SELECTED FEEDING TECHNIQUES TO IMPROVE NUTRITIONAL STATUS IN HANDICAPPED CHILDREN

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CHAPTER I

INTRODUCTION

The purpose of this study is to test the use of selected feeding techniques in training mentally retarded, physically handicapped children to feed themselves.

The feeding techniques selected have been used at Winfield State Hospital and Training Center, Winfield, Kansas, as a means of improving the nutritional condition of children in the Pediatric Section. In past studies of eating habits of physically handicapped persons it was suggested that the problem of malnutrition in this group may be related to the inability to eat a sufficient quantity of needed foods (31, 39).

The author has been employed as Chief Dietitian at Winfield State Hospital and Training Center for over sixteen years. She has been concerned for many years by the lack of interest and knowledge about the nutritional problems of the retarded, handicapped child. It has been her observation that these children do not eat the amount of food needed to promote growth in the normal child. Although it has not been proven, it is commonly accepted that the poor growth patterns of retarded, handicapped children are probably due to uncontrollable factors as irreversible brain damage, metabolic errors or other unknowns. This study was undertaken in an attempt to determine whether growth and development patterns can be improved if the retarded, handicapped child is able to eat the quantity and quality of foods known to promote growth in healthy children.

It is the author's belief that the basic problem is teaching the child to develop normal eating patterns. Until a child is able to eat a variety of foods it is extremely difficult to provide a diet adequate in all nutrients. While it is theoretically possible to promote growth by artificial methods of feeding, development implies an increase in complexity, differentation, and function (51). Development in eating ability is an integral part of the total physical, social and emotional development of the child. Development of more complex neuromuscular activity will be inhibited if the child is not permitted or encouraged to develop eating reflexes.

It is extremely difficult to teach a retarded, handicapped child to develop a normal eating pattern. Often the methods used to get a child to eat interfere with or impede the development of chewing, sucking and swallowing reflexes. The common belief is that the reflex centers are so damaged that normal development is impossible. The inborn reflexes of sucking and swallowing still exist in most cases, however, even though they may have been disturbed by injury at birth, by disease, and further disorganized by improper methods of feeding after birth (5).

The problem of teaching the handicapped person to eat has been recognized by various disciplines. A variety of techniques such as use of positioning and special eating devices have been proposed by occupational (17) and physical therapists. For many years speech pathologists have used reflex stimulation techniques to develop chewing, sucking, and swallowing in the cerebral palsied (5, 7, 8, 38, 52). These techniques based on investigations by other disciplines are not generally known by dietitians and others concerned with nutrition. Only recently has any attempt been made to apply this knowledge to the problem of feeding mentally retarded, physically handicapped children.

In previous programs at Winfield State Hospital many of the techniques recommended by occupational therapists, physical therapists and speech pathologists have been used. From these programs some understanding of the processes by which retarded children learn to eat has been attained. The most successful programs have been based on the premise that retarded children learn to eat in the same developmental sequence as normal children and that by the use of reflex-stimulation techniques, reflex action of oral eating structures can be established (48).

Motivation has been used with some success to encourage self-feeding in children who have progressed beyond the sucking and swallowing developmental stages (48). Many children in the Pediatric Section do not have normal sucking and swallowing patterns so this type of motivation is ineffective. The techniques that have been developed for these children are a combination of the reflex-stimulation techniques used by speech pathologists and the motivation techniques that have been found effective in children with more developed eating structures. It is essentially a program of developing conditioned reflexes of eating by which the child learns through association to respond to a repeated stimulus. The usual stimulus is the taste, texture, and smell of food but other stimuli as massage of the lips, and gentle stroking of cheek and throat are also used.

These techniques were used in a pilot project involving six children at Winfield, in November, 1964. Within four months definite improvement in sucking and swallowing patterns were noted in all of the children and many were being offered hard foods as one of the first steps in stimulation to develop chewing. All were being fed strained baby foods at the time they were placed in the pilot project.

In this study the following assumptions were accepted:

1. Subjects can be obtained that are approximately the same chronological age.
2. Subjects can be obtained who are physically handicapped, mentally retarded, and rank less than 50 percentile for height or weight according to the standards of Boyd, Denver Child Research Council (24)
3. Subjects can be assigned to a separate ward for the duration of the study (11 months).
4. Consent of the subject's parent or guardian can be obtained to forego home visits and visits out of the ward during the duration of the study (11 months).
5. Aides can be assigned to the training ward who are capable of learning the feeding techniques to be used.
6. Trained aides can be given sufficient time to correctly follow feeding techniques.
7. During the study the feeding of subjects can be supervised by a dietitian or a student.
8. Personnel feeding the subjects can be limited to those trained in the use of the feeding techniques.

The author tested the following hypotheses:

1. Mentally retarded, handicapped children can be helped to increase their efficiency in eating by using specific techniques to stimulate the inborn reflexes of sucking and swallowing.
2. Nutritional improvement of mentally retarded, physically handicapped children can be shown by increased volume of food intake, height, weight, hemoglobin, hematocrit,

change in A/G ratio and serum electrophoretic pattern, if they are able to eat the amounts and kinds of food needed for physical growth and development of normal children of the same age and sex.

Twenty-four subjects were randomly selected from the Pediatric Section according to the following criteria: inability to feed self; eight years of age or under; physically handicapped; profoundly or severely mentally retarded; rank less than 50 percentile for height or for weight according to the Boyd Tables (1952) of height and weight standards for age of girls and boys as published by the Denver Child Research Council (24); have no cranial anomaly.

Subjects were grouped according to neurological impairment. Twelve subjects were classified as microcephalic and twelve included other types of impairment. Each of the two groups of twelve subjects were randomly divided into two treatment groups. The subjects in the experimental group were moved to a separate experimental ward and the subjects in the control group were left unchanged.

Aide staff of the experimental ward remained constant and included seven psychiatric aides and three hospital attendants. Time schedules were so planned that each aide or attendant had a maximum of four subjects to feed at each meal.

All personnel working directly with the subjects or supervising the aide staff were trained in the use of the feeding techniques. Continuous supervision of feeding techniques was maintained throughout the study.

The amount of food consumed, as measured by volume, was determined by seven-day intake records of all food eaten at the beginning of the study, at five week intervals during the first six months and at the end of the eleven months. Subjects were offered a fixed menu that in the seven-day cycle included all of the foods normally eaten.

Initial height and weight measurements were taken at the time of patient selection. Succeeding measurements were made within seven days after the completion of the seven-day dietary intake record.

Tests which were made on each of the 24 subjects three weeks after the beginning of the experiment, at approximately six-week intervals during the first six months and at the end of eleven months included:

1. hemoglobin
2. hematocrit
3. total serum protein
4. albumin-globulin ratio
5. serum electrophoresis for proteins

Clarification of Terms

The subjects of this study were profoundly retarded with potential to be severely retarded. All were physically handicapped, non-ambulatory, with varying degrees of neuromotor handicap. Their adaptive behavior for physical handicap was between the levels of four and five.

The profoundly retarded is composed of individuals with an intelligence quotient below 20. Many of these retarded children have marked physical handicaps such as cerebral palsy and blindness. As adults their mental age will be below that of a three and one-half year old child (3).

The severely retarded are those with an intelligence quotient between 20 and 35. They are likely to have physical and medical problems associated with their retardation. As adults their mental age ranges from three and one-half to seven and one-half years (3).

The measure of adaptive behavior refers to the effectiveness with which the individual copes with the natural and social demands of his environment. It has two aspects: (1) degree to which the individual is able to function and maintain himself independently; and (2) degree to which he meets satisfactorily the culturally-imposed demands of personal and social responsibility. It is always evaluated in terms of the degree to which the individual meets the standards of social responsibility and personal independence expected of his chronological age group (25).

In Kansas institutions for the retarded, adaptive behavior is categorized in terms of five levels. They are scaled from mild negative deviation from population norms to complete lack of adaption at the extreme lower limit of level five. Children on level four are capable of responding to the simplest of environmental stimuli and interpersonal relationships. They will be dependent upon nursing supervision for their maintenance and help in following the routines of daily living. Level five includes children who are either grossly physically handicapped or function in that manner. They require continuous medical-nursing care for their survival (49).

Microcephaly is a congenital anomaly which presents the characteristic clinical picture of abnormal smallness of the head with smallness of the cerebral hemispheres. The adult head circumference is 17 inches or less. Head circumference is 13 inches or less at six months, 14 inches at one year, and 15 inches at two years. The primary microcephalic is invariably moderately to severely retarded (25).

CHAPTER II

REVIEW OF LITERATURE

Growth and Development of the Mentally Retarded

There have been numerous studies made of growth patterns of the mentally retarded. In 1914, Goddard (20) collected data on 10,844 mentally retarded patients from 19 institutions. He noted that the height and weight of these patients were generally lower than those of normal children and concluded that there was a remarkable correlation between physical and mental development. In his report, Goddard (20) referred to the work of previous investigators. Tarbell in 1881 weighed and measured children from the Massachusetts Institution for the Feeble Minded in an attempt to determine a growth curve. In 1884, Shuttleworth compiled data from 1209 patients in English institutions that was in agreement with Tarbell's in showing the institution patients to be shorter and lighter than that of the general population. A study of 161 boys and 174 girls from the Minnesota Institution for the Feeble Minded was made by Wylie in 1899. In 1903 he enlarged it to about 400 patients of each sex. He confirmed the previous findings of Tarbell and Shuttleworth and added that the mean variation of defectives is much greater than in the case of normal people.

Flory (18) in 1935 investigated the physical growth of 800 institutionalized boys and concluded the growth rate of mentally deficient males was slower than normal males and appeared to be related to the degree of mental defect. He also concluded that the period of growth was longer than in normal boys and the slower growth rate and longer duration of growth indicated an extended period of immaturity.

In 1960, Sterling (45) compared height and weight of 100 children having cerebral palsy with normal children and with patients who had acquired brain damage late in childhood. He found that patients having congenital or early acquired brain damage were significantly shorter and lighter than would be expected by comparison with siblings or use of standard anthropometric charts. Out of the 100 cerebral palsied patients observed, 69 fell below the tenth percentile for height and 62 under the tenth percentile for weight.

More recent studies include Culley, Jolly, and Mertz (12) who in 1963 determined height, weight and body build of 256 patients in a state institution who were 12 years of age or younger. The variations of these measurements were assessed against a measured intelligence level and diagnostic category. They found a significant deviation from the standard population in respect to height, weight and body build. Patients without motor dysfunction were similar to mongoloids with short statures and standard body builds. Patients with motor dysfunctions were short for their age, and about one-half had a body build below the standard. Patients with severe motor dysfunction tended to be shorter and thinner for their age than those with less severe motor dysfunction. Profoundly retarded patients with or without motor dysfunction were shorter and lighter for their age than patients who were less severely retarded.

A more complete anthropometric study of an entire population of a state institution was reported by Mosier et al (35) in 1964. Using 2472 patients of all ages, measurement of ten body dimensions were obtained and this data considered in relation to both intelligence quotient and diagnostic category by age and sex. They found that body weight, crown-heel height, symphysis-heel height, biacromial diameter and bicristal diameter had smaller dimension than the standard in both sexes and the degree of impairment was related to the intelligence quotient level. They found no difference among diagnostic categories in degree of stunting except in mongolism where stunting was greater.

Leamy (31) determined the skeletal age of a group of 21 cerebral palsy patients by roentgenograms of the wrist-hand area. With five exceptions, the children were retarded in skeletal development ranging from -1.4 months to -47.4 months below their chronological ages.

Nutritional Problems of the Mentally Retarded, Handicapped Patient

While it is generally agreed that mentally retarded patients with motor problems are commonly retarded in height and weight, there is less certainty as to the causes of the retarded growth.

Various investigators have observed that cerebral palsy patients consume inadequate amounts of calories as well as other nutrients. Peeks and Lamb (39) studied the dietary intake of 29 children. Parents were interviewed, dietary histories were obtained, and records of the food intake for one week were recorded by the mother. The weekly dietaries were computed for calorie, protein, mineral and vitamin content. In comparing the number of subjects receiving 90 per cent or more of Recommended Dietary Allowances it was found that one-half of the subjects were consuming enough ascorbic acid, iron and protein; less than one-half had intakes of calcium and calories equal to 90 per cent of recommended allowances and the majority consumed vitamin A, thiamine, and riboflavin in adequate amounts.

Leamy (31) observed the food intake of 21 cerebral palsy children. A 48-hour record was obtained by using a combination of weighing and estimating methods. The Recommended Daily Dietary Allowances for 1948 were used as standards. It was found that 18 of the 21 children ate less than the recommended allowance for calories; 11 did not eat sufficient protein and ten consumed inadequate amounts of calcium. Eighteen had less than the recommended allowance for iron; 16 had an inadequate ascorbic acid intake; 16 had an inadequate intake of niacin and six ate insufficient thiamine.

Karle et al (28) evaluated 12 cerebral palsy patients in a university hospital with respect to past and present dietary intakes and concentrations of hemoglobin, serum ascorbic acid, serum vitamin A, and serum carotene. Dietary intakes were recorded as estimated portions of food consumed by each child for the two or three days before blood samples were drawn. The diet offered the patient met the Recommendations of the National Research Council (1948). Food composition tables were used to determine nutrient content of the diet. All children consumed fewer calories than the National Research Council recommended for well children. Fluid milk provided 40 to 50 per cent of the calories. Ten children did not meet iron requirements. One-half of the children would have had inadequate ascorbic acid intakes if vitamin supplements had not been given. Only two of the children failed to consume 90 per cent of the protein allowance which was attributed to the large proportion of milk in the diet.

Calories appear to be the most serious individual deficiency in food intake in the studies mentioned (13, 28, 45), and may be an important factor in retarded growth. It has been suggested that when calories are inadequate the body tends to adapt itself by using protein for energy rather than growth (13, 39). Swanson (47) demonstrated that energy balance and nitrogen balance were interwoven and that nitrogen retention is a function, in part, of calorie intake. In a 15-year growth study of children, Macy and Hunscher (32) noted that a difference in intake of as few as ten calories per kilogram of body weight may be critical in making satisfactory progress in growth.

The causes of growth retardation in mental defectives are complex and are probably a combination of genetic, uterine and post-natal factors. Mosier (35) suggested that the central nervous system may be involved in growth disturbance of the mentally retarded. Sterling (45) questioned the theory that the retarded growth of cerebral palsy patients may be caused by damage to a presumed growth center or centers. He suggested that careful studies of metabolic needs, intake and incidence of fever and infections must be determined before a satisfactory explanation can be made. Culley et al (12) stated that there was basis for concluding that the markedly depressed heights of patients with motor dysfunction may be the result of inadequate caloric intake. Leamy (31) suggested that the retarded growth of cerebral palsy may be a long term result of inadequate food intake.

Patients with motor problems frequently have problems in eating. The difficulty these patients have with chewing and swallowing may be a factor contributing to their thinness (14). Phelps (40) pointed out that it takes these children an hour or more to eat each meal and if this amount of time is not taken the child will become extremely undernourished. He stated that the constant involuntary movements of the athetoid required a very high calorie diet in order to maintain normal weight while the inactive spastics had low caloric requirements and tended to gain excessive weight. Leamy (31), however, did not find a significant difference between the caloric intake of athetoids and spastics. Eddy et al (15) measured the energy requirements and dietary intakes of five children in a boarding school for spastics. They concluded that although the total energy requirements and intakes of cerebral palsy children were less than the standard for children of the same age, their requirements were normal in relation to their handicap and the limitation of their physique. They also noted that since dietary intakes tended to be small, close attention must be given to the diet if the recommended allowance of nutrients were to be attained.

Malnutrition and Brain Function

Recent studies on the effect of malnutrition on brain function gave increased emphasis to the importance of adequate and post-natal nutrition to the infant.

The embryological development of the brain is one of the most rapid processes during gestation and after birth. The brain achieves 70 per cent of its adult weight by the end of the first year (46). Some 90 per cent of the adult brain has been formed by four years of age (23). At the time of birth, the human brain gains weight at the rate of one to two milligrams per minute (43). Coursin (10) noted that the process of nerve cell maturation, differentation and integration is complete and without benefit of regeneration or adaptive function as seen in other organs. He suggested that it is probable that abnormalties of intercellular metabolism may result in inhibition of the formulation of a specific function or may limit the capacity of the brain cells for future operation despite the availability of adequate nutrients at a later date.

In 1944, Kugelmass et al (30) studied the effect of nutritional improvement on child mentality. Ninety-one malnourished children, two to nine years of age, were matched by chronological age and intelligence quotient with 91 well-nourished children. Approximately one-half of each group were mentally retarded and one-half had standard intelligence. They found that improvement in the diet of the malnourished children was followed by an average rise in intelligence quotient of ten points for the mentally retarded and 18 points for the mentally normal. There was an average zero change for the well nourished group. The younger the child at the time the nutritional therapy was started the better the rise in intelligence quotient. They found a slightly positive correlation between length of interval and intelligence quotient rise in the malnourished group which suggested that as long as two years may be necessary to bring about the average gain.

Craviato (11) reported that children with severe protein-calorie malnutrition gave low developmental scores. As recovery took place the developmental scores increased except in those children who were less than six months of age at the time of beginning of treatment. He stated that underfeeding affects the weight and size of different organs to a varying extent with the ultimate pattern depending on the period of growth at which undernutrition begins.

Stoch and Smythe (46), in 1963, reported a longitudinal study of 21 malnourished Cape Coloured infants. Eighteen of the group were between ten months and two years of age, and the remainder were between two and three years. They were matched with an adequatedly nourished control group on the basis of age and sex. All came from approximately similar socio-economic backgrounds. The children were examined at about one year of age and at six to 12-month intervals for periods of two to seven years. At all ages, both intelligence quotient and brain growth, as reflected by head circumference, of the malnourished children were significantly lower than the controls. There was no improvement shown during seven years reported. A follow-up of head measurements in 1967 showed the control group were within standard limits for United States children of the same age while the malnourished children averaged a full inch smaller (44).

Methods of Feeding the Handicapped Child

There is agreement that many handicapped persons have inadequate intakes of food due to difficulty in eating, but there is much less agreement on the method of feeding a handicapped child.

Several investigators have stressed the importance of an eating environment conducive to relaxation (1, 2, 21, 22, 29). Abel (1) suggested absolute quiet during feeding with the child rested, the room quiet, and the person feeding relaxed. Gorey (21) stated that outside stimuli should be reduced at meal time. Kerr (29) emphasized that the child who is slow or clumsy should be allowed time to complete a motion and not be hurried. If the child had difficulty coordinating his tongue with swallowing he should be given an opportunity to relax between motions and if he became tired before completing a meal she suggested that the last part be fed to him. She also suggested that attention to his comfort such as adjustment of a tight shoe or brace might be needed to get the child to relax.

Adaptations for plates, spoons, trays and other eating devices have been recommended as helpful to the handicapped child (2, 16, 17, 21, 27). Gorey (21) described a food tray with inserts to hold deep dishes which would prevent food falling on the floor and thus give a sense of security while eating. Suction tips on the base of dishes to hold them in place and a table with a raised outer edge to keep dishes from falling off were other suggestions (29). Various types of spoons with build-up handles, swivels, straps, and various twisted shapes have been used with good results with patients who have a limited range of motion and incoordination (2). The size and shape of the spoon and the length of the handle may play a big part in success in eating (16).

The importance of the child sitting in an upright position was repeatedly mentioned (2, 4, 16, 17, 22, 29). Kerr (29) stated that the head should be kept upright during the feeding process. The child should be taught to hold his head in a slightly downward position, which is the normal head position during eating (17). Arnold (2) stated that no one could be expected to learn how to chew, drink and swallow properly while lying flat on their back. Tables and chairs used for handicapped patients should be of correct size and height for the child (29). Elbows should be even with the top of the table with the feet placed flat on the floor or supported by a foot rest (17).

Phelps (40) discussed the reversed swallowing wave which he described as being commonly found in cerebral palsied children. The wave of tongue motion that normally takes the food down the throat and pushes it on the tongue is reversed and food put in the child's mouth is pushed outward. He suggested that tube feeding, sometimes for months, may be necessary. He stated that by placing the food far back on the tongue and tipping the head back the child may learn to swallow. Blanchard (4) considers these methods detrimental to the development of normal reflex behavior of the lip and tongue. She stated that gavage feedings deprive the infant of sucking exercise and keeps the pharyngeal area under constant stimulation and when food is placed far back on the tongue, choking and gagging will result. In a brochure on feeding suggestions for the cerebral palsied, distributed by the United Cerebral Palsy Association, (17) it was stated that spoon feeding to the back of the mouth can delay progress by prolonging the infant swallowing pattern. They suggested putting the spoon on the tongue with some downward pressure to eliminate the tendency to push the food out of the mouth. According to Westlake and Rutherford (52) difficulty with swallowing liquids and solids is usually associated with inactivity of the lips and inability to lateralize and elevate the anterior part of the tongue.

Vomiting, choking, and drooling are frequently encountered when feeding the handicapped child. Gorey (21) attributed vomiting to a hyperactive reflex triggering the gag reflex. She told of a young boy who had never been given solid food who vomited when small pieces of food were introduced in his diet. When in spite of his vomiting, bulky but soft foods were continued in his diet and he realized that others ate it easily, his gag reflex became less sensitive. Kerr (29) suggested that vomiting during feeding could not always be attributed to behavior but might be caused by food that was too coarse or by feeding too fast.

According to Gorey (21) drooling was believed to be caused by certain sights and if the stimulus to drooling could be found the child might be able to overcome it. She suggested that eating something tart such as a persimmon might decrease the drooling by tending to dry up the secretion. Abel (1) was of the opinion that acid fruits and juices tended to increase drooling. Palmer (38) contended that drooling is usually not due to extra stimulus from the central nervous system or to excessive secretion of saliva but is almost always simply an indication that sucking and swallowing reflexes are not normal and saliva accumulates in the mouth without swallowing. Bosley (7) stated that drooling is due to sluggish swallowing reflexes or to failure to keep the mouth closed or both. Drooling will automatically cut down when chewing, sucking, and swallowing reflexes become adequately developed.

Kerr (29) believed that choking or gagging may be caused by food that is too coarse or by the dropping of food or liquid into the mouth when the head was thrown backward. Blanchard (4) contends that certain feeding practices such as the use of nipples with large holes, placing spoonsful of food far back on the gagging center of the tongue, or pouring large quantities of liquid into the mouth result in choking. Bosley suggested (9) that choking may mean simply poor ability to manage the tongue and keep the food in the right place until it has reached swallowing consistency.

Abel (1) stated that the texture of the food must be determined for the child according to his stage of development. She suggested that it may be more desirable to work toward a diet of ordinary texture as soon as possible, including foods that require strenuous chewing. Development of techniques to teach the cerebral palsied to chew have been pioneered by speech specialists because of its importance in speech development (9, 52). A very complete discussion on how to teach the cerebral palsied to chew has been published by Bosley (9). She emphasized the need to include solid foods in the diet and warned that the child must not be allowed to wash food down or moisten it with liquid.

Some authorities (17) advise not to attempt self feeding until there is adequate shoulder and arm control and the child can relax his head and neck. Kerr (29) suggested that self feeding could be started when the child had learned the fundamental motions of eating and showed a desire to feed himself. She suggested that if the child was given food he especially liked when self feeding was started it might be more successful. Teaching the child to drink through a straw might be the initial step in teaching self feeding if the child has adequate lip and tongue control and a good sipping and swallowing pattern (17). To teach a child self feeding the person doing the training may sit in front or beside the child but never stands or leans over him (6, 17).

Blanchard (4) believed that speech potential could be enhanced by the way food is presented to the neurologically damaged individual. She developed a method of feeding for the proper presentation of food by spoon. Her recommendations include: talking to the child during the feeding process; elevation of patient to an upright position facing the feeder; presenting the spoon of food horizontally to the center of the lips; closing the lips manually by the feeder's fingers if necessary to keep the lips closed until food is swallowed; removing the spoon from the lip area at once; and waiting until overt swallowing is observed before presenting another bite.

Holser-Buehler (26) conducted a feeding experiment with a group of ten cerebral palsied children using the Blanchard method of spoon feeding. The children in the study were spastic and athetoid cerebral palsied, with moderate to severe neuromotor handicaps. Their age range was from three to 22 years, with an intelligence quotient range of 20 or below to 100. A variety of feeding problems existed as weak or incomplete chewing, pushing out of food, excessive drooling, inability to hold food in the mouth, outward tongue thrust, curling of the tongue in the mouth, and other abnormal movements. She concluded that the Blanchard spoon feeding method led to improved use of the reflex behavior of the lips, tongue, and throat.

The feeding of the profoundly and severely retarded spastic patient presents special problems. These patients are unable to understand and follow directions or to communicate verbally. They are frequently malnourished and difficult to feed.

Wolfson et al (53) tested the use of a commercially produced diet mixture developed for severely retarded spastic patients. The mixture, when mixed with water and supplemented with a quart of milk, provided 2,000 calories and 78 grams of protein. Patients were fed two meals with the formula and given two supplemental intakes of milk and two of custard. Weight gains were shown and general health improved. The control group also showed a weight gain which was attributed to the increased attention given during the study. The feeding was rejected by patients of higher intelligence.

Tube feeding of 27 severely retarded spastic children using a commercially prepared product was reported by Pitts (41). These patients were difficult to feed and had been placed on gastric feeding because of personnel and time shortage. Caloric needs were calculated for ideal weight and each child received 21 calories per pound of ideal weight per day. Weight gain was shown and the general condition improved. There was no comparison made of respiratory infections, nutritional anemia, diarrhea and chronic regurgitation.

Feeding Reflexes

It is well documented that the infantile reflexes of sucking, chewing and swallowing are the primitive reflexes upon which speech is based (4, 5, 7, 38, 52). It was in the 1930's that Muyskens, a professor at the University of Michigan, first called attention to the importance of chewing, sucking and swallowing in speech disorders (38). To Muyskens, language was a modification of eating even more than it was a modification of breathing (33). His ideas were not well received, however, and his work was not published until 1950 (33). Students of Muyskens, inspired by his teaching, did not lose interest in his ideas and in the late 1940's a number of articles were published concerning the development of chewing, sucking and swallowing reflexes in the cerebral palsied

(7, 8, 38). It is believed that although the eating reflexes may be distorted by spasticity and athetosis or stopped developing at a primitive level, they are still intact in the cerebral palsied child, or the child would not have lived (7).

Motor patterns for breathing, sucking and swallowing are present from birth and those for mastication represent a modification of the sucking pattern. These activities are among the earliest patterned movements of the infant and seem to be mediated at fairly low levels in the central nervous system. Voluntary inhalation and exhalation for speech are controlled by higher centers in the motor cortex. This seems to be true for other muscle groups used in speaking. It appears that movements as tongue tip elevation and lip rounding, which originally were part of the infant's reflex feeding and breathing activities, gradually come under the control of higher voluntary motor centers (52).

Reflex therapy can best be understood when based on the stimulation-development principle of emergent reflexes. This principle applies to the excitation of desired reflexes which have not developed or have disappeared. According to this principle, unless the type and extent of nervous system damage precludes it, reflexes which emerge as a function of maturation may be facilitated by proper stimulation (37).

The feeding reflexes - rooting, lip, mouth opening, biting, sucking, chewing and swallowing - form the background for the emerging movements necessary for articulation. When they are absent or weak they can be excited by applying the appropriate stimulus and whenever possible, guiding the expected response. By excitation it is hoped that the particular synpathic pathway necessary for the motor action being sought can be established and developed (37).

This is well illustrated by Bosley (7) when she described how to manipulate the lips so they will round around the straw and the use of gentle pressure under the chin to start the swallowing movement. One of her techniques for teaching chewing is to take the child's jaw in her cupped hand and guide it into the desired grinding pattern (9). In Blanchard's (4) method the lips are brought together manually over the spoon.

The rooting reflex is the name given to the reflex orientation of the head toward a touch stimulus around the mouth area. It is closely associated with the lip and sucking reflexes (27). Prechtl (42) described the rooting reflexes in two stages. The first phase is characterized by side-to-side head-turning which decreases as the head is gradually directed toward the stimulus. This reflex disappears at about three weeks and merges into the directed head-turning reflex. The directed head-turning reflex is a single, well-guided movement of the head toward the stimulus. The time of disappearance of this reflex varies and it may be observed at one year (37).

A visual stimulus such as a breast or a bottle of milk may elicit a reflexive mouth opening at about four months of age. The biting reflex can be observed if a stimulus object is placed between the gums. It is usually inhibited by four months (36).

The lip reflex and the actual sucking reflex make up what is often called the sucking reflex. They are closely interrelated but the stimuli which elicits the lip reflex are different from those that most easily cause sucking. The lip phenomen consists of involuntary movements of the lips toward a touch stimulus placed on or about the mouth, and their closure and pouting as for sucking. A gentle stroking stimulus beginning on the cheek and moving gently toward the mouth produces the lip reflex most easily. In the newborn, the mouth opens, the tongue comes forward, the infant commonly swallows and makes sucking movements. Between six and 12 weeks of age the lip reflex changes slightly. The tongue does not come forward as the mouth opens, swallowing is less constant, and sucking is less frequent (27).

The sucking reflex is the response made by the baby when objects are placed in contact with the lips, front of the tongue, gums or hard palate (27). It consists of a forward, upward, and backward movement of the tongue (37). Sucking is easily elicited by placing a teat or a teat-sized object between the lips and into the mouth. If the baby does not suck, gentle movement of the object within the mouth will usually produce sucking. The first or second sucks are usually followed by swallowing but later swallowing follows sucking inconstantly (27). Inhibition of the sucking reflex occurs from about four months up to the first year (36).

The presence of food in contact with the walls or back of the pharynx, the back of the tongue, the epiglottis and soft palate is the common stimulus to swallowing (34). Coughing, sneezing, hiccoughing may also cause swallowing (27). The easiest way to elicit swallowing in babies is to initate the sucking response and watch for the swallow which precedes the first or second suck. The act of sucking presumably throws saliva into the reflexogenic zone for the swallowing reflex. In the new-born, swallowing is commonly preceded by mouth opening, protrusion of the tongue and sucking. The tongue is smoothly retracted as the mouth is closed and the movements of sucking and swallowing are difficult to differentiate (27). At about 12 weeks the pattern of swallowing is changed. The tongue does not come forward as the mouth is opened and there is more jaw movement. In a minority of babies tongue protrusion persists (37). This change in pattern is a good indication that the child is ready for semi-solid food (27).

Ingram (27) cautions that feeding reflexes should not be thought of as isolated neurological phenomena. Reflex follows reflex, one merging into the other imperceptibly, in the actual feeding situation. If feeding is to be successful, feeding reflexes must be integrated one with the other such as the closely coordinated sucking and swallowing reflex. The feeding reflexes also have to be coordinated with other activities of the infant. It is particularly important that there is coordination of sucking and swallowing with respiration.

Biochemical Studies of the Mentally Retarded

Culley et al (13) determined total serum protein, electrophoretic pattern and hematocrits on 164 institutionalized, mentally retarded patients. Hematocrits and total serum proteins were not depressed even for those patients whose weights were below the third percentile. The A/G[1] ratio decreased progressively for the lower weight percentiles although they were still within the normal range. Since the mean total serum protein level was about the same for the underweight and desirable weight patients it appeared that the low albumin level was balanced by a high globulin level in the emaciated patients. The lowered A/G ratio was interpreted as indicating a mild protein deficiency.

Karle et al (28) determined hemoglobin, serum concentrations of vitamin A, carotene, and ascorbic acid values for 12 cerebral palsied children in a university hospital. The children appeared to be well nourished on the basis of the biochemical findings. The dietary intakes

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[1]Albumin-globulin ratio.

indicated that in several instances intakes of iron and protein did not meet the Recommended Dietary Allowances - 1948 for healthy children of the same age.

CHAPTER III

METHODS AND PROCEDURE

Research Design

Twenty-four subjects that met the criteria for selection were randomly distributed into two test groups of twelve subjects each. The subjects in the experimental group were placed in a ward reserved for their use only. The subjects in the control group were left unchanged.

All subjects were fed the seven-day cycle control diet. The experimental subjects were fed using the selected feeding techniques. The subjects in the control group were fed by the regular feeding methods used in their ward. All other activities and treatment regimes of the subjects in both groups were left unchanged.

The first six-month period of the study was divided into five seven-day periods of measured dietary intake and four 35-day training periods. Final measurements were made at the end of the eleven months.

The first height and weight measurements were made at the time of patient selection and before the first intake record period. Succeeding measurements were taken within seven days of the completion of each intake record period.

Fasting blood samples were drawn for biochemical and hematological tests three weeks after the study began and at six to seven-week intervals during the study. Blood samples were taken by venous puncture if possible. If sufficient volume for the tests required could not be obtained by venous puncture, blood was taken from the femoral artery.

Because of the extreme difficulty in obtaining a sufficient volume of blood from some subjects it was decided to limit the biochemical and hematological test periods to four.

See Table 1 for more detailed research design.

Sampling Procedure

Thirty-three subjects were available that met the criteria for sampling. Subjects were grouped according to neurological impairment. Sixteen subjects were classified as microcephalic and seventeen included other types of neurological impairment. The sampling was done in two parts. In the first sample, twelve subjects and two alternates were selected from each of two groups three weeks before the study began. In the second sample six subjects were selected from each group for the experimental ward and six subjects for the controls. This was completed on the eighth day of the study and after the first dietary intake period.

Procedure for Sampling I

Names of subjects for each of the two groups were arranged in alphabetical order and assigned a number. Numbers were placed in a container and drawn at random. The first twelve drawn from each group were designated as subjects for the study. Two alternates for each group were drawn in the same manner.

Procedure for Sampling II

Names of subjects selected for each group in Sampling I were arranged in alphabetical order and assigned a number. Numbers were placed in a container and drawn at random. The first number drawn was assigned to the experimental group, the second number drawn was assigned to the

Table 1 Research design

PERIOD		DAYS	DATE	SUBJECT	TREATMENT	DIETARY INTAKE	TEST DAYS
I.	Measured Intake	7	June 29-July 5	All	2[&]	Weighed control diet	June 8 - measurements
II.	Training Period	35	July 6-Aug. 9	Group A* Group B**	1[+] 2	Measured control diet	July 22 - blood samples
III.	Measured Intake	7	Aug. 10-Aug. 16	Same as II	Same as II	Same as I	
IV.	Training Period	35	Aug. 17-Sept. 20	Same as II	Same as II	Same as II	Sept. 9 - blood samples drawn Aug. 23 - measurements
V.	Measured Intake	7	Sept. 21-Sept. 27	Same as II	Same as II	Same as I	
VI.	Training Period	35	Sept. 28-Nov. 1	Same as II	Same as II	Same as II	Sept. 29 - measurements Oct. 24-blood samples drawn
VII.	Measured Intake	7	Nov. 2 - Nov. 8	Same as II	Same as II	Same as I	
VIII.	Training Period	35	Nov. 9 - Dec. 13	Same as II	Same as II	Same as II	Nov. 14 - measurements Dec. 9 - blood samples drawn
IX.	Measured Intake	7	Dec. 14 - Dec. 20	Same as II	Same as II	Same as I	Dec. 20 - measurements
X.	Training Period	147	Dec. 21 - May 16	Same as II	Same as II	Same as II	May 5 - blood samples drawn
XI.	Measured Intake	7	May 17 - May 23	Same as II	Same as II	Same as II	May 24 - measurements

* Experimental Group
** Control Group
\+ Selected feeding techniques taking as much time as needed up to 70 minutes
& Regular feeding methods, no maximum or minimum time

control group. This was continued until all numbers were drawn and the same number of subjects were placed in an experimental and a control group. There was one subject on a bottle in each group. The experimental group had two subjects on a tube feeding, the control group had one.

Calculation of the Diet

Three kinds of seven-day control diets were calculated: pureed baby food[1]; soft; and soft with one or two finger foods each meal. Diets were calculated to meet 100 per cent or more of the Recommended Dietary Allowance, National Research Council - 1964 (19), for the oldest age group included in the study. The pureed diet provided a maximum of 15.0 per cent of calories by protein, 54.1 per cent by carbohydrate and 30.9 per cent by fat. The soft diet provided 15.6 per cent of calories by protein, 40.2 per cent by carbohydrate, and 44.2 per cent by fat. Three of the subjects were fed on pureed food tube feeding which provided 32 calories and 2.0 grams protein per fluid ounce. Two of the subjects were on bottle feedings - one on Mullsoy[2] and one on Nutramigen[3]. In order to meet caloric requirements, without increasing the volume of food over what the children could reasonably be expected to eat, lactose was added to the fruit and fruit juice. Lactose was selected because a larger amount could be added without changing the flavor of the food. This sugar changed the consistency and the texture of the fruit making it more

[1]Contributed by H. J. Heinz Co., Pittsburg, Pennsylvania.

[2]Manufactured by Borden Co., New York. Normal dilution provided 20 calories and 0.96 grams protein per fluid once.

[3]Manufactured by Mead Johnson and Co., Evansville, Indiana. Normal dilution provided 20 calories and 0.6 grams protein per fluid ounce.

difficult to feed. All subjects received supplemental vitamins[4]. Day to day deviations in amount of calories, protein and volume were negligible. Portion sizes were uniform for all subjects regardless of age or customary intake of food. See Appendix pages 79 and 80.

The seven-day control diet was repeated throughout the study. During the training period all food was measured and during the intake period all food was weighed on an Ohaus balance scale.

Procedure for Making Feeding Assignments

In order to eliminate the variable that might occur due to subject-aide interpersonal relationships feeding assignments were made randomly. Subjects were assigned a number which was used throughout the study. At each meal, the aide in charge drew numbers to determine feeding assignments. Names of aides on duty were listed alphabetically. Numbers were drawn randomly with the first number going to the name at the top of the list, the second number going to the second name, and so on until all feeding assignments were made.

Feeding Techniques

Three distinct types of feeding techniques were used in the study. Spoon feeding at mealtime was based on the Blanchard method (4). The use of the straw was patterned after that developed by Palmer (38). Chewing techniques had been developed at Winfield State Hospital (22, 48) but had many similarities to those suggested by Bosley (9). Aides were trained in the use of the techniques before they were allowed to feed

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[4]Tri-vi-sol, 0.6 cc. daily - provided 3000 U.S.P. units of vitamin A, 400 U.S.P. units vitamin D, and 60 mg. ascorbic acid. Manufactured by Mead Johnson and Company, Evansville, Indiana.

the subjects. During the first six months a trained observer was present at each meal to supervise feeding and record the progress of each subject.

Method of Feeding at Mealtime

1. Make the child as comfortable as possible - dry; hands, face, and nose clean; clothing clean and not binding.
2. Place child in an upright position. If support is needed, place it so hands are not restricted. Do not bind across chest or under armpits in such a way that there is interference with natural breathing or movement.
3. Prepare the child for mealtime by talking to him while putting on his bib. Tell him you are going to feed him and let him see the tray with food.
4. Give food in the form that it is served on the tray. Do not mix foods together or add medicine. Medicine is to be given either before the tray is served or after the meal is completed and the tray removed so there is no association between mealtime and the taking of medicine. The only exception to mixing food is cereal at breakfast - cereal is to have milk added before feeding.
5. Using a small spoon, dip the spoon vertically into the food, lifting it quickly to get a very small bite on the tip without smearing the bottom of the spoon. Present the food so that the child can see and smell it. Aim the spoon horizontally to the center of the lips making certain that the upper lip is touched lightly.
6. With one hand, bring the lips together over the food and remove the spoon at once. As the spoon is removed, pull upward

so the food comes off in a sucking action.

7. Remove the spoon from the lip area at once. Do not wipe away dripped food from the mouth area until another bite of food is about to be offered.

8. Do not offer another taste until swallowing action has been observed.

9. If the child has difficulty in keeping the mouth closed, it may be necessary to hold the lips together lightly with the thumb and forefinger until swallowing is completed.

10. If the child pushes food out of his mouth with his tongue, present the food as the tongue is going into the mouth. If necessary, lift the tongue with the tip of the spoon to get the child to push his tongue in. With one hand, bring the lips together over the food, remove the spoon and hold the lips together lightly to prevent tongue from pushing food out.

Straw Technique

The straw technique was used each meal with every subject who was spoon fed regardless of his ability to suck and swallow. Plastic surgical tubing, 1/8 inch in diameter, cut in four to five inch lengths, was used to begin training.

1. Insert one end of the plastic tubing into a glass of liquid, usually milk or fruit juice. The food should be something well accepted by the child.

2. When the liquid has entered the tubing, place the finger on the tip end of the tube so two to three inches is filled with liquid.

3. Hold the tubing horizontally so the liquid will not run out and

place it on the middle of the tongue. Stimulate tongue action by stroking the middle of the tongue with the tubing. Do not stimulate the tip of the tongue or it will protrude.

4. Remove the finger from the tip of the tubing and let the fluid run into the mouth.

5. Remove tubing to allow the swallow reflex to occur. If the swallow does not follow immediately after the liquid is released it may be necessary to remind the child to swallow by gently stroking upward on the throat under the chin. If the child does not close his lips voluntarily, hold the lips together lightly until swallowing occurs.

6. Repeat the same procedure several times until the child becomes aware that something good will come out of the tube.

7. Lower the tubing so it is slightly below horizontal and the liquid will not flow into the mouth. Mold the child's lips around the tubing by putting the forefinger above the upper lip and the thumb below the lower lip. The child is then encouraged to move his tongue around to find the taste. Raise and lower the tubing until the child begins to move his tongue around the straw producing a weak sucking motion. Immediately release the liquid so he will connect the sucking motion with the good taste of the liquid.

8. As the child begins to understand what is expected of him, lower the tubing and place forward nearer the tip of the tongue each time you go through the procedure. Each time he will have to suck harder to taste the liquid. This is to be continued until the tube is being placed between the lips and in a vertical position.

9. As the child develops a stronger sucking action increase the length of the plastic tube.

10. When the child is able to suck through a seven to eight inch plastic tube change to a plastic straw in a glass. All liquids are to be taken by straw when the change to plastic straw occurs.

11. As the sucking reflex becomes more developed and lip control improves, change to a paper malt straw.

12. For children who have difficulty in closing their mouth it may be necessary to hold the lips together while using the straw.

Chewing Technique

Those subjects that became proficient in sucking food off of the spoon and in swallowing were encouraged to learn to chew. The first step was to develop biting ability.

1. Small pieces of toast or tender pieces of meat are placed between the canine teeth.

2. The child is encouraged to apply pressure on the food with his teeth. If he does not understand what is expected of him, gentle pressure is applied on the lower jaw in an upward movement.

After the child was able to bite well, training in chewing began.

1. The food is presented on the canine teeth for biting.

2. Chewing movements are simulated by placing one hand on the lower jaw and moving it up and down and side to side in a rotary fashion.

3. Lips are held together if there is a tendency to push the food out with the tongue.

Procedure for Recording Dietary Intake

The dietary intake record period consisted of a seven-day record of volume of intake of the control diet. Since the control subjects were fed as usual with no increase in personnel it was not possible to determine intakes of individual food items because of lack of time and the practice, of some aides, of mixing food together before feeding. In the experimental ward, where personnel was available, the holding of food in the mouth and the poor swallowing patterns of subjects precluded any attempt at determining intakes of individual food items.

All food served during the intake record period was weighed on a balance scale. Pureed baby meats and vegetables were weighed and served in the container. All other foods were weighed and served in paper serving dishes. All food for each meal was assembled and served on a plastic, divided tray.

Subjects were fed in the usual manner as outlined in the treatment procedure.

At the beginning of the study the order of serving trays was determined. This same order of service was followed each meal so each subject had approximately the same time interval between meals.

At each meal the weight of food, tray, spoon, serving dishes and bibs served each subject were recorded on an intake record form. See Appendix page 81.

Bibs of a coverall design with a turn up pocket were made of terry cloth lined with plastic. The bib was fastened on the subject in such a manner that all food would fall on the bib. Food left on the face was either wiped off with the bib or a paper tissue. If food was spilled but did not drop on the bib it was wiped up with a paper tissue. The paper tissue with food particles was placed in the pocket of the bib.

After feeding, the subject's face was cleaned of all food with a tissue, and the tissue was placed in the pocket of the bib. The bib was folded with the plastic outside so the food would not fall off.

Each subject's tray, spoon, uneaten food, serving dishes, bib and used tissues were returned to a central area and weighed and recorded on the intake record form. If tissues were used the weight of the tissue before using was added to the bib weight. By subtraction, total volume of intake by grams was determined for each subject each meal. See Appendix page 81.

Anthropometric Measurements

Height and weight measurements were taken at the same time of day for each weighing period.

Height was measured using a specially constructed measuring table as described by Vaughan (50). The child was placed on the table with his feet held firmly against a fixed upright at the zero mark. A movable upright was then brought firmly against the head. If a child was too tense or rigid to lie flat on the table, the measurements were taken with the knees flexed.

The subjects were weighed recumbent, without clothing, on a bedside scale[1] which had been calibrated for accuracy at the beginning of the study. Before each subject was placed on the scale, the weights were returned to zero and the scale balanced.

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[1]In-Bed Scale, manufactured by Acme Scale Co., 3620 San Pablo Ave., Oakland, California.

Laboratory Procedures

Blood for total serum protein and electrophoresis was allowed to clot not more than 45 minutes, then centrifuged and the serum removed. If not processed within 24 hours the serum was frozen[1] at -10 degrees C. Total serum proteins were determined on the Multi-12 Analyzer[2]. Controls were run every ten samples to see that the machine was in phase. Electrophoretic patterns were determined by paper electrophoresis.[3] The processed strips were stained and scanned electronically.[4]

Evaluation of Eating Ability

To obtain a permanent record of changes in eating ability, moving pictures of each subject were made during the feeding period. These pictures were taken before the first intake record period, at six to seven-week intervals during the first six months, and at the end of the eleven months. These picture records were made on a 16 mm. Bell and Howell camera using Kodak Kodachrome film. Processing was done by an authorized Kodak Processing Laboratory in Dallas, Texas. In the first period 100 feet of film was used for each subject. At the second filming, in an attempt to cut costs, only 50 feet of film per subject was used. It was found that this was not significant footage to get a realistic picture of performance, so for the remaining periods, 100 feet per

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[1] Revco Freezer, contributed by Revco Corporation, Deerfield, Michigan.

[2] SMA-12, manufactured by Techicon Corporation, Ardsley, New York.

[3] Manufactured by Gelman Instrument Company.

[4] RB Analytrol, manufactured by Beckman Instrument Company. Modification to scan cellulose strips - B-2 cam and 500 millimicron wave length filter.

subject was filmed. Before the first series of movies were taken the subjects were exposed to camera noise and bright lights so they would be less likely to be distracted during the actual filming session. All pictures were made during regular meal hours. Aides were instructed to feed the children as usual and alternate between spoon feeding and the giving of liquids.

The procedure for filming consisted of setting up the camera and lights and making all the adjustments necessary for focus and lighting. After the equipment was in place, the subject and the aide doing the feeding were placed into position and the focus rechecked. With lights on, but camera off, feeding was started. At the end of two minutes the camera was turned on and the filming continued without interruption until the designated amount of film had been used.

Statistical Procedure

Data collected during the study was compiled at a program prepared for using an IBM computer 7040 at the Computer Center, Oklahoma State University.

Since there was an uneven number of observations in all treatment combinations a disproportionate data analysis was programmed.

The various parameters μ, α's, β's, δ's, and ρ's and their interactions were estimated for each variable using the following linear equation:

$$Y = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \delta_{ijk} + \rho_m + (\alpha\rho)_{im} + (\beta\rho)_{jm} + (\alpha\beta\rho)_{ijm} + \epsilon_{ijkm}$$

μ is the general mean, α is the group effect, β is the treatment effect, δ the subject effect and ρ the period effect.

An analysis of variance breaking the total variation into component parts was prepared for each variable using the F test of significance.

X'X Inverse/Beta was computed for each variable breaking it down into its component parts by treatment, group, period, and their interactions. From these values, means for each combination of treatment groups were calculated. From the mean values, a comparison of the treatment groups by periods was graphed. See Appendix pages 82, 83 and 84 for mean values of data presented in graphs.

CHAPTER IV

RESULTS AND DISCUSSION

Changes in Eating Ability

Improvement in eating ability may be shown by progression from one developmental level of eating to the next. Evaluation of changes in eating ability are based on observations of moving pictures made at regular intervals throughout this study.

At the beginning of the study, nine of the 12 subjects in the experimental group were being spoon fed. Two of the children were on tube feedings and one on a bottle feeding. Of the nine subjects being spoon fed, three had some previous training in chewing, sucking and swallowing. None of the three were being given their liquids by straw at meals at the time the study commenced.

In the control group, ten of the 12 children were being spoon fed. One subject was on tube feeding and one on a bottle. Three of the ten children being spoon fed had some previous training in chewing, sucking and swallowing. None of the three subjects with previous training were being given liquids at meal by straw.

In the control group the patient on tube feeding died nine months after the study began of chronic lobular pneumonitis. Eight months after the study commenced subject 28 died of bronchial pneumonia. Of the ten remaining patients there was no noticeable change in eating ability observed.

In the experimental group, one of the subjects on tube feeding died two months after the study began. His death was attributed to aspiration pneumonia. Although aides and others working in the experimental ward believed that the other subject on tube feeding could be trained to eat from the spoon, it was not possible to obtain medical permission for removal of the tube. Subject 05 was taken from the institution by his parents three months after the study commenced.

The subject on the Nutramigen bottle feeding presented one of the most difficult feeding problems in the experimental ward. He was a three year old male, weighing 18 pounds, who as far as could be ascertained from medical records and from conversations with his mother and grandmother, had never since his birth, taken a drop of food without being force fed. At the time the study was begun he was being fed by restraining his arms and feet and holding his head so he could not turn or evade the bottle. The nipple had a large hole and as he was held down the Nutramigen was dropped in his mouth. Sometimes two aides worked together to feed him. Feeding was accompanied by screams, sobs, and choking. Frequently after a several minute struggle resulting in an intake of three or four ounces, he would immediately vomit the feeding. He would not allow anything to be placed in or near his mouth and would resist by refusing to open his mouth or by rapid head turning. Since it was apparent this method of feeding only aggravated the problem, a complete reversal of approach was used. Before offering the bottle, he was held for several minutes. Instead of being tightly held while being fed, he was put in a chair where his arms and feet were not restrained and could move freely. His head was allowed to move from side to side. He was offered his bottle every three or four hours but was not forced to eat. At first it was necessary to quickly insert the bottle in his mouth between head turnings. Every effort was made not to hurt his mouth. After following this procedure for five days he stopped fighting, allowed the bottle to be put in his mouth, and made a few feeble sucks. After he had stopped fighting the bottle it was observed that he liked to be held. It was also observed that he liked to be rocked so a rocking chair was obtained. From then on he was usually held and rocked while taking his bottle. He became a much happier child, seldom vomited, and fussed only if he wanted to be held. His sucking action became stronger and he took the bottle well if he was hungry. No attempt was made to put him on a schedule. At the end of the eleven months he was still on the bottle feeding. A few attempts were made to give solid food but were rejected.

The nine children who were spoon fed had various types of feeding problems: a tendency to push food out of the mouth with the tongue; inability to close the mouth; inability of the tongue to move the food to the back of the mouth for swallowing; poor occlusion of the teeth; poorly coordinated suck-swallow reflex; vomiting; drooling; and a tendency to let food lie in the mouth without swallowing. Other types of feeding problems not directly related to poor development of feeding reflexes were also present. The spitting of food, temper tantrums, and refusal to eat anything but fruits and desserts, all indicated that many of the children had found food an effective attention-getting device.

Subject 09 was an alert, quadraplegic child whose main difficulty in eating was his tendency to push food out with his tongue and the inability to close his mouth voluntarily. At the time the study began, he always sat with his mouth open. At mealtime much of his food was pushed out by the tongue. He had had previous training and was fairly proficient using the plastic straw but was not receiving his liquids at mealtime by this method. Although his basic problem was his spasticity it was interwoven with his use of food as an attention device. If he was not fed by one of his favorite aides he would frequently use his tongue to keep food out of his mouth or would resist lip closure when eating, and be generally uncooperative. This subject made a good response to the spoon feeding method. The bringing of the lips together over the spoon, and holding them together while swallowing, was particularly effective in teaching tongue control in this subject. At the end of six months there was much less tendency for food to be pushed out with the tongue. At the end of the study he could, when relaxed, retract his tongue when directed to do so, but was far from having complete tongue control. While he was still unable to voluntarily close his mouth, mouth closure had improved. It was no longer necessary to hold his lips together for every bite. This subject progressed rapidly to the use of the paper malt straw and within weeks was being given finger foods as a first step in chewing. He developed a good up and down motion but had not developed a rotary chewing motion or the ability to move the food from side to side with his tongue. At five months an attempt was made with self feeding using hand to mouth techniques. It was quite apparent that he understood what he was to do and desired to do so but because of his extreme spasticity no progress was shown.

Drooling, a tendency to let food lie in the mouth without swallowing, poor occlusion of the teeth, and a poorly coordinated suck-swallow reflex were seen in several of the subjects. Subject 06 was passive and unresponsive to food. He had a slight appetite and an irregular food intake pattern. He ate very little for several meals and then for one meal ate everything offered. If he was not hungry, or showed no apparent interest in food, he would let food lie in his mouth without swallowing. His teeth and gums were in extremely poor condition. It was difficult to bring his lips together over the spoon or to close his mouth because of the protrusion and irregularity of his teeth. He showed limited tongue movement. His response to the spoon feeding method was fair. He made a slight improvement in tongue motility but it was sporadic and variable. It was not possible to teach this subject to use the straw because of the difficulty of bringing his lips together tightly enough to mold around the straw. While some aides were occasionally successful with the straw, it was an unusual occurrence. In spite of his limited progress in eating, his general appearance improved, and he became more alert and interested in ward activities.

Subject 07 was passive with little awareness of her environment. At the beginning she ate everything offered and gained five pounds the first six weeks. She responded well to stimulation at the lip area, opened her mouth readily and usually swallowed without having to be reminded. She took her milk from the bottle. She frequently had hand tremors at which time she had difficulty in bringing her tongue forward to receive the food. At about the fifth week she had several severe seizures over a 24-hour period. After this period of illness her appetite decreased although she continued to maintain her weight. The straw technique was started at about the sixth week and in two weeks she was able to draw the milk up in her mouth. She had a poorly coordinated suck-swallow reflex and would let the milk lie in her mouth without swallowing. At about eight weeks she was taken off the bottle entirely. Her response to spoon feeding and the straw technique was fair. Although she did not present any great difficulty in feeding she made little improvement and at the end of the study was still holding food in her mouth without swallowing. She was taking all her liquids from plastic tubing but her suck-swallow reflex had not improved.

Subject 04 was a hyperactive, microcephalic who had occasional seizures. He was constantly in motion with head moving and arms flying. He had had previous training with the straw and was an expert in the use of the paper malt straw. He rejected coarse foods and ate meat and vegetables poorly. If he did not like what was offered he would push it out rapidly with his tongue. He was an extremely messy eater and dropped much food on his chin and bib. He would projectile vomit without any noticeable reason or provocation. In spite of repeated efforts, it was impossible to use the spoon method of feeding and close his lips over the spoon. There was no improvement shown in his eating ability. In spite of his expertness with the straw it was not possible to get him to develop any satisfactory eating pattern.

Subject 11 was a problem child in many areas. His problem in eating appeared to be more related to his behavior than to poor development of eating reflexes. At the time the study started he had frequent temper tantrums with screams and head banging if he was not fed before the other subjects or if he was served food he did not like. In the past he had been able to manipulate the aides with his tantrums to the extent that he was being fed a diet consisting mostly of ice cream and milk. It was difficult to devise an adequate means of handling the behavior problem associated with his eating. There was a difference of opinion among the aides as to how he should be disciplined. At meal time he was offered his tray, and if he refused to eat, it was removed and he was not fed until the next meal. An attempt was made to be consistent about removing him from the feeding area when he started to scream or had a tantrum. After a few weeks his tantrums became less frequent but never ceased completely. He had developed a kind of open-mouth chewing that was quite effective. At first he fought having his mouth closed, later he tolerated it occasionally, but it was never possible to effect mouth closure. He had excellent tongue motion except it was incorrectly used. His actions indicated that at some time he had been hurt while being fed and he was very cautious whenever he was approached with a spoon. He drank reasonably well from a glass. Attempts at teaching him to use a straw were not successful because he would not allow the straw in his mouth. There was no response to the spoon method of feeding and he showed no progress in eating ability. His behavior improved over the 11 months but there were occasional episodes. It was difficult to assess his behavior. Undoubtedly he had found bad behavior more rewarding than good behavior but it is probable there were organic causes. Blood glucose levels on this subject showed a wide fluctuation between 42 to 97 mg. per 100 ml., which may be a partial explanation of his frequent tantrums.

Subject 10 was a quiet but alert child. She had a good eating pattern at the start of the study. She was proficient in the use of the straw having had previous training. Her difficulty in eating was more related to behavior than to poor development of eating reflexes. She was frequently uncooperative at meal time and if she did not like the food offered would spit it out. She was very adept at sucking milk or liquid in a straw, holding it in her mouth, and then showering it on her unsuspecting feeder. This she did with evident enjoyment. She responded well to the spoon method of feeding. It was seldom necessary to remind her to close her lips. She was on a soft diet with one finger food each meal at the time the study began and within a few weeks advanced to two finger foods each meal. She improved her chewing ability and at the end of the study had developed a good rotary chewing motion, and moved the food from side to side in her mouth with her tongue. She continued to reject certain foods with occasional episodes of spitting.

Subject 08 was a four-year-old boy who was an arrested hydrocephalic. At the time the study started he was taking milk from a bottle. He still had the directed head-turning reflex when he was stroked softly near the mouth area. He was spastic and with his large head had difficulty finding a firm and comfortable sitting position. He had a very small mouth with good teeth and occulsion. At times it was difficult to get him to open his mouth, or he would bite down on the spoon. He made an exceptional response to the spoon method of feeding and the straw technique. Within six days after he entered the experimental ward he was using the plastic tube. He developed a strong sucking action and always took his liquids well. Within three weeks his rooting reflex was no longer present. He learned to suck food off the spoon within two weeks. In eight weeks he was being offered bites of bread and toast as a first step in chewing. He was a slow eater and while he usually ate well he could not be hurried. This subject had frequent infections and high temperatures. In spite of this he had one of the highest intakes in the experimental ward. He made improvement in other levels of development as well as eating. He tried to turn over in bed but his spasticity and large head made this impossible. His response to the spoon-feeding method and the straw technique was very good. He continued to make progress and at the end of the study was chewing vegetables and occasionally meat.

Subject 12 was a seven-year-old boy who weighed 28 pounds. At the time the study started he was vomiting once or more a day after meals. This child was considered a problem feeder, and required 30 to 45 minutes or more to eat each meal. He had frequent coughing and choking spells while eating. Since he was a mouth breather he became upset at having his lips closed too tightly. His teeth were poor and he was unable to close his mouth voluntarily. He was started on the spoon method of feeding and allowed to eat very slowly. At first he choked almost every meal and frequently vomited. Within two weeks the vomiting decreased and the choking became less frequent. Several attempts were made to teach him to use the straw. Because of his poor teeth he had great difficulty in molding his lips around the straw. Some aides were able to get him to use a straw and take two to three ounces of milk but his response was generally poor. His response to the spoon method of feeding was good and he frequently sucked food off the tip of the spoon. Although his intake decreased by one-half when he entered the experimental ward he maintained his weight. It was felt that most of what he had eaten before was vomited and his actual intake was very low.

There was great variation in food intake in the experimental ward. Only four of the subjects made good progress in eating ability. When the food intake, weight and height changes of these subjects were plotted over the 11-month period they were noticeably greater than the other subjects. Figure 1 shows the intake record of the four subjects. They all had a decreased food intake during the first six weeks of training. At the end of the next six weeks there was an upward trend. There was another drop in food intake at the fourth period and from that point a gradual increase. Subject 09 did not follow the typical pattern but showed less decrease during the first period and a steady increase from then on. Subjects 09 and 10 showed a greater intake at the end of the study than at the beginning.

All four subjects exhibited a weight increase. Even though the intake records indicated a lessened intake it was reflected only slightly in the fourth period by a small drop in weight of two subjects. Figure 2 showed the weight change over the 11-month period. Figure 3 gives the

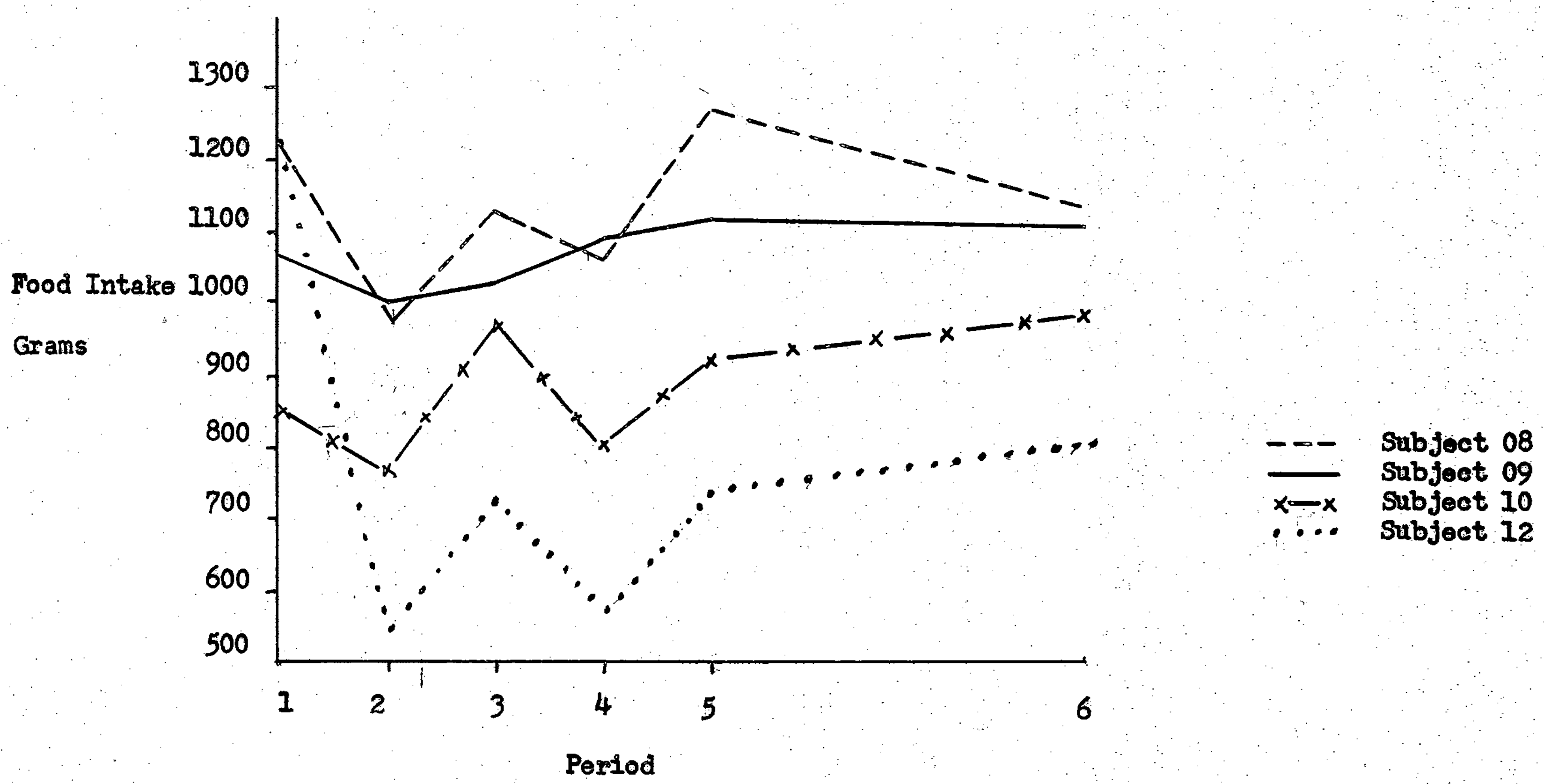

Figure 1. Food intake over 11-month period of subjects in treatment group who made good progress in eating ability.

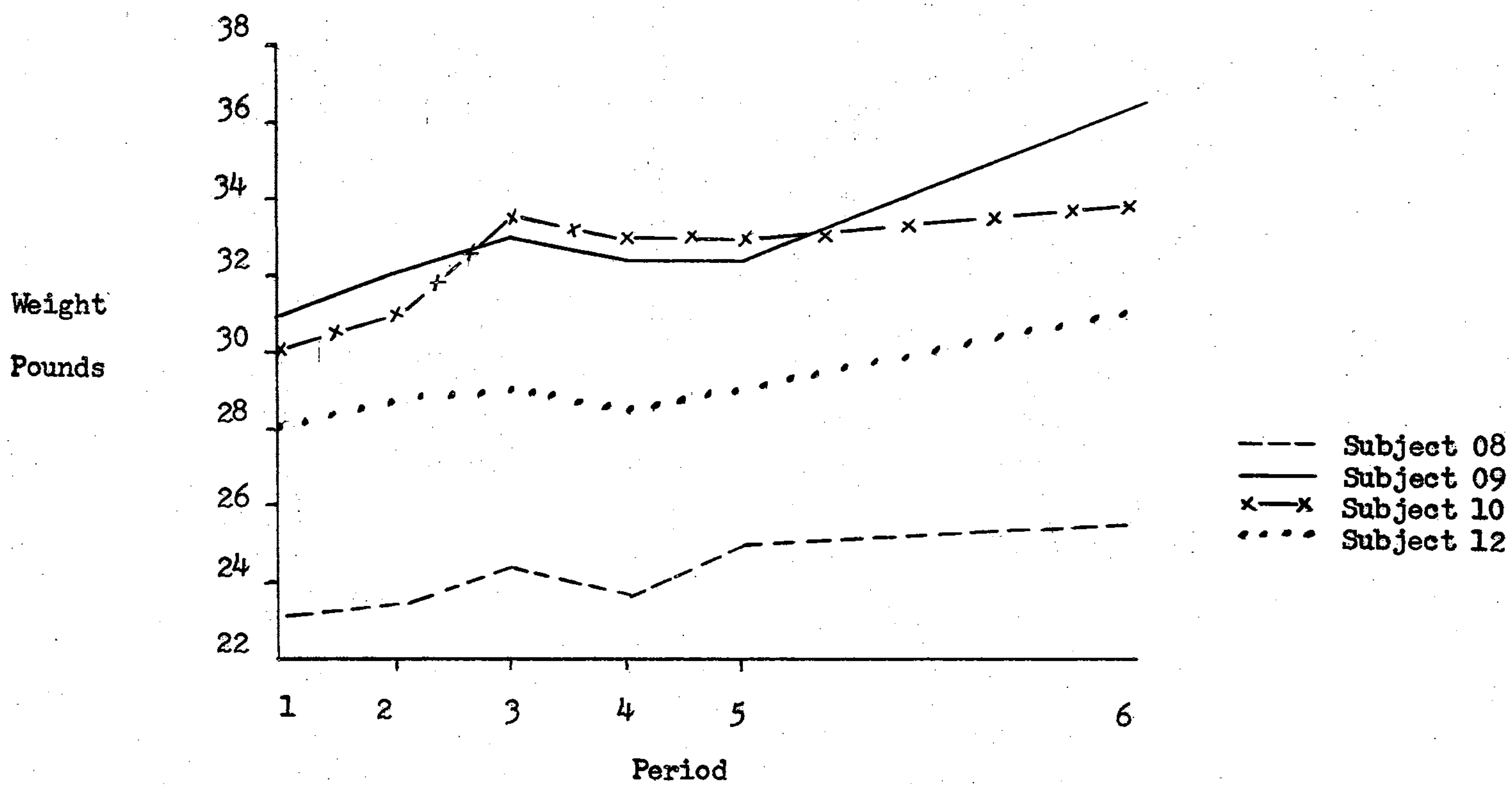

Figure 2. Weight change over 11-month period of subjects in treatment group who made good progress in eating ability.

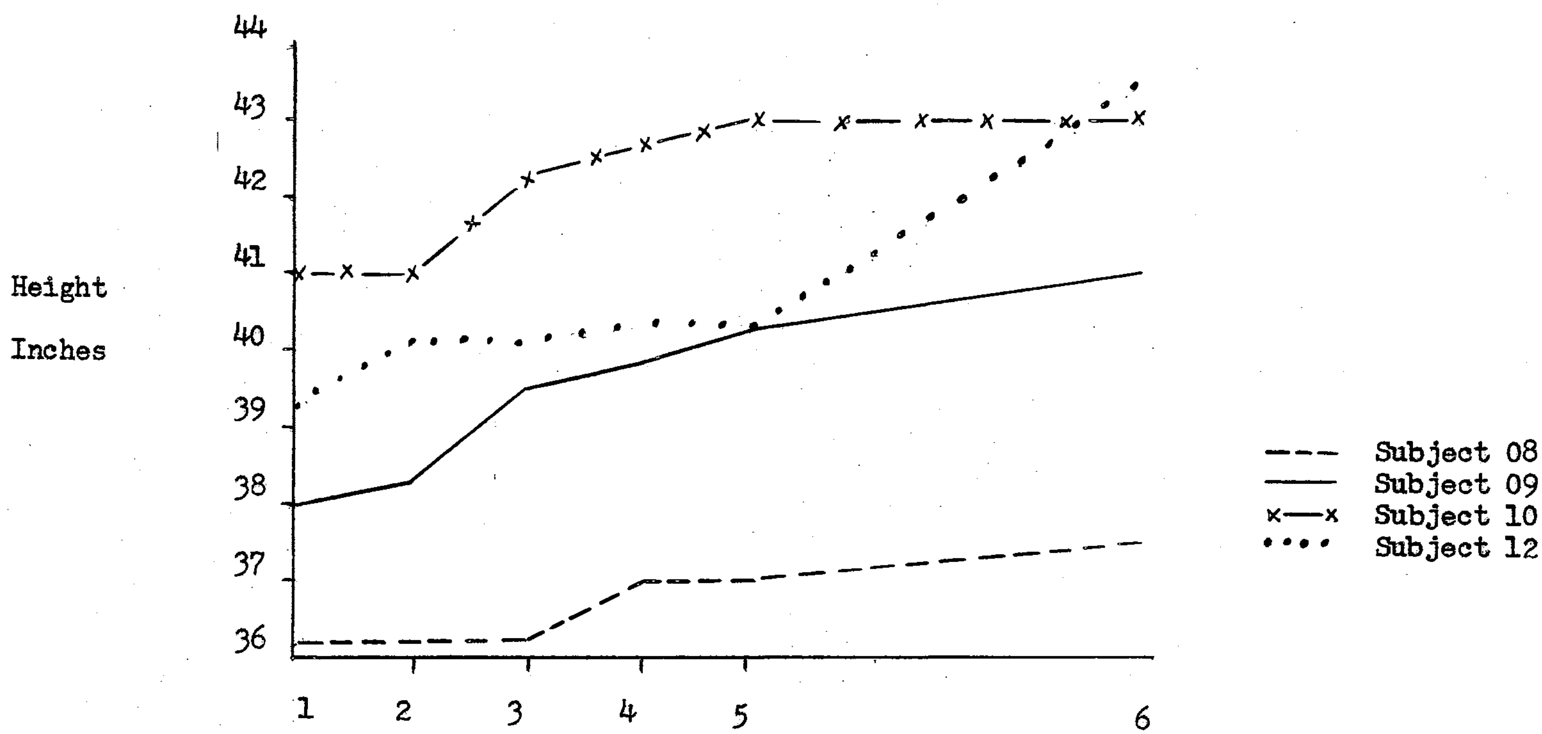

Figure 3 Height change over 11-month period of subjects in treatment group who made good progress in eating ability.

height change of the same four subjects over the same period. The changes in height are more evident and ranged from one to four inches.

Another indication of improved ability was demonstrated by a decrease in amount of time required to feed the subjects. Figure 4 shows the change in time required to feed the four subjects over the 11-month period. All subjects showed a sharp increase in feeding time during the first six weeks. Starting with the seventh week a gradual decrease in feeding time was observed in subjects 08 and 12. Subject 09 leveled off at the seventh month and subject 10 showed a time increase. The food intake increased and the time required to feed decreased from the seventh month in all subjects except 12. This indicated that all subjects were becoming more proficient in eating ability. During the same period of decreased feeding time gains were made in height and weight.

Food Intake

The difference in volume of food intake between the control and treatment groups was significant at the ten per cent level. The mean intake for subjects in the control group was 1122.8 grams and in the treatment group 984.1 grams. The individual mean range in the control group was from 921.5 to 1331.7 grams and in the treatment group the range was from 670.5 to 1284.3 grams.

Figure 5 shows the food intake over a 11-month period by treatment groups. There was a decreased intake during the first 18 weeks of training in the experimental group. Part of this may be attributed to the change in the method of feeding. After 18 weeks there was a gradual increase for the remainder of the 11-month period.

In order to make a calorie comparison with previous studies of food intakes, a conversion factor was calculated for each type of diet and

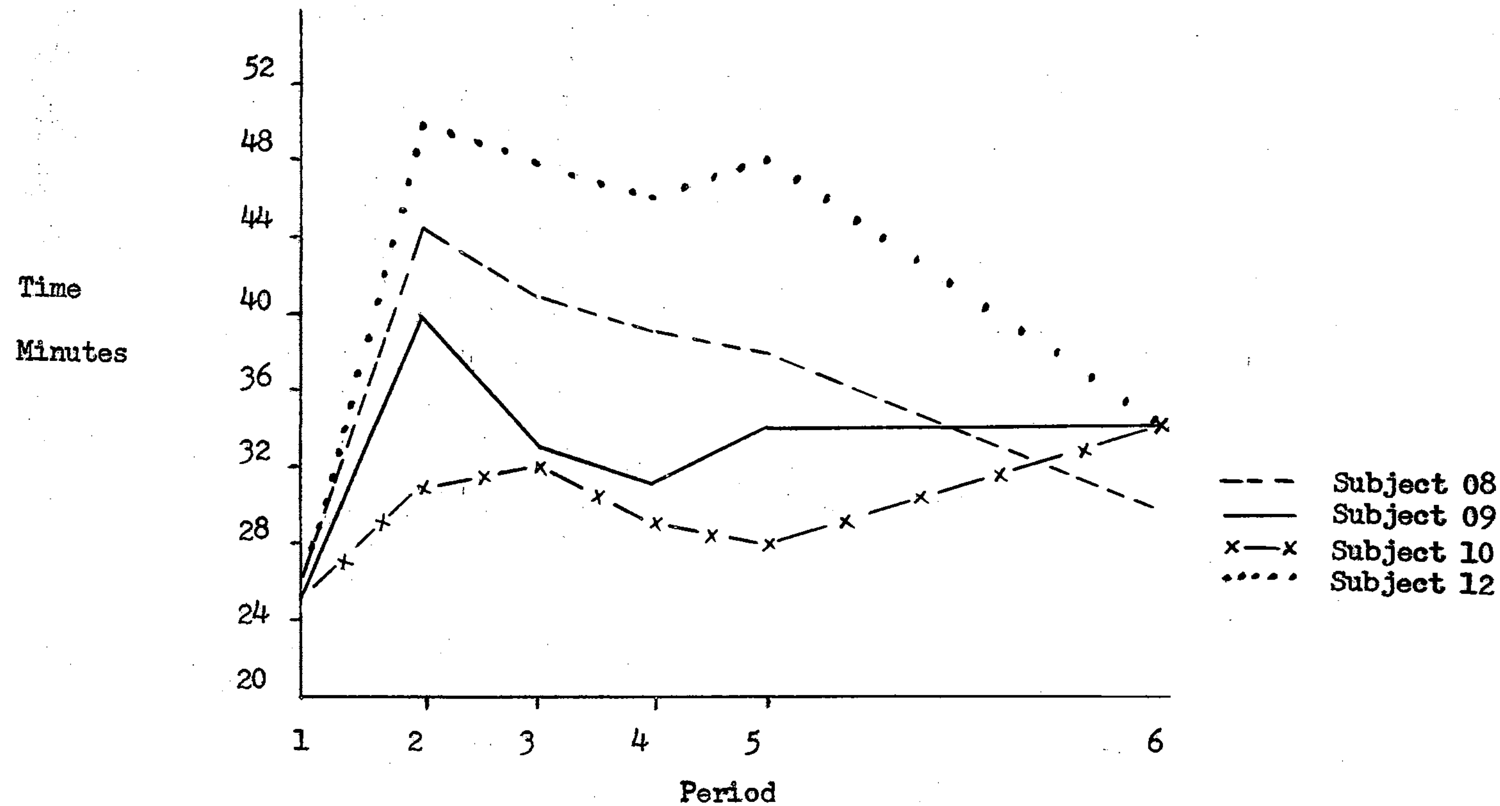

Figure 4 Time required to feed subjects in treatment group who made good progress in eating ability. Changes over 11-month period.

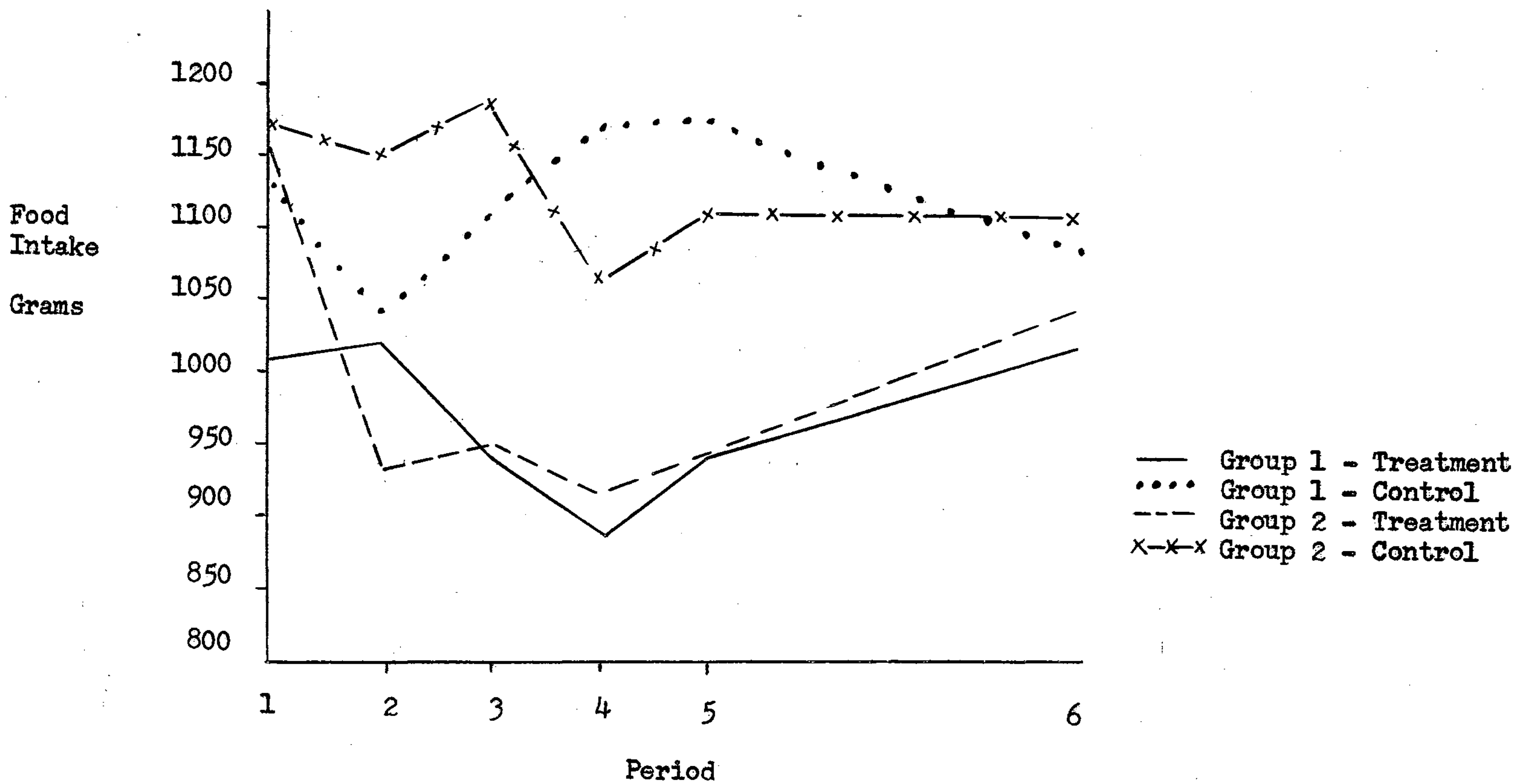

Figure 5 Food intake over 11-month period. Comparison by treatment groups.

feeding. Total calories was divided by total volume in grams. By multiplying the gram volume intake by the conversion factor an approximation of calorie intake was made. Based on calorie approximations the mean caloric intake for the treatment group was 1054.2 calories and for the control group 1091.2 calories. These caloric intakes are less than those reported by Leamy (31), Karle et al (28), and Peeks and Lamb (39) for cerebral palsied children of approximately the same age. Peeks and Karle used the interview technique with parents to obtain dietary histories. Leamy used a combination of weighing and estimating methods over a 48-hour period. While there is error involved in using a conversion factor, because of variation in kinds of food eaten, the error would favor lesser values instead of greater values.

Per cent of calories as recommended by the National Research Council were calculated. The range in the treatment group was from 33.8 to 85.6 per cent of recommended allowance for calories and in the control group 35.9 to 87.7 per cent. The mean on the treatment group was 58.3 per cent and in the control group 59.0 per cent. Calculations are presented in Table 2.

Height

There was no significant difference in height changes due to treatment effects between the treatment and control groups. There was a significant difference between periods and their interaction with the group and treatment at the five per cent level of significance. The mean increase of the treatment group from the first to the last period was 4.94 inches and in the control group 1.48 inches. The mean increase of group one treatment subjects was 2.75 inches while no increase was shown in group one controls.

Table 2 Food intake by volume, calorie approximation, and per cent of recommended allowance

Subject	Mean volume intake-grams	Conversion factor	Calorie approximation	Per cent RDA
Experimental				
01	1254.0	1.066	1336.8	63.6
02	1284.3	1.066	1369.1	85.6
03	670.5	1.333	893.8	55.9
04	1153.9	1.186	1230.0	58.6
05	904.3	1.186	964.0	60.2
06	740.5	.959	710.3	33.8
07	983.4	.959	943.1	58.9
08	1121.5	1.186	1195.5	74.7
09	1064.8	1.186	1135.1	54.0
10	869.3	1.186	926.7	44.1
11	1138.5	1.186	1213.6	75.8
12	763.7	.959	732.4	34.9
Controls				
21	1209.6	1.186	1289.4	80.6
22	1061.3	1.066	1131.3	53.9
23	1038.7	1.186	1107.2	52.7
24	921.4	.959	883.6	42.1
25	1131.7	.959	1085.3	67.8
26	1131.8	.666	753.8	35.9
27	1181.8	.959	1132.7	53.9
28	1132.8	.959	1086.3	67.9
29	1236.2	1.186	1317.8	62.7
30	961.3	1.186	1104.1	87.7
31	1286.8	.959	1234.0	58.8
32	973.2	.959	933.3	44.4

Mean for the treatment group was 40.45 inches with the individual means ranging from 34.9 to 47.1 inches. The control group had a mean of 41.0 inches. The individual means ranged from 33.3 to 48.6 inches.

Figure 6 shows the height change over the 11-month period by treatment groups. With the exception of group one controls, height changes of all groups closely parallel each other. The pattern of the group one control subjects reflects the difficulty of getting accurate measurements on spastic subjects or those who are too tense to lie flat on the measuring table. Even allowing for error in measurement it would suggest that in this group of subjects there was a significant difference in height increase due to treatment.

Weight

There was no significant difference due to treatment between the treatment and control groups.

The mean of the treatment group was 30.1 pounds with the individual means ranging from 19.5 to 37.6 pounds. The mean of the control group was 32.6 pounds with the individual mean range of 20.5 to 48.7 pounds. The mean increase of the treatment group was 6.4 pounds and in the control group 6.8 pounds.

Figure 7 shows the weight change over the 11-month period. With the exception of the group one controls, weight changes of all treatment groups closely parallel each other.

All of the subjects in the study were below the 10th weight percentile using the Boyd tables (24) at the time the study began. One subject in the control group had a weight increase of nine pounds placing him in the 25th weight percentile.

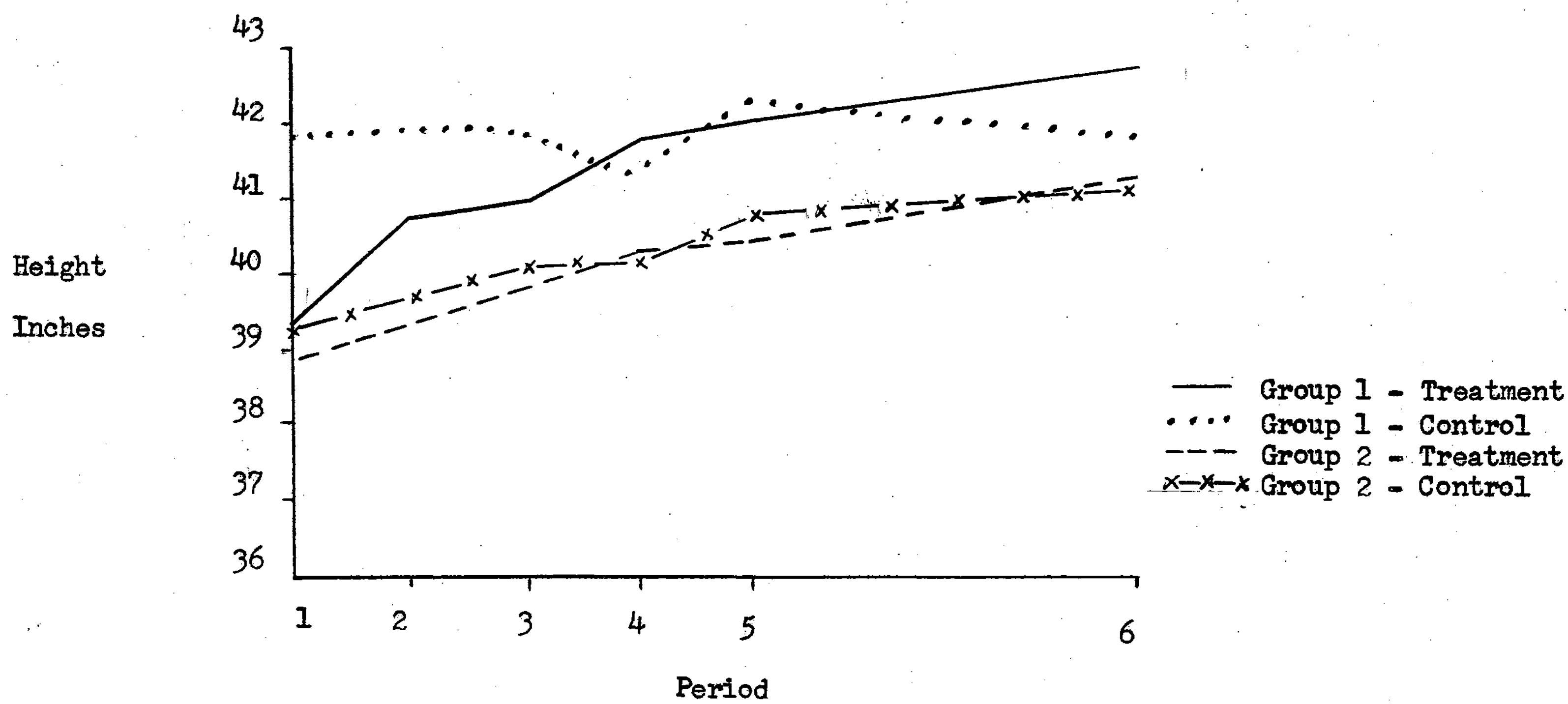

Figure 6 Height change over a 11-month period. Comparison by treatment groups.

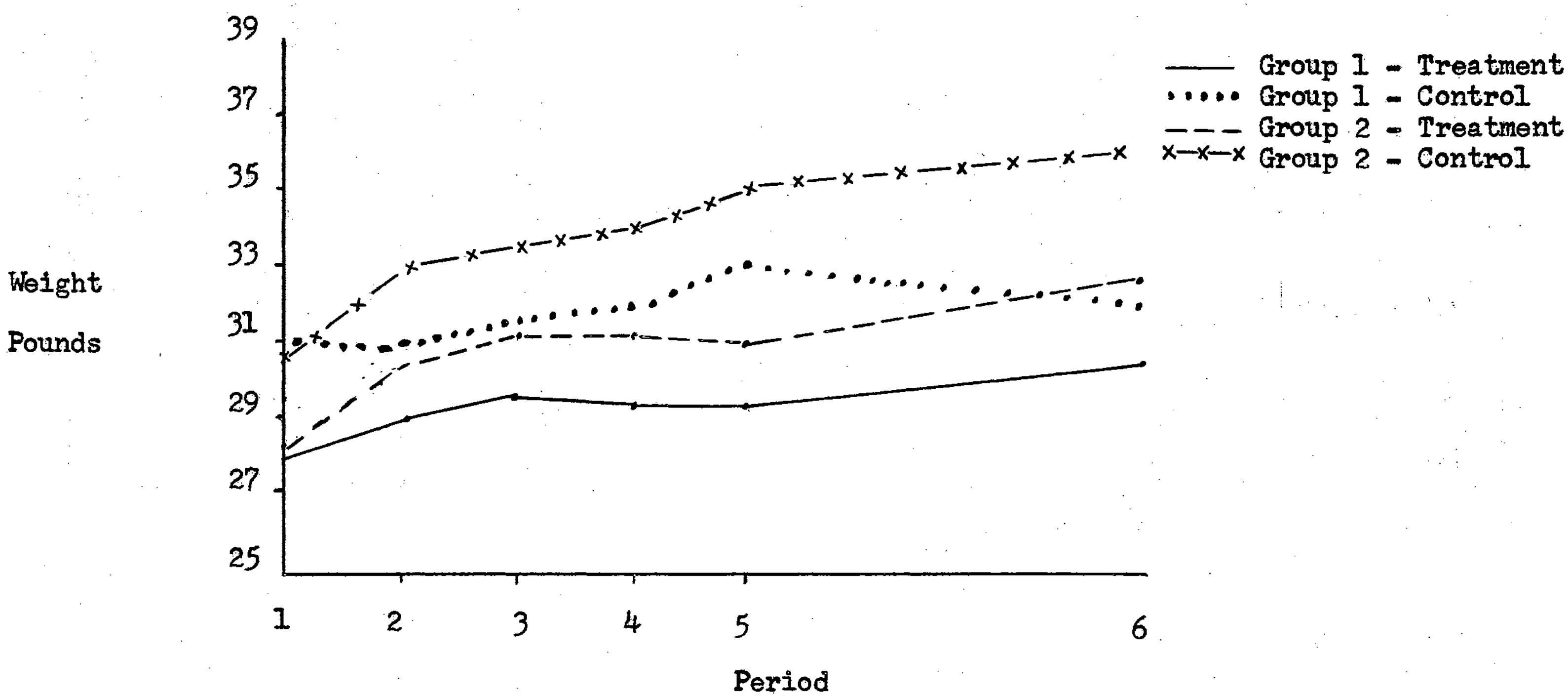

Figure 7 Weight change over 11-month period. Comparison by treatment groups.

Hemoglobin

There was no significant difference between the treatment and control group.

Mean value for the treatment group was 13.3 gm. per 100 ml. with individual means ranging from 12.0 to 14.3 gms. per 100 ml. The control group had a mean of 13.4 gm. per 100 ml. The individual means of the control group ranged from 12.0 to 15.3 gm. per 100 ml.

These values are all within the standard range and are in agreement with those reported by Karle et al (28) for cerebral palsied children.

Hematocrit

There was no significant difference due to treatment between the treatment and control groups. There was significant difference at the five per cent level due to interaction between treatment and period.

The mean for the treatment group was 39.5 per cent and the control 40.5 per cent. The individual means ranged from 37.8 to 43.0 per cent in the treatment group and 35.7 to 45.1 per cent in the control group.

Hematocrit values which are fairly sensitive indicators of protein nutrition were within the normal range. The overall mean compared favorably with those reported by Culley (13) on mentally retarded institutionalized patients.

Total Serum Protein

There was no significant difference due to treatment between the treatment and control groups. There was a significant difference at the five per cent level due to interaction between the group and treatment and between treatment, group and period.

The treatment group had a mean of 7.2 gm. per 100 ml. and the control group 7.3 gm. per 100 ml. Individual means for the treatment group ranged from 6.2 to 7.5 gm. per 100 ml. and for the control group ranged from 6.3 to 7.9 gm. per 100 ml.

The overall mean for groups were within normal ranges although in each group there were subjects at the lower end of the scale. Figure 8 shows the comparison by treatment groups over the 11-month period. There was much variation apparent between group and treatment. High and low peaks are present in both groups and in both control and experimental subjects. In the group one experimental subjects there were consistently lower values. The reverse pattern was shown in the control group where the lower values were in the group two subjects.

The mean values in this study are comparable with those reported by Culley (13) on mentally retarded patients.

Albumin-Globulin Ratio

There was a significant difference at the ten per cent level due to treatment between the treatment and control groups.

The mean for the treatment group was 2.09 with individual means ranging from 1.57 to 2.63. The control group had a mean of 1.71 with individual means ranging from 1.38 to 2.49.

Lowering of the A/G ratio can be due to an absolute decrease in the albumin fraction or an absolute increase in the globulin fraction or to both (13). If in the control subjects there was an increase in the globulin level with no change in the albumin level, the total serum protein level would be higher than the experimental group. If the reverse happened and the albumin fraction decreased with no change in the globulin fraction the serum protein level would be lower than the

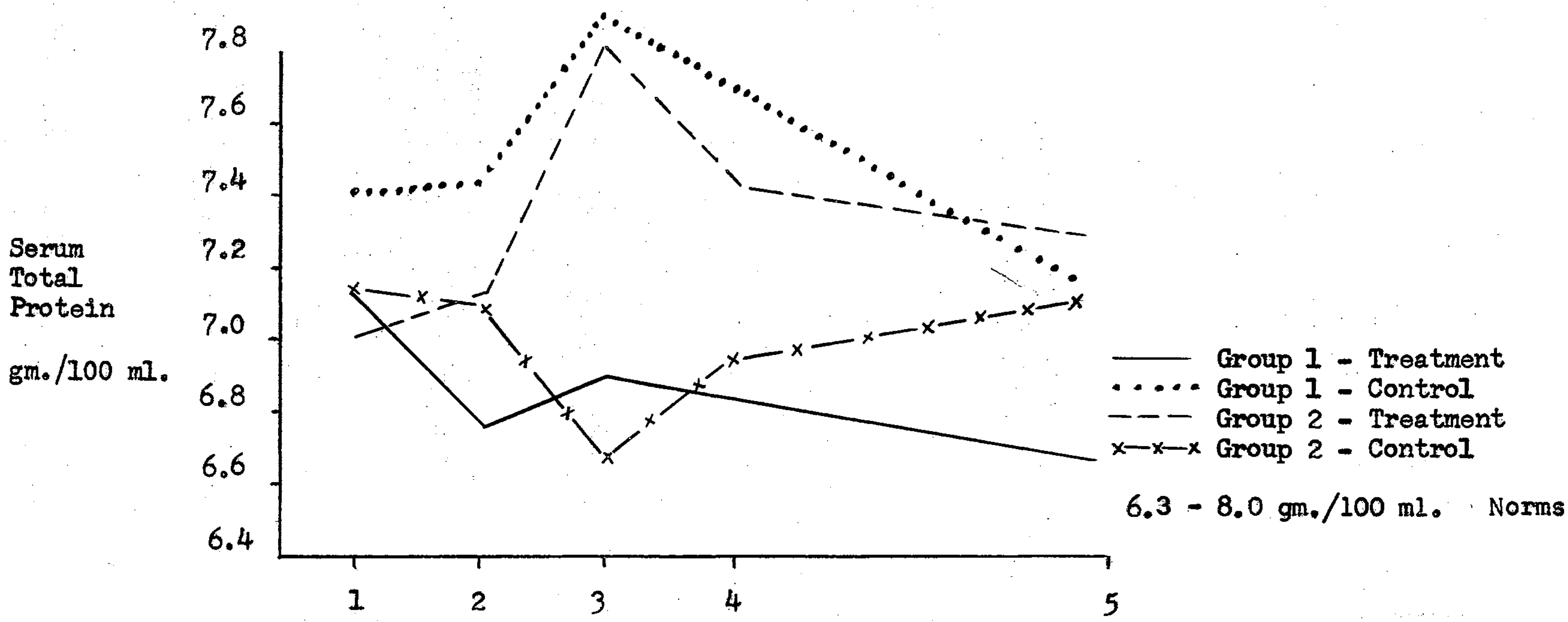

Figure 8 Total serum protein over a 11-month period. Comparison by treatment groups.

experimental group. Since there is no significant difference between the two groups this suggests that the lowered A/G ratio may be due to both an increase in globulin and a decrease in albumin.

Figure 9 shows the change in A/G ratio over the 11-month period. There was considerable fluctuation during the first three periods in the treatment group and then a leveling off. The control groups were consistently lower and until the last six months closely paralleled each other.

Albumin-globulin ratios in this study were consistently higher than those reported by Culley (13) for patients in the same weight percentile. His sample was taken from 105 patients with one observation per subject. In this study 24 subjects were sampled with three to six observations per subject. Because of the difference in sampling procedures a valid comparison was difficult. Variation could also be due to difference in laboratory procedures.

Albumin

There was a significant difference due to treatment at the five per cent level between the treatment and control groups. There was a significant difference at the five per cent level due to period effects between the two groups.

The mean for the treatment group was 67.0 per cent with individual means ranging from 61.0 to 72.2 per cent. The control group mean was 62.8 per cent with individual means ranging from 57.4 to 70.3 per cent.

The significant decrease in albumin level in the control group, as shown in Figure 10, closely parallels the change in A/G ratio as indicated in Figure 9. In Figure 9 there was a sharply decreased albumin level in the group two controls that was reflected in the decreased A/G

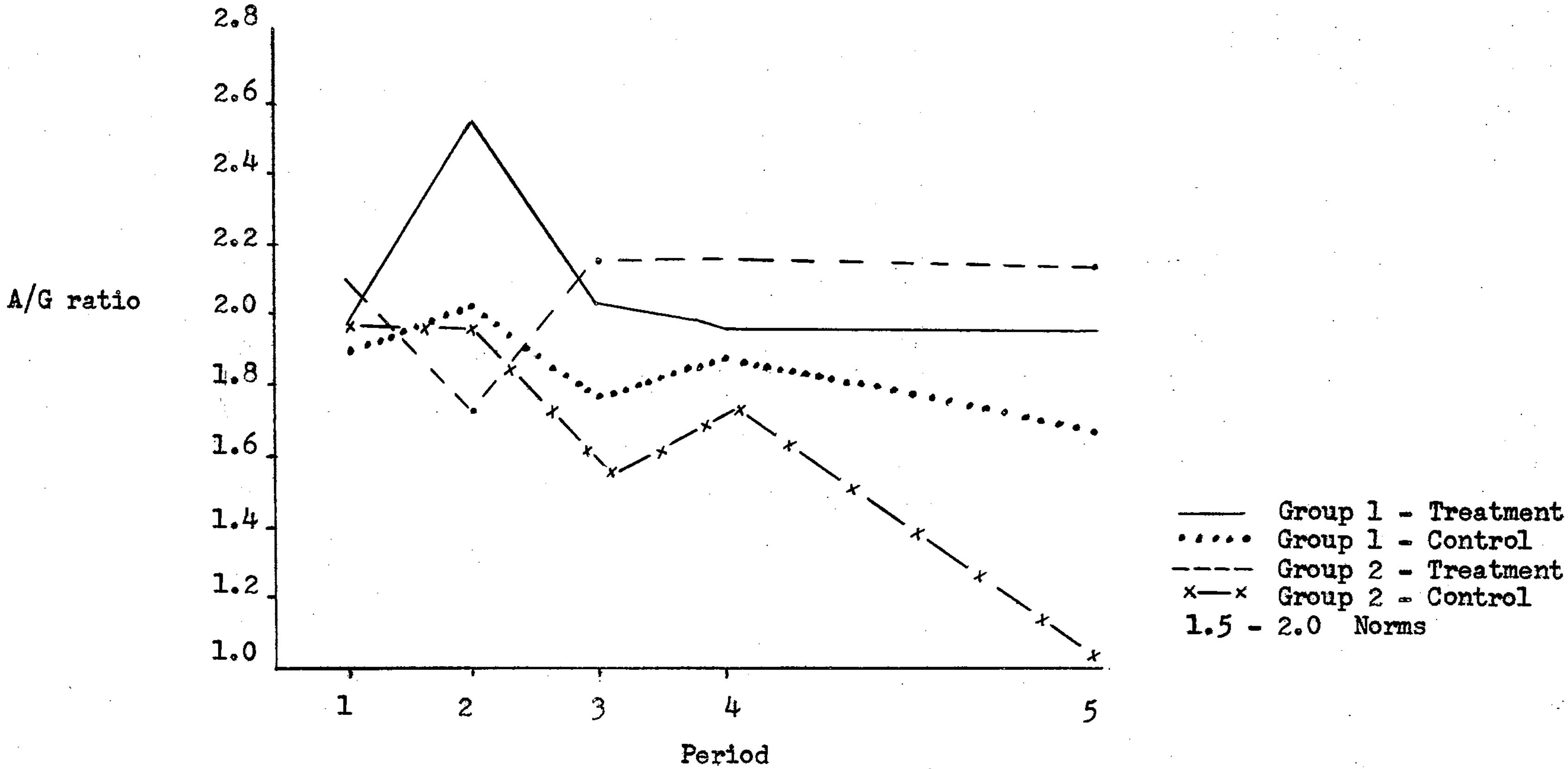

Figure 9 Change in Albumin-globulin ratio over a 11-month period. Comparison by treatment groups.

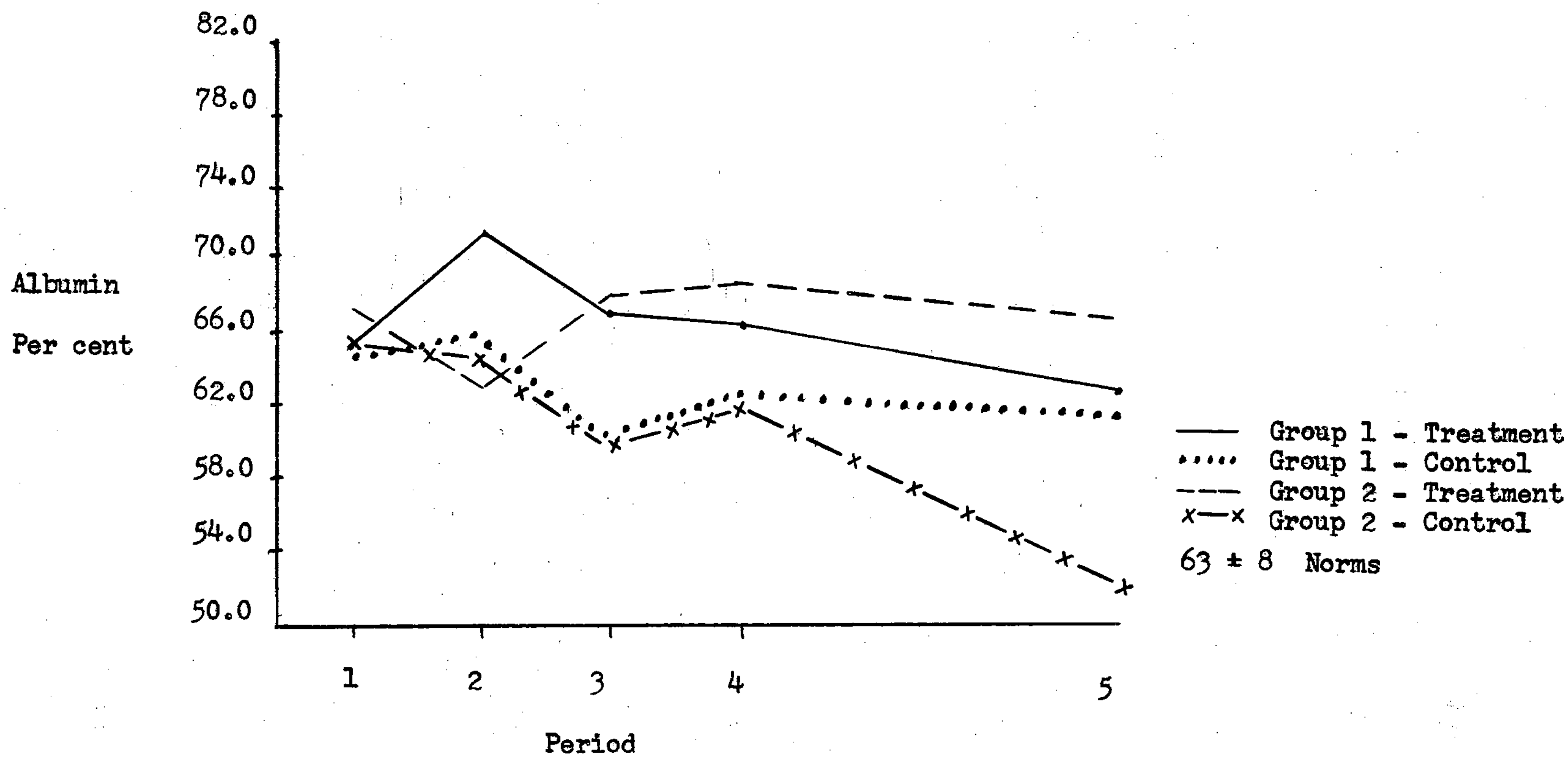

Figure 10 Change in albumin over a 11-month period. Comparison of treatment groups.

ratio for group two controls in the same period. Albumin levels for all groups at the beginning of the study were within a range of 64.6 to 67.5 per cent. At the end of the study the range had widened to 52.2 to 67.0 per cent.

Alpha-1 Globulin

There was no significant difference in these values between the treatment and control groups. There was a highly significant difference due to period effects at the five per cent level.

Mean value for the treatment group was 3.2 per cent and 3.5 per cent for the control group. Individual means ranged from 3.0 to 6.8 per cent in the treatment group and 1.2 to 4.6 per cent in the control group.

Alpha-2 Globulin

There was no significant difference between the treatment and control group. There was a significant difference at the five per cent level due to period effects.

The mean for the treatment group was 8.1 per cent with individual means ranging from 6.0 to 10.2 per cent. The control group had a mean of 8.7 per cent with the individual mean range of 6.9 to 9.9 per cent.

Beta Globulin

There was no significant difference between the treatment and control groups.

The treatment group had a mean of 8.9 per cent with individual means of 7.0 to 9.9 per cent. The mean for the control group was 9.2 per cent with individual means ranging from 6.8 to 12.9 per cent.

Gamma Globulin

There was a significant difference due to treatment at the five per cent level between the treatment and control groups. There was a significant difference at the five per cent level due to period effects between the two groups.

The mean for the treatment group was 13.0 per cent with individual means ranging between 8.9 to 16.6 per cent. The mean of the control group was 15.7 per cent with an individual mean range of 11.1 to 19.6 per cent.

Presented in Figure 11 are the changes in gamma globulin over the 11-month period. When compared to Figure 9 showing the changes in A/G ratio and Figure 10 showing changes in albumin levels there was a close relationship. In each group as albumin decreased, gamma globulin increased and there was a decrease in A/G ratio.

Implication of Results

The lowered ratio of albumin to globulin in the control group suggested a mild protein deficiency. All of the groups except group one controls indicated a small but regular increase in weight although weight changes were not significant. There was a similar pattern in height for all subjects except group one controls, which showed an increase in height. The group one experimental subjects exhibited the greatest increase in height but these were not statistically significant. Improvement in eating ability, as demonstrated by progression to a higher developmental level in eating, was observed in four patients in the experimental group. There was no improvement in the controls.

However, when one compared the food intakes of the subjects over

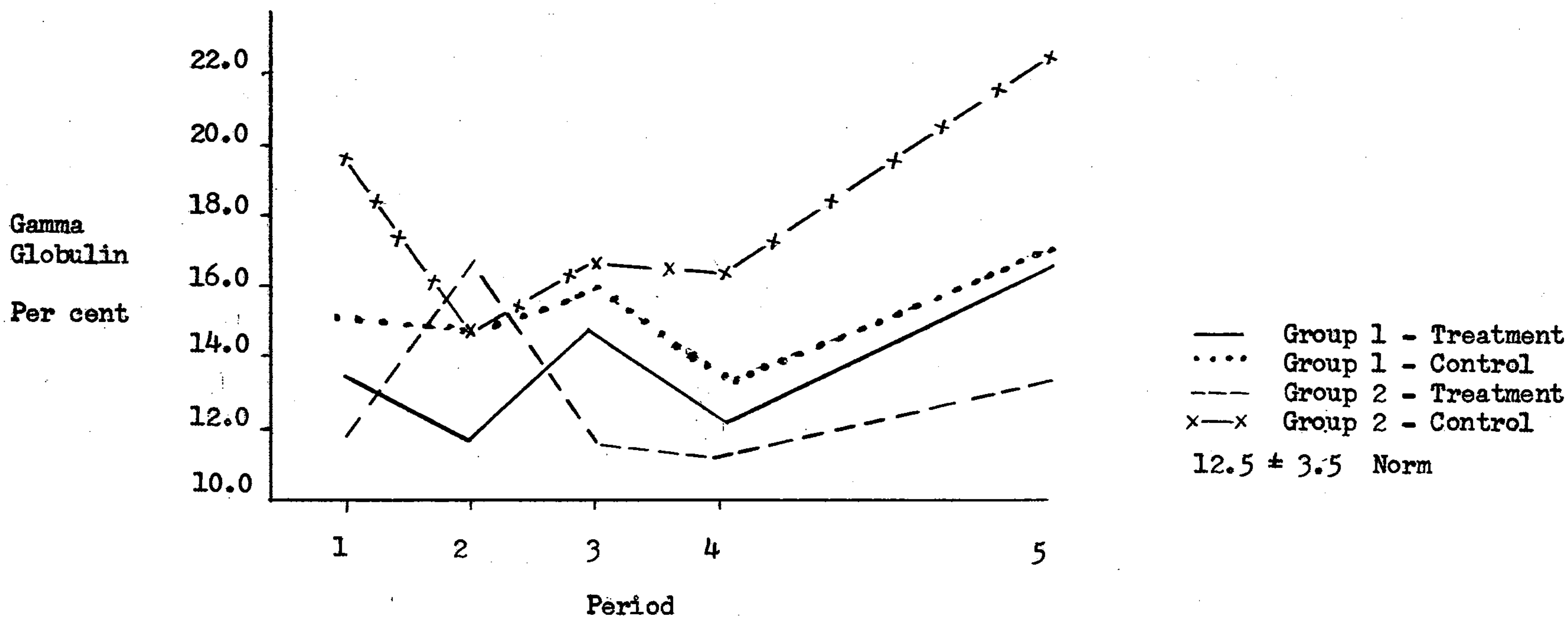

Figure 11 Change in Gamma globulin over a 11-month period. Comparison by treatment groups.

the same period as in Figure 5, it was apparent that the control group had a consistently higher volume intake of food than the treatment group. When the volume intake was converted to calorie values it was found that the level of the two groups were similar.

No clear cut explanation is known to explain why the treatment group had higher values in relation to height and A/G ratio than the control group.

During the study, feeding of subjects in the experimental ward was supervised by dietitians. Although there was no emphasis given to feeding certain types of food it is possible, because of the emphasis on nutrition, subjects were given meat and milk in preference to other foods. It is the author's belief that when she participated in the feeding she had a tendency to offer high protein foods more frequently than others. Aides in the experimental ward could, without being consciously aware of it, have followed the author's example. Thus the subjects may have received a higher proportion of protein to calories than in the control group.

The increased activity of the subjects in the experimental group may have improved their utilization of protein. Subjects in the experimental ward, because of the increased number of personnel, were much more active than the control subjects. They always were placed in chairs at mealtime and given exercise on mats during the day. In the control group subjects were frequently fed in their cribs and seldom were given exercise.

The role of infections in worsening the nutritional status of children has been reported by Scrimshaw (43). Infections cause a stress reaction which results in increased loss of nitrogen. They are more frequent and severe in malnourished children because malnutrition lowers resistance. At the beginning of the seventh month a severe rubella epidemic occurred in the pediatric wards. Only one subject in the experimental ward became ill and he had a mild case. Several of the controls were severely ill. The experimental ward was set aside for this study and was the only pediatric ward that was not overcrowded. All of the other wards were very overcrowded making the possibility of infection much greater in the controls.

CHAPTER V

SUMMARY AND CONCLUSIONS

The use of selected feeding techniques to train mentally retarded, handicapped children to develop ability in eating was tested. Twenty-four retarded, handicapped children who had difficulty in eating were randomly distributed into an experimental and a control group. Food intake, hemoglobin, hematocrit, height, weight, and electrophoresis of protein were measured at the beginning and at regular intervals throughout the study.

Four of the experimental subjects made progression to a higher developmental level of eating ability. There was no improvement shown in the twelve control subjects. The four subjects who progressed in eating ability had greater gains in height than other subjects in the experimental ward. Three of the four increased their food intake over the 11-month period. The time required to feed the four subjects increased and food intake decreased during the initial training period. There was no drop in weight of these four during the period of lowered food intake.

Many undesirable eating habits associated with behavior were observed in the twelve experimental subjects and contributed to the problem of teaching them to improve their eating ability. Temper tantrums and the spitting out of unliked food to get attention at mealtime all indicated a previous pattern of rewarding bad behavior. Over the 11-month period, feeding time for the experimental group decreased and food intake increased.

The volume of food intake of the control subjects was significantly larger than the experimental subjects. When food intake was converted to calories, the mean for the experimental subjects was 1054.2 calories and for the control subjects 1091.2 calories. When the per cent of recommended dietary allowance for calories was calculated the experimental subjects had a range of 33.8 to 85.6 per cent with a mean of 58.3 per cent. The control subjects ranged from 35.9 to 87.7 per cent with a mean of 59.0 per cent.

Gain in height of the experimental subjects was significantly larger than the control subjects. The experimental subjects had a mean increase in height of 4.94 inches and the controls 1.48 inches. The control subjects had a mean increase in weight of 6.8 pounds and the experimental subjects 6.4 pounds.

Hemoglobin and hematocrit values for both experimental and control subjects were within the normal range as were the total serum protein values. Total serum protein values showed wide variation in both groups and in both experimental and control subjects.

The control subjects had a significant decrease in albumin-globulin ratio. The mean for the experimental subjects was 2.09 and for the control subjects 1.71. Mean values for alpha-1, alpha-2, and beta globulin were within the normal range for both experimental and control subjects. In the control subjects there was a significant decrease in albumin levels and a significant increase in gamma globulin levels. The lowered A/G ratio is a direct reflection of this change in the albumin and gamma globulin fraction and suggests that the control subjects had a mild protein deficiency.

The increased A/G ratio and height gains of the experimental subjects cannot be adequately explained on the basis of food intake. It is suggested there was improved utilization of food due to the increased activity of the experimental subjects. The higher incidence of infection in the control subjects, which may be partially attributed to overcrowded living conditions, may have caused excessive protein losses.

While none of the findings are conclusive they suggest new areas of investigation. Interpretation of results are difficult because of the lack of information about the retarded, handicapped individual. The need for establishment of norms for this group is evident.

Increased alertness of the experimental subjects was noted as the study progressed. The inclusion of psychological tests could have added to the value of the study.

The children in the experimental ward manifested definite preferences for certain kinds of foods. Food acceptance studies on desirable texture, consistency and flavor could be helpful in planning for the dietary needs of this type of patient.

The difficulty of eating an amount of food that would provide an adequate intake of required nutrients, especially calories, suggests the need for development of high caloric foods to meet the special needs of the retarded, handicapped child.

Follow up studies on the 20 remaining subjects could be of value in determining the long-range effects of the use of the feeding techniques.

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A P P E N D I X

Table A Nutritive value - pureed food diet

Day	Volume gm.	Calories	CHO gm.	Protein gm.	Fat gm.	Calcium mg.	Iron mg.	Vit. A I.U.	Thiamine mcg.	Riboflavin mcg.	Niacin mg.	Asc. Acid mg.
1	1824	1750	250.0	64.02	54.84	948	13.37	9554	970	1936	23.89	106.8
2	1824	1750	225.8	66.53	65.10	1523	14.63	11328	1200	1764	23.22	76.6
3	1824	1749	245.2	65.02	56.43	969	14.06	18000	1168	2029	23.92	76.9
4	1824	1749	231.7	65.12	62.54	1592	14.95	22514	1403	1738	23.36	67.2
5	1824	1748	240.8	66.82	57.46	867	14.47	9636	1188	1863	24.55	79.4
6	1824	1751	246.0	64.72	56.44	890	12.69	9364	1171	1770	21.53	106.2
7	1824	1751	218.9	65.92	67.94	1539	15.47	15332	1338	1812	23.63	77.3
Mean	1824	1750	236.9	65.45	60.11	1190	14.21	14533	1205	1845	23.01	84.3
Percent of Calories			54.1	15.0	30.9							
Percent Recommended Dietary Allowance, 1964												
1-3 years		135		205		148	178	727	241	231	256	211
3-6 years		109		164		148	142	581	201	185	209	169
6-9 years		83		126		148	118	415	151	142	164	141

Table B Nutritive value - soft and soft with finger food diet

Day	Volume gm.	Calories	CHO gm.	Protein gm.	Fat gm.	Calcium mg.	Iron mg.	Vit. A I.U.	Thiamine mcg.	Riboflavin mcg.	Niacin mg.	Asc.Acid mg
1	1767	2102	218.5	80.4	110.7	1043	14.50	11,779	938	2024	22.63	101.5
2	1769	2099	226.4	83.0	96.8	865	14.47	10,538	1284	1961	19.81	69.8
3	1768	2102	248.8	82.1	106.1	1131	12.66	4,106	1313	2031	21.25	102.3
4	1772	2199	247.2	83.6	96.9	995	14.66	4,384	963	1933	26.68	64.7
5	1773	2101	236.6	81.2	102.0	1042	12.73	14,697	964	2004	16.56	102.3
6	1772	2099	234.3	82.1	103.8	987	12.60	4,635	1109	2001	23.33	99.8
7	1772	2100	230.8	82.3	105.6	825	13.69	6,371	1204	2299	19.31	70.3
Mean	1770	2100	234.6	82.1	103.1	984	13.62	8,073	1111	2036	21.37	87.2
Percent of Calories			40.2	15.6	44.2							
Percent Recommended Dietary Allowance, 1964												
1-3 years		162		256		123	170	404	222	254	237	218
3-6 years		131		205		123	136	323	185	204	194	174
6-9 years		100		158		123	114	231	139	157	153	145

Food Intake Record Form

DAY 1 WEDNESDAY CYCLE______ DATE______ NAME______ WARD____

MEAL	FOOD	TOTAL WT. JAR & FOOD gms.	AMOUNT gms.	WEIGHT DISH gms.	WEIGHT CLEAN BIB gms.	TOTAL gms.	WT.RTD. DISH FOOD&BIB gms.	DIFF. gms.	WEIGHT TRAY gms.	WT.RTD. TRAY gms.	DIFF. gms.	WEIGHT FOOD EATEN gms.
BREAK-FAST	Lactose Pears, str.		12.0 200.0									
	Lactose Oatmeal, Heinz, dry		5.0 10.0									
TIME:	Egg, soft cooked (2)											
	Milk		120.0									
	TOTAL											
10:00 a.m.	Lactose Orange Juice		10.0 120.0									
DINNER	Butter Chicken, str.		5.0 99.0									
	Butter Spinach, str.		5.0 128.0									
TIME:	Lactose Pineapple & Bananas, str.		12.0 200.0									
	Milk		120.0									
	TOTAL		569.0									
SUPPER	Butter Lamb, str.		5.0 99.0									
	Butter Sweet Potatoes, str.		5.0 128.0									
TIME:	Lactose Prunes, str.		12.0 200.0									
	Milk		120.0									
	TOTAL		569.0									
7:00 p.m.	Milk		120.0									
	TOTAL											

WSH-TEP-11a

Table C Food intake, time required to feed, height and weight of four experimental subjects who made good progress in eating ability by periods

Subject	Period	Food intake grams	Time required to feed minutes	Height inches	Weight pounds
08	1	1216.6	26	36.12	23.00
	2	980.9	45	36.00	23.25
	3	1128.4	41	36.00	24.25
	4	1057.4	39	37.00	23.75
	5	1113.8	38	37.00	24.50
	6	1232.0	29	37.50	25.25
09	1	1060.6	25	38.00	31.00
	2	1006.4	40	38.25	32.00
	3	1017.8	33	39.50	33.00
	4	1089.7	31	39.75	32.25
	5	1104.0	34	40.25	32.25
	6	1110.5	34	41.00	36.50
10	1	885.6	25	41.00	30.00
	2	756.4	31	41.00	31.00
	3	960.1	32	42.00	32.50
	4	779.3	29	42.25	32.00
	5	870.0	28	42.50	32.00
	6	964.7	34	43.00	32.75
12	1	1236.0	26	39.25	28.00
	2	542.7	50	40.25	28.75
	3	726.5	48	40.00	29.00
	4	536.8	46	40.37	28.50
	5	740.6	48	40.25	29.00
	6	799.9	34	43.50	31.00

Table D Mean values of height, weight, and food intake by treatment groups and periods

Treatment group	Period	Height inches	Weight pounds	Food intake grams
Experimental				
group 1	1	39.37	28.21	1015.4
	2	40.72	29.20	1023.7
	3	40.97	29.65	942.7
	4	41.84	29.31	883.6
	5	42.00	29.31	940.2
	6	42.12	30.37	1018.1
group 2	1	38.96	28.42	1152.9
	2	39.41	30.45	933.2
	3	39.75	31.25	949.1
	4	40.25	31.12	921.6
	5	40.46	31.00	945.6
	6	41.25	32.71	1038.6
Control				
group 1	1	41.79	31.00	1135.4
	2	41.85	30.97	1044.2
	3	41.77	31.46	1112.4
	4	41.42	31.65	1165.5
	5	42.25	33.00	1170.6
	6	41.60	32.30	1067.3
group 2	1	39.48	30.79	1173.3
	2	39.73	33.04	1148.7
	3	40.02	33.54	1160.4
	4	40.46	34.14	1063.0
	5	40.75	35.00	1113.2
	6	41.15	36.27	1108.7

Table E Mean values of total serum protein, albumin, gamma globulin, and A/G ratio by treatment groups and periods

Treatment group	Period	Total serum protein gm./100 ml.	Albumin per cent	Gamma globulin per cent	A/G ratio
Experimental					
group 1	1	7.1	65.5	13.4	1.97
	2	6.8	71.8	11.6	2.58
	3	6.9	67.0	14.9	2.01
	4	6.8	66.2	12.2	1.96
	5	6.7	63.5	16.6	1.95
group 2	1	7.1	67.6	11.8	2.10
	2	7.1	62.9	16.7	1.72
	3	7.8	67.7	11.9	2.16
	4	7.4	68.2	11.4	2.16
	5	7.3	66.1	13.1	2.08
Control					
group 1	1	7.4	64.6	15.0	1.91
	2	7.4	66.1	14.6	2.04
	3	7.9	60.2	15.7	1.78
	4	7.7	64.4	13.4	1.87
	5	7.3	62.2	17.1	1.69
group 2	1	7.1	65.7	19.9	1.97
	2	7.0	64.5	14.6	1.88
	3	6.7	60.3	16.8	1.55
	4	6.9	62.3	16.7	1.73
	5	7.1	52.3	22.5	1.14

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