the diet? Very well

12. Family Involvement

A. Could you explain the diet to the other children in the family? Yes

B. Do you think they will cooperate? Yes

C. How often is there sibling rivalry or teasing? Chronic

D. Do you need to interfere to stop quarreling or teasing?

Sometimes. These do not pertain to diet at all.

13. New Foods

A. Does your child try new foods on his - her own?

Yes, when okayed.

B. Does the patient need coaxing? Very seldom

C. Does the patient refuse to try new foods? No

14. Does your child help with meal preparation Sometimes

table setting No shopping Yes dishes No

15. Emotional involvement with food

A. When your child is angry does he - she refuse to eat?

Maybe 3 times in 2 yrs.

B. When your child is upset does he - she gorge himself? No

16. Fussy eating habits

A. Do you consider your child to be a picky eater? No

B. Are there any fussy eaters in the family? Yes

C. Are different foods prepared for family members pending

on likes and dislikes at one meal (peas for one - carrots for another)? Sometimes

D. Do you require your child to eat all foods even if it is not his - her favorite? We don't force.

17. Does your child eat canned soups not now canned ravioli  
not now T.V. dinners not now other prepared foods  
sometimes fish, olives how often not often

18. Illness's effect upon your child

A. Does your child feel "different" due to his - her illness? Yes

B. Does he feel unlike his friends? Sometimes

C. Do you think your child is more self-conscious?

D. Do you think your child is more dependent upon you than your other children? Yes, for some specific tasks.

E. Do you think his illness has affected his personality?

I don't know.

F. When your child is angry does he - she refuse to take their medication? No

G. Does he - she know approximate time to take their medication? Yes

COMMENTS: We try not to emphasize the food part of life and to see that occasions can be happy from other standpoints. Food is not a reward, mealtimes are times for conversation. Fresh fruit and vegetables are delicious for all; we all try not to have seconds! S.C.'s diet is a lesson in tact for the rest of us--and he has gained our great respect!

DIETARY-MEDICAL-PSYCHOLOGICAL IMPLICATIONS  
OF KETOGENIC DIET

by

ANNE SEEMAN

B. A., University of Vermont, 1966

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1971

Thirteen patients with seizure disorders from Children's Hospital Medical Center were treated with the Ketogenic diet. Four patients are continuing on the diet and doing well. One patient did well on the diet for 13 months; however, home management problems caused discontinuance. Six patients improved moderately; however, the diet was discontinued because of psychological and management difficulties. One patient did not respond significantly to the diet because of the nature of seizure disorder treated. One patient was not on the diet for more than a week because of the inability to create a level of ketosis while the patient was on a high carbohydrate medication.

It is believed that a liberalized diet based on a broader grouping of foods and unlimited food items offered is effective in overcoming part of the management area. Diamox can offer a synergistic effect in the liberalization of the diet by reducing the amount of fat-containing foods and the increase of carbohydrate-containing foods. Cognizant of the fact that the personality of these children is sometimes affected by their seizure disorder, a mode of treatment should not compound the psychological overtone. It was observed that the dietitian, physician, and parent must work together to aid the child to accept the diet and overcome behavior difficulties which might arise while on the diet. It was found that a liberalized diet and increased insight into the child's personality and family situation caused greater cooperation. Cooperation is essential for the effectiveness of the Ketogenic diet. The researcher



believes that if these certain limitations are overcome, the diet will have a greater use. Its value in the treatment of idiopathic epilepsy will be justified by the physician and extended in practice to benefit additional patients.