AN INVESTIGATION OF THE INCIDENCE OF OBESITY IN INFANTS RECOVERED FROM CHRONIC DIARRHEA AS COMPARED WITH THE INCIDENCE IN NORMAL INFANTS

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NURSING

BY

L. MICHELLE RÍOS, B.S.

DENTON, TEXAS

DECEMBER 1982

The Graduate School

Texas Woman's University

Denton, Texas

July 14, 1982

We hereby recommend that the thesis prepared under our supervision by L. Michelle Rios entitled An Investigation of the Incidence of Obesity in Infants Recovered from Chronic Diarrhea as Compared with the Incidence in Normal Infants

be accepted as fulfilling this part of the requirements for the Degree of Master of Science.

Committee:

Terry A. Shockmorton
Chairman

M. Christine Hawkins

Diane Ragsdale

Anne Gudmundson

Accepted:

Dean of The Graduate School

TABLE OF CONTENTS

CHAPTER

LIST OF TABLES

Table

ACKNOWLEDGMENTS

The investigator would like to express her gratitude to her family and friends for their continual interest and support during graduate school. In addition, the investigator wishes to thank the following persons:

Ms. Terry A. Throckmorton, thesis committee chairman, for her excellent guidance, unfailing support and encouragement, and professional inspiration.

Dr. Diane Ragsdale and Ms. Christine Hawkins, committee members, for their recommendations, contributions and positive reinforcement.

Dr. G. S. Gopalakrishna, Assistant Professor of Pediatrics, Section of Nutrition and G.I., Baylor College of Medicine, for his cooperation and support in this study.

Mr. and Mrs. Antonio A. Ríos, my parents, for their moral and financial support during graduate school as well as their typing assistance for the thesis.

CHAPTER 1

INTRODUCTION

A commonly known and accepted fact is that an infant is born totally dependent upon his caretaker for all of his needs. Of these needs, which must be met by the caregiver, one of the most important for survival is that of adequate nutrition. As a result, the judgment regarding good or bad caregiving has commonly been based upon the nutritional status or appearance of the infant. If the infant is chubby, it is assumed that he is healthy and, therefore, receiving good care, whereas the opposite is assumed if the infant is small and thin.

If the infant fails to thrive due to excessive vomiting or diarrhea, a great deal of stress may be placed not only on the parents, but also on the rest of the family. This period of stress is often accompanied by a negative reflection on the parents and particularly on the mother. Many of the people involved in the situation tend to view the mother as responsible for the infant's failure to thrive and, therefore, as a poor caregiver.

When an infant is hospitalized for failure-to-thrive (FTT), much emphasis is placed on the type of formula the infant receives, the amount taken, and the weight gained or lost over 8 or 12 hour intervals. This monitoring of diet and weight gain or loss then becomes a pattern which may be later carried over into the home care in varying degrees. As the infant gains or loses weight at home, the mother is either positively or negatively reinforced by family members, friends, and hospital personnel regarding her ability to adequately nurture her infant. Because the infant's illness is often a life or death situation with progress or lack of it reflected in the amount of weight gained or lost, the reinforcement for both parents and medical personnel is strong. Thus the stage is set for overnutrition which may lead to obesity in the former FTT infant.

Problem of Study

Since the possibility of overnutrition which may lead to obesity exists in these FTT children, the following problem was studied: Is there a difference in the incidence of obesity in former FTT children between the ages of 12 and 24 months, and the incidence of obesity in children who have been thriving normally at the same age?

Justification of Problem

Obesity has been considered a medical as well as a public health problem for many years. In 1977 a conference, Obesity in America, was sponsored by the National Institutes of Health in conjunction with six other agencies. The consensus of the panel was that obesity is a national problem. They noted that research had been conducted in the area, yet understanding and treatment of the problem remained inadequate (Salans, 1980).

The traditional belief that a fat baby is healthier than a more slender one and, therefore, more desirable is a well-known American cultural characteristic. Although many individuals believe they are doing the best for their infants by encouraging obesity, they may in fact be predisposing the infants not only to a higher frequency of illness, particularly respiratory illness in infancy (Hooper & Alexander, 1971; Tracey, De, & Harper, 1971), but also to childhood and adult obesity (Charney, Goodman, McBride, Lyon, & Pratt, 1976). Various other diseases associated with obesity to which the obese infant in later life may be predisposed include: glucose intolerance as a result of an insulin-resistant state, hyperinsulinemia, hyperlipoproteinemia, diabetes mellitus, cardiovascular dysfunction, coronary heart disease, hypertension and pulmonary dysfunction (Glueck & Tsang, 1979; Salans, 1980; Weil, 1975).

In a study by Hirsch and Knittle (1970), the results of the analysis of adipose cellularity in obese and nonobese subjects indicated that the subjects with early age onset of obesity had the largest number of cells whereas the obese subject with adult onset of obesity had the largest cell size. The nonobese subjects had an average cell count and size. A cross-sectional study of infants and children indicated that between birth and six months of age there was a threefold increase in cell size. Although the cell number showed gradual increase all through childhood, the greatest period of proliferation was noted in the first year of life. Any reduction of weight decreased the cell size but not the cell number. Therefore, the first year of life could be considered as a "critical period" in the development of adipose tissue which could lead to obesity.

In a study of the growth and development of fat cells in infancy conducted by Boulton, Dunlop, and Court (1978), adipose tissue was shown to be composed of two groups of cells. The small cells were found in tissue before birth and early postnatal life, and did not appear to contain fat. The larger cells contained fat, constituted the second peak in distribution curves of infants two months of age or more, and represented maturing fat cells. This second group of cells included fat cells recognized by previous workers. However, up to 24.6% of these fat-containing cells were found to be less than 25 micrometers in diameter and were not included in the number of fat-containing cells. Therefore, these smaller fat-containing cells in the early stages of fat accumulation may make an important contribution to the cell population of fat.

Infants with FTT due to organic causes (such as chronic diarrhea of bacterial or viral origin) are usually hospitalized for varying lengths of time depending on the severity of diarrhea, and are followed in clinics after their hospital stay. Frequently these infants develop an intolerance to various infant formulas as a result of damage to the intestinal villi by the invading organisms. The damaged villi no longer secrete the enzymes necessary to break down the various sugars present in the infant formulas. As a result, the infants continue to lose weight and generally fail to thrive (Burke & Danks, 1966; Jalili, 1980; Solimano & Lederman, 1979). During hospitalization much emphasis and importance is placed on the feeding and weight gain of the infant. The primary caregiver, who is usually the mother, is given careful instructions concerning the method of formula preparation, and the amount and frequency of the feedings. Mothers are instructed that failure to comply strictly with the feeding schedule and prescribed diet could result in recurrence of diarrhea and possible death of the infant.

Often, the infant is weighed at least twice a day while in the hospital so that the weight gain or loss can be measured. After discharge from the hospital, the infant is followed on a predetermined schedule to have the weight gain and growth rate monitored. If the infant is gaining weight satisfactorily, the caregiver is then positively reinforced by medical personnel and family members and thus would tend to continue the same feeding pattern. Since these FTT infants do not consistently gain weight each day, positive reinforcement is given at unequal intervals. The need to adhere to the feeding patterns established in the hospital is also stressed. Therefore, a strong schedule of reinforcement is established.

This reinforcement from members of the family and health team to keep the infants alive, and to maintain the feeding patterns and schedules, is usually not extinguished once the child reaches normal weight. As a result, this specific group of infants could easily be more predisposed to problems of obesity in childhood. Based on the preceding information and due to the limited amount of research conducted in this specific area, this investigator studied the incidence of obesity in former FTT infants as compared to the incidence in the infants who thrived without episodes of organic problems.

Theoretical Framework

The theoretical framework was composed of the reinforcement theory derived from B. F. Skinner's theory of learning. This theory is based upon the direct relationship between the occurrence of events or stimuli and the changes of behavior which follow as a result of some stimuli (Skinner, 1953; Wilcoxon, 1969). According to Skinner (1953), operant conditioning is the process of learning or behaving which is a continuous shaping process that tends to become stronger when reinforced. There is never any specific point when something very different emerges from what has preceded it, even though the end product seems to have a special design. Similarly, the end product of conditioning does not appear full grown in an organism's behavior, but results from a continuous shaping process (Skinner, 1953).

According to Carpenter (1974), the process of operant conditioning involves a voluntary behavior related to a specific act which is followed by a consequence of that act. The quality or strength of a consequence will influence any further action. Carpenter (1974) stated that any frequently occurring pattern of behavior must have automatically been reinforced. Therefore, operant behavior is voluntary behavior which can be modified by environmental feedback through various types of reinforcement (Carpenter, 1974; Skinner, 1953; Wilcoxon, 1969).

Reinforcement consists of three types: positive, negative, and differential. Both positive and negative reinforcement serve to strengthen a desired behavior. Negative reinforcement consists of unpleasant actions which the subject tries to successfully avoid, whereas positive reinforcement generally consists of pleasant or rewarding actions which the subject seeks (Carpenter, 1974). Negative reinforcement in a situation with a FTT infant would be the worsening of this condition indicated by weight loss, increased diarrhea, and/or vomiting, with the ever-present threat of the infant's possible death. Positive reinforcement would take the form of praise and approval for the infant's retained feedings, increased weight, lack of diarrhea and/or vomiting. Both types of reinforcement achieve the same goal, namely, that of the infant's survival. However, the positive reinforcement is that which is consistently sought.

Differential reinforcement as defined by Carpenter (1974) is that reinforcement which gives immediate feedback, serves to make small changes in how an act is performed, and results in general improvement. Applied to the FTT situation, the caregiver receives this type of reinforcement each time the formula is prepared, given and retained by the infant, and contributes to the gradual but consistent weight gain and well-being of the infant.

The progression toward health in the FTT infant is usually slow and often accompanied by episodes of recurring diarrhea and/or vomiting with weight loss. When setbacks of this type occur, medical personnel and family usually withhold praise or may even infer some causation on the part of each of the parents. This withholding of praise or application of blame fits the definition of punishment in the stimulus-response theory. This differs from negative reinforcement in that the goal of punishment is to control behavior or to eliminate a previously reinforced response (Carpenter, 1974; Williams, 1973).

The schedule of reinforcement generally seen in the FTT cases is the variable-ratio. This schedule is such that the positive reinforcement occurs after a random number of responses, for example, the caregiver continues to adhere to the feeding schedule and pattern knowing that the weight gain can occur at any time. This variable-ratio reinforcement is intermittent because the positive reinforcement is not continuous or given every time the caregiver takes the infant for a clinic visit and is therefore more resistant to extinction (Skinner, 1953; Williams, 1973).

Extinction is that process in which a learned, reinforced response decreases to such an extent that it rarely occurs once the reinforcement is stopped. This process takes much longer than the conditioning process (Skinner, 1953). Because of the nature of the illness in FTT infants, the caregivers are conditioned to feed their infants at frequent intervals and are positively reinforced. Once the child has begun to gain weight consistently and has reached the appropriate weight for his length, the professional health caregiver should begin extinguishing the frequent-feeding behavior and initiate a more reasonable feeding schedule. In reviewing the literature, the investigator found no documented studies on this particular subject indicating that any effort had been taken to extinguish this behavior. Therefore, it is possible that because both the primary caregiver and the health care personnel have equated the consistent weight gain with success, few attempts have been made in this direction.

Assumptions

For the purpose of this study the following assumptions were made:

1. All infants were measured using the same measuring devices, i.e., infant measuring board for height, tape

measure for arm and head circumference, and scales for weight.

2. The measurements were taken and recorded accurately.
3. All caregivers were reinforced positively by either the weight gain itself or by peers and health care personnel each time the infant gained weight.

Hypotheses

The hypotheses for this study were as follows:

H_o1: There will be no significant incidence of obesity in former FTT children at 12 and 24 months of age as indicated by comparison with the growth grids of normal weight and height.

H_a1: There will be a significant incidence of obesity in former FTT children at 12 and 24 months of age as indicated by comparison with the growth grids of normal weight and height.

H_o2: There will be no significant difference in the mean centiles of former FTT males and females at 12 months of age.

H_a2: There will be a significant difference in the mean centiles of former FTT males and females at 12 months of age.

H_o3: There will be no significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 12 months of age.

H_a3: There will be a significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 12 months of age.

H_o4: There will be no significant difference in the mean centiles for weight of former FTT males and females at 24 months of age.

H_a4: There will be a significant difference in the mean centiles for weight of former FTT males and females at 24 months of age.

H_o5: There will be no significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 24 months of age.

H_a5: There will be a significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 24 months of age.

H_o6: There will be no significant difference in the mean number of hospital days between former FTT males and females.

H_a6: There will be a significant difference in the mean number of hospital days between former FTT males and females.

H_o7: There will be no significant difference in the mean number of hospital days for former FTT black, white, and Mexican-American children.

H_a7: There will be a significant difference in the mean number of hospital days for former FTT black, white, and Mexican-American children.

Definition of Terms

The following terms were defined for this study:

Obesity--a child was classed as obese if his weight was at least one standard deviation from the mean higher than his height as demonstrated on a height/weight chart (Waterlow, Buzina, Keller, Lane, Nichaman, & Tanner, 1977).

Failure-to-thrive--an infant was classed as a failure-to-thrive if the arm circumference divided by the head circumference equalled less than 0.3 or if the height/weight ratio fell below the 10th percentile on an anthropometric chart for height and weight (Kanawati & McLaren, 1970; Waterlow et al., 1977).

Thriving--an infant or child was considered thriving if the arm circumference divided by the head circumference equalled at least 0.3 or if the height/weight ratio fell above the 10th percentile of an anthropometric chart for height and weight and values fell within 10 percentiles of each other above the 10th percentile (Kanawati & McLaren, 1970; Waterlow et al., 1977).

Former failure-to-thrive--any child who experienced an episode of failure-to-thrive and then returned to normal weight for his age and height.

Limitations

The limitations which were noted in this study include the following:

1. This was a retrospective study. Therefore, the investigator was not able to speak with the parents to assess the degree of reinforcement and manner of care given by them during the course of their child's illness. However, the number of visits made to the clinic during the period of illness and the length of time followed for illness were the basis for measuring the correlation between the reinforcement and the obesity ratio.
2. The sample was limited and systematically chosen thereby not permitting the generalization beyond the specific sample.

Summary

The purpose of this study was to investigate whether a former FTT population of infants had a higher incidence of obesity than the normal population. Although the belief that a fat baby is a healthy baby is still fairly popular, researchers are finding that obesity in children may be predisposing them to diseases later in life. Therefore, attention was focused on the detection of obesity in infancy and early childhood.

The theoretical framework upon which the study was based is Skinner's theory of shaping or conditioning behavior. The positive reinforcers included praise and encouragement by the health care personnel, family, and friends when the sick infant began to tolerate feedings and gain weight. The strong negative reinforcer was that of avoiding the infant's death.

The justification of this study of the incidence of obesity in this former FTT population was based on:

1. The reinforcers mentioned above.
2. The lack of information available concerning childhood obesity in conjunction with FTT due to diarrhea and vomiting.
3. The probability of predisposing this particular population to various adult-type diseases.
4. The existing potential of caregivers to modify the situation if obesity does appear to be a significant threat for these infants.

CHAPTER 2

REVIEW OF LITERATURE

Although diarrhea accompanied by malabsorption and malnutrition has been a fairly common problem for many years, research in this area has resulted in effective treatment of the problem. This treatment consists of the use of total parenteral nutrition after which specialized formulas are prescribed, contributing to the return of normal growth (Solimano & Lederman, 1979). Another area related to growth and nutrition which has begun to receive more attention is that of infant and childhood obesity. Only within the past decade has any research been reported which indicates the possibility of obesity in children who have been severely malnourished.

A discussion of the relevant published research conducted in the areas of chronic diarrhea, obesity, and infant nutrition is presented in this chapter. Also included is the method of classification regarding malnutrition (marasmus) and obesity as found in the literature. Under the heading of reinforcement, the role of nursing as related to the theories of learning and behavior by Skinner and Bandura is discussed.

Diarrhea

Diarrhea is usually classified into two groups depending upon the duration of illness. Acute diarrhea has been defined as that which lasts for two weeks or less (Jalili, 1980). According to Arasu, Wyllie, and Fitzgerald (1979), the definition of chronic or protracted diarrhea is controversial. However, Arasu et al. (1979) have defined chronic diarrhea as diarrhea which lasts for at least one month and results in either weight loss or failure to gain weight during the period of illness. Larcher, Shepherd, Francis, and Harries (1977) concur with this definition of protracted diarrhea. The only addition is that the infant has four or more loose stools per day for longer than two weeks (Larcher et al., 1977).

Sex Differences

In a study of the sex differences in infantile diarrhea conducted by Newell, Dover, Clemmer, D'Alessandro, Dueñas, Gracian, and LeBlanc (1976), the incidence of diarrhea was higher in males than in females. A similar study reported by Plank and Milanesi (1979) revealed the same findings of a higher incidence of diarrhea in males. The length of illness was also found to be greater for the males on the average than for the females in this study (Plank & Milanesi, 1979). Although not specifically addressed in

Jalili's (1980) study of acute diarrheal syndrome (ADS) and acquired monosaccharide intolerance (AMI), one of the tables given showed that males had a higher incidence of both ADS as well as AMI than did the females. The duration of diarrhea was divided according to the type of diarrhea rather than sex.

Relationship to Breast-Feeding

Following acute gastroenteritis or during protracted diarrhea, the problem of malabsorption has been noted (Burke & Danks, 1966; Kilby, Dolby, Honour, & Walker-Smith, 1977; Larcher et al., 1977). This problem involves the malabsorption of all carbohydrates, i.e., monosaccharides and disaccharides. Monosaccharide intolerance, which was originally believed to be congenital, was found to have developed in four infants during the first two weeks of life (Burke & Danks, 1966). Of the four infants studied by Burke and Danks (1966), only one was being breast-fed at the time of the onset of disease. In another study of protracted diarrhea in infancy conducted by Larcher et al. (1977), none of the 82 clients had ever been breast-fed. The feeding method of the 10 infants studied by Kilby et al. (1977), all of which had acute gastroenteritis followed by transient monosaccharide intolerance, was not mentioned. In Jalili's (1980) study of slick gut syndrome he mentioned that of the two groups, AMI and ADS, only one infant from each group was breast-fed and for a period of less than one month. In a case report on monosaccharide intolerance and hypersensitivity to soy protein, Goel, Lifshitz, Kahn, and Teichberg (1978) indicated that the six-week-old infant was being breast-fed when the diarrhea began, and the sickness abated only after termination of breast feeding. However, bacteria was found in her stools (Goel et al., 1978).

Of the 10 cases of chronic diarrhea and secondary monosaccharide intolerance presented by Macho, Güiraldes, Sorensen, Gutiérrez, Lobos, Harún, and del Pozo (1979), most of the infants were not breast-fed or if they had been, it was only for a very short time and diarrhea began subsequent to weaning. Except for the study by Kilby et al. (1977), all of the reported research above support the findings of Bullen and Willis (1971), as well as Ghai, Jaiswal and Seth's (1971) study, that breast-fed infants have a lower incidence of gastroenteritis and diarrhea than bottle-fed infants. (These studies may also indicate that the incidence of monosaccharide intolerance is uncommon in breast-fed infants.) Vandale (1978), White (1978), and Nutt (1979) mentioned that breast feeding is not commonly practiced among the mothers of the lower socioeconomic level. The majority of the feeding practices include bottle feeding and early introduction of solid foods. Ghai et al. (1971) and Vandale (1978) also indicated that there is a higher incidence of diarrhea in the rural and/or lower socioeconomic population. This diarrhea frequently develops when the children are weaned from the breast. The lower socioeconomic population does not generally breast-feed their infants (Nutt, 1979; Vandale, 1978) and they have a higher incidence of diarrhea (Ghai et al., 1971; Vandale, 1978). Bullen and Willis (1971) suggested that the breast-fed infant is somewhat resistant to gastroenteritis. Therefore, the increased incidence of diarrhea may be due to not breast-feeding the infants.

Malabsorption

The malabsorption of carbohydrates has been labeled as transient, secondary, or acquired monosaccharide intolerance (Burke & Danks, 1966; Goel et al., 1978; Jalili, 1980; Larcher et al., 1977; Kilby et al., 1977; Macho et al., 1979), chronic diarrhea (Arasu et al., 1979), and/or slick gut syndrome (Jalili, 1980). Factors which are believed to contribute to this malabsorption include infection (Burke & Danks, 1966; Goel et al., 1978; Gracey, Burke, Thomas, & Stone, 1975; Larcher et al., 1977; Macho et al., 1979), intestinal mucosal damage (Arasu et al., 1979; Jalili, 1980;

Klish, Udall, Rodriguez, Singer, & Nichols, 1978; Macho et al., 1979), and intestinal villous atrophy ("Intestinal Surface Area," 1978; Goel et al., 1978; Jalili, 1980; Klish et al., 1978). Macho et al. (1979), as well as Gracey et al. (1975), stated that malnutrition is also a factor which inhibits intestinal carbohydrate absorption.

Klish et al. (1978) studied the absorption of glucose as it related to the degree of intestinal mucosal surface area damage. The results indicated that the greater the intestinal surface area, the greater the glucose absorption (Klish et al., 1978). Although there was no etiology given by Klish et al. (1978) for the reduction of intestinal surface area, Burke and Dank (1977) and Goel et al. (1978) suggested that this reduction of surface area could be the secondary result of diseases which affect the mucosa of the small intestine such as gastroenteritis or hypersensitivity to some particular food product. Arasu et al. (1979) noted that "diffuse small-bowel epithelial damage occurs in most types of infectious enteritis" (p. 88). A small-bowel biopsy taken from an infant with acquired monosaccharide intolerance in Jalili's (1980) study showed total or subtotal atrophy of the villi, flat or cuboid epithelial cells, and elongated crypts, conditions which are opposite to those which are found in normal bowel mucosa. An intestinal biopsy was done on a patient with monosaccharide intolerance and soy-protein hypersensitivity studied by Goel et al. (1978) and showed fused, shortened microvilli as well as subtotal atrophy of the surface epithelium accompanied by large liquid stools. A change of formula was well tolerated and the diarrhea stopped. These investigators indicated that when monosaccharide absorption is impaired, small bowel surface area and mucosal damage follow as a result of acid diarrhea (Food & Nutrition Board, 1978).

Management of diarrhea does not always involve hospitalization. However, in the case of infants who have severe diarrhea and have developed an acquired monosaccharide intolerance, malnutrition and failure to thrive, prolonged hospitalization has been a necessary part of the treatment. In the cases reported by Burke and Danks (1966), Larcher et al. (1977), Goel et al. (1978), and Macho et al. (1979), the infants presented with dehydration and metabolic acidosis which were corrected by giving intravenous solutions of the fluids and electrolytes assessed as necessary through use of laboratory test results. The infants in these studies were also placed on nothing by mouth (NPO) for not more than 24 hours. The use of the NPO status for infants with severe diarrhea is recommended in order to determine whether the diarrhea is osmotic/absorptive or secretory in nature, since secretory diarrhea characteristically continues during the fasting state (Arasu et al., 1979; Beachler, 1976; Udall, 1975). If an infant is kept in the fasting state for longer than 24 hours, deprivation of the necessary calories and protein results. According to Avery, Villavicencio, Lilly, and Randolph (1968) fasting provides a bowel with rest; however, after that short period of time, inadequate provision of nutrition has a deleterious effect on the gut (Brueton, Regusci, & Anderson, 1976; Greene, McCabe, & Merenstein, 1975). Chronic or protracted diarrhea has been noted to be accompanied by infection; therefore, a course of antibiotic therapy is generally included in the management of the affected infants (Arasu et al., 1979; Beachler, 1976; Hirschhorn, 1975; MacLean, López de Romaña, Massa, & Graham, 1980).

Since the infants with acquired monosaccharide intolerance cannot tolerate oral glucose/electrolyte solution which is usually given prior to reinstituting regular oral feedings with half-strength formula, the use of a modular formula is instituted as indicated by the overall nutritional status of the infant. As previously mentioned in this chapter, damage to the intestinal mucosa and villi result in an inability of the bowel to produce enzymes needed to absorb monosaccharides (Buntain & Coran, 1978). Therefore, if an infant is severely malnourished, total parenteral nutrition (TPN) combined with intralipids is the only means of providing essential calories and protein for sustenance of life and promotion of growth as well as for healing of the intestinal tract (Buntain & Coran, 1978). While TPN provides a protein source of calories, in addition to water, nitrogen, vitamins, minerals and trace metals, intralipids and glucose provide nonprotein calories from fat and carbohydrates. The caloric requirement, then, is made up of protein, fat, and carbohydrate sources (Solimano & Lederman, 1979).

Following improvement of the nutritional status during TPN therapy, evidenced by consistent weight gain, infants are then begun on oral feedings (Arasu et al., 1979; Blattner, 1975; Buntain & Coran, 1978; Greene, Stifel, Hagler, & Herman, 1975; Solimano & Lederman, 1980). The composition of the oral feedings is an elemental (Greene et al., 1975) modular one (Klish, Potts, Ferry, & Nichols, 1976), designed to meet the specific gastrointestinal tolerance of the infants (Arasu et al., 1979; Blattner, 1975; Burke & Danks, 1966; Buntain & Coran, 1978; Goel et al., 1978; Greene et al., 1975; Klish et al., 1976; Larcher et al., 1977; Macho et al., 1979; MacLean et al., 1980; Solimano &

Lederman, 1980). The modular formula described by Klish et al. (1976) has a basic core composed of protein (whole casein), electrolytes, and sterile tap water which provides the trace minerals. To this core can be added fats, and carbohydrates as tolerated. Medium-chain triglycerides are used for fat in the formula because of their ability to be more easily absorbed in the digestive tract (Roy, Ste-Marie, Chartrand, Weber, Bard, & Doray, 1975). Since the medium-chained triglycerides used are deficient in linoleic acid (an essential fatty acid), safflower oil is added to the formula (Klish et al., 1976). Long-chain triglycerides are frequently used if no problem of fat absorption has been noted. The carbohydrates most frequently used in this modular formula, based on the infant's particular tolerance, are glucose, sucrose, and honey. Honey contains 40.5% fructose, 34.2% glucose, 1.9% sucrose, and 23.4% water (Klish et al., 1976).

The elemental diet described by Greene et al. (1975) consisted of Vivonex which is mainly composed of glucose and crystalline amino acids (Arasu et al., 1979). Because of the low content of glucose found in the elemental as well as modular formulas, caution must be taken to avoid hypoglycemia in the infants. An intravenous solution is given concurrently, supplying the remainder of the glucose that cannot as yet be absorbed in the bowel and is needed by the body to prevent hypoglycemia (Arasu et al., 1979; Greene et al., 1975; Klish et al., 1976). Other essential nutrients such as vitamins and minerals not found in the elemental or modular formula diets also must be supplemented in some manner until the infant is able to tolerate and absorb all the nutrients via the alimentary tract (Arasu et al., 1979; Greene et al., 1975; Klish et al., 1976).

Progression from modular or elemental formula to a more standardized formula that most closely resembles the standard formula is determined by the amount of consistent weight gain over a period of time. During this period of weaning to a standard formula, the amount, consistency, pH, and glucose of each stool is monitored as is the daily weight. Intolerance to the added concentrations of glucose in the formula during the weaning period can cause intestinal irritation, leading to acid diarrhea, malabsorption, and weight loss. When this problem occurs, management requires a regression to a lower concentration of the modular formula that can be tolerated. This process of changing formulas is continued until the infant is able to tolerate a full strength standardized formula such as Nutramagen, Portagen, Pregestimil, soy-based formula or a lactose-based formula--Mead-Johnson (Arasu et al., 1979;

Beachler, 1976; Blattner, 1975; Burke & Danks, 1966; Goel et al., 1978; Greene et al., 1975; Macho et al., 1979; MacLean et al., 1980). Once the infant is gaining weight on the full-strength formula without episodes of diarrhea, he is discharged from the hospital. Follow-up on an outpatient basis is generally for a period of six months to one year.

Obesity

Although a great deal of research has been conducted in the area of infantile and childhood obesity, conclusive evidence establishing the cause and effect of obesity during this period of growth and development has not been determined (Dubois, Hill, & Beaton, 1979; Food & Nutrition Board, 1978; Taitz, 1977; Weil, 1977). The important hereditary and environmental factors which contribute to the overall picture of obesity have been recognized by all researchers in this area. These social, cultural, economic, and genetic factors, while often investigated separately in research, are interrelated to such an extent that none can really be considered individually as the main contributing factor in obesity.

Sociocultural Factors

Sociocultural factors, such as income, education and social environment, have been correlated with the incidence of obesity by Moore, Stunkard, and Srole (1962), Silverstone, Gordon, and Stunkard (1969), Stunkard, d'Aquili, Fox, and Filion (1972), Bernfeld (1976), Oken, Hartz, Giefer, and Rimm (1977), Boulton and Coote (1979), Kohrs, Wang, Eklund, Paulsen, and O'Neal (1979). In a descriptive study of the relationship between obesity and mental illness, Moore et al. (1962) indicated a positive relationship between obesity and socioeconomic level. The population in the study was 99% white and from all levels of the socioeconomic spectrum. Obesity in women from the lowest socioeconomic level was reportedly seven times more frequent than in the women from the highest level. Although the same pattern existed among the men in this study, the differences were not as pronounced (Moore et al., 1962). A similar study in which obesity and social factors were compared using an adult population was conducted in London, England, by Silverstone et al. (1969). The findings of this study were similar to those of Moore et al. (1962) in that the incidence of obesity was twice as high in women from the lower socioeconomic level compared with the incidence among women from the higher socioeconomic level (Silverstone et al., 1969). However, the incidence of obesity in men did not follow the same pattern as in women. Silverstone et al. (1969) found that the highest incidence of obesity in men occurred in the middle socioeconomic level.

In the above-mentioned studies of obesity and socioeconomic status the investigators utilized adult populations. In 1972, Stunkard et al. conducted a study to investigate the influence of socioeconomic level on obesity and thinness in children. The population was comprised of white, urban children, from 5 to 15 years of age. Based upon the father's occupation, the socioeconomic level of the child was determined (Stunkard et al., 1972). The results obtained by Stunkard et al. (1972) indicated that obesity in girls is more prevalent in the lower socioeconomic level than in the higher one. There was only a 4% difference between the two groups at age 12; however, the difference was again increased after age 12 (Stunkard et al., 1972). In this same study obesity in boys from the lower socioeconomic level was greater than in boys from the higher socioeconomic level until the ages between 12 and 14. Within this particular age group, the incidence of obesity is high in the boys from the higher socioeconomic level. After age 14, however, the boys from the lower socioeconomic level again have a higher incidence of obesity

(Stunkard et al., 1972). Therefore, Stunkard et al. (1972) concluded that obesity was found mostly in the lower socioeconomic level.

Kohrs et al. (1979) studied the prevalence of obesity related to socioeconomic factors in Missouri. They indicated that males between 10 and 16 years of age who were from a low income rural area had the highest incidence of obesity. Following this first group, the next highest incidence of obesity was found in the low income rural males older than 59 years of age. Rural males between the ages of 10 and 16, low income rural males ages 35 to 39, and urban and low income rural females between the ages of 10 and 16 all had equally high percentages of obese individuals within their groups (Kohrs et al., 1979). When income, education, and environment were compared to the prevalence of obesity among males and females, Kohrs et al. (1979) found that in females there was a higher incidence of obesity in the low income, rural groups with 12 grades or less of education. The higher incidence of obesity in males, however, was found in the urban, middle income ($6,000-$8,999) group who had more than 12 grades of education (Kohrs et al., 1979).

DuRant, Martin, Linder, and Weston (1980) examined the prevalence of obesity in children related to sex, race, and age. The children in the study were from the lower socioeconomic level, receiving comprehensive health care, living in the Southeastern United States and were between the ages of two months to 18 years. The authors stated that, overall, the lowest percentage of obesity was found in black males. Black females, white males, and white females all had even percentages. However, when the over-weight and obese youth categories were combined, white females had the lowest percentage of obese/overweight youth. The highest percentage of obese/overweight youth was found among the black females followed by white males and black males. From birth to 10 years, the pattern of obesity between black males and females is similar, except that the development of obesity in males was two years later than in females. No similar pattern was found in white children; therefore, no generalizations were made (DuRant et al., 1980).

A comparison of the growth of Mexican-American children in Brownsville, Texas, to that of the national sample obtained by the United States Health Examination Survey (HES) was made by Zavaleta and Malina (1980). The age range of the children in the sample was from 6 through 17 years and included both males and females. Results indicated that Mexican-American children are shorter and lighter than American children when compared to the HES values. However, during childhood and adolescence, the triceps skinfold thicknesses and estimated fat areas of the Brownsville Mexican-American children were equal to those given by HES (Zavaleta & Malina, 1980).

The relationship between obesity and social factors has been confirmed (Bernfeld, 1976; Boulton & Coote, 1979; Kohrs et al., 1979; Moore et al., 1962; Silverstone et al., 1969; Stunkard, 1980; Stunkard et al., 1972). Attitudes toward obesity or fatness depend on individual emotional experiences as well as social and cultural conditions (Bernfeld, 1976). In France, Bernfeld (1976) studied obese French and immigrant children who were placed on a reducing diet. Many children dropped out of the study because their parents stopped taking them. If the child was very obese and/or obesity was a family characteristic, it was difficult for the child to follow the reducing regime. It was also noted that the mothers of these children had a difficult time perceiving real fatness in their children. In the Mediterranean group, food was symbolic and important. A cultural factor which contributed to obesity in Jewish girls from North Africa was that all but food was forbidden to them (Bernfeld, 1976).

Physiological Factors

According to Weil (1975) there is a genetic factor influencing obesity. However, the form of this genetic influence is unknown, that is, whether it is due to caloric intake and/or utilization (Bray, 1978; Weil, 1975). The idea of genetics correlating with obesity was supported by a study of 101 twin pairs by Börjeson (1976) who found that the difference in the skinfold thickness of monozygotic and dizygotic twins was three times greater in the dizygotic twins. Skinfold thickness of all the twins and their siblings was plotted on a percentile scale. The skinfold measurements of the dizygotic twin siblings were between those of the fatter twin and the average one (Börjeson, 1976). That obesity occurs in some families more frequently than in others is also a supported finding (Börjeson, 1976; Food & Nutrition Board, 1978; Salans, 1980; Taitz, 1977; Weil, 1977).

Study of the development and proliferation of fat cells which make up adipose tissue was first reported by Hirsch and Knittle in 1970. Successive reports on this particular topic did not support the view of Hirsch and Knittle (1970) that there is a particular "critical period" during the first year of life which will determine the number of fat cells an individual will have throughout life. Researchers have agreed, however, that proliferation of fat cells may be induced by a diet containing calories in excess of the normal physiological requirements (Durrant & Garrow, 1977; Boulton, Dunlop, & Court, 1978; Dunlop, Court, Hobbs, & Boulton, 1978; Hirsch, 1975). In a study by Faust, Johnson, Stern, and Hirsch (1978) conducted with adult rats, although the authors indicated that there appeared to be an increase in cell number, conclusive evidence that the new cells were adipocytes was not found. Application of the findings to humans was not stated (Faust et al., 1978). However, it has been shown that once the fat cells have been produced, the number remains constant regardless of weight loss. Weight loss will only reduce the fat cell size (Food & Nutrition Board, 1978; Hirsch & Knittle, 1970).

Though not indicative of a causal relationship with illness, obesity has been noted to coexist with various health problems (Glueck & Tsang, 1979; Kannel & Gordon, 1980; Rimm & White, 1980; Salans, 1980; Weil, 1975, 1977). Some of these associated health problems found in childhood and infancy include central nervous system damage and infections. Central nervous system damage may cause increased caloric consumption while at the same time cause a decreased level of activity (Weil, 1975). Hooper and Alexander (1971) reported a higher frequency of respiratory illness in obese infants. Weil (1975) stated that obese or overweight infants had a higher incidence of infections, and a child who had repeated infections could possibly become overweight/obese because of a decreased level of activity without a decreased appetite.

The physiological mechanisms which are found in hypertension, atherosclerosis, and adult-onset diabetes mellitus have been found to positively correlate with adult obesity (Glueck & Tsang, 1979; Kannel & Gordon, 1980; Rimm & White, 1980; Weil, 1977). Investigation of these problems has been carried out in the pediatric population with results indicating tentative predisposition to these various diseases if obesity continues into adolescence and adulthood (Charney, Goodman, McBride, Lyon, & Pratt, 1976; Glueck & Tsang, 1979; Kannel & Gordon, 1980; Rimm & Gordon, 1980; Salans, 1980; Weil, 1977). The relationship of infantile obesity to adult obesity was studied by several researchers. However, Charney et al. (1976) were the first to report this correlation. They used a sample that had been followed by a pediatrician during infancy and childhood, and was still available for follow-up between the ages of 20-30. Results of this study indicated that those who were over the 90th percentile on the growth grids during the first six months of life were 2.6 times as likely to be overweight or obese as adults than those who were either average or below average weight. The length or height of the infant in relation to weight did not seem to reduce the adult risk of overweight or obesity (Charney et al., 1976).

A study of obesity in 798 urban black adolescents when compared with their relative weights at one year of age indicated a consistently higher percentage of obesity among the adolescents who were one standard deviation above the mean at one year of age. When those in the group who were one standard deviation above the mean for weight were compared to those in the group who were one standard deviation below the mean for weight at one year of age, a ratio of 4:1 in both boys and girls was seen. Therefore, this study supports the findings that infantile obesity may indeed lead to adolescent obesity (Johnston & Mack, 1978).

Zack, Harlan, Leaverton, and Cornani-Huntley (1979) conducted a study to investigate whether or not body fatness in childhood affected body fatness in adolescence. Obesity was determined by skinfold thicknesses which were equal to skinfold thicknesses which had been identified in obese adults, >2 cm subscapular skinfold thickness. When a multiple regression analysis of all the potential factors contributing to obesity in adolescence was done, results indicated that the most important factor predicting adolescent fatness was childhood fatness regardless of sex, physiological growth, or maturation (Zack et al., 1979).

Collipp (1980) reported that 30% of the obese adults were obese already before the age of 18. He also stated that 80% to 85% of the obese teenagers were still obese as adults. Several of the researchers agreed that overnutrition and a lack of physical activity are very important contributing factors leading to health problems and obesity (Dubois et al., 1979; Fomon, 1974; Food & Nutrition Board, 1978; Glueck & Tsang, 1979; Kannel & Gordon, 1980; Neumann, 1977; Rimm & White, 1980; Salans, 1980; Taitz, 1971; Weil, 1975).

Feeding Practices

The methods of infant feeding practiced over the years are closely linked with the sociocultural habits and economic levels. Common to all cultures and economic levels is the nurturing of infants demonstrated in a large degree by feeding practices resulting in the growth and development of the infants. It has been said that "the giving of food is one of the main ways in which a mother shows her love for her child" (Wolff, 1977, p. 115).

A history of feeding styles from the early 20th century indicates a cyclic pattern which began with breastfeeding as the sole means of nutrition for infants during the first year of life. With the advent of homogenized milk and development of conveniently packaged infant formulas, breastfeeding was left mostly for the lower social classes. Accompanying this trend toward bottle feeding was that of the earlier introduction of solid foods (Nutt, 1978). By the late 1960s and early 1970s, infantile overnutrition and obesity became a concern and was believed to be a potential health hazard. Therefore, studies were undertaken to evaluate this problem. A discussion of the findings indicated that bottlefeeding and introduction of solid foods was associated with increased caloric intake which contributed to excessive weight gain and infantile obesity (Jelliffe, 1973; Jelliffe & Jelliffe, 1975; Oates. 1973; Shukla, Forsyth, Anderson, & Marwah, 1972; Taitz, 1971).

Subsequent investigations of infant feeding and formula preparations supported the previous findings (Crow, 1977; Fomon, 1974; Maclean, 1977; White, 1978). Formula preparations were often more concentrated than they should have been, thus increasing caloric intake without sufficient water. This overconcentrated formula created thirst in the infant. When the infant cried, more formula was given thereby establishing a vicious cycle (Fomon, 1974; Taitz, 1977). Solid foods were also introduced earlier in bottle-fed infants than in breastfed infants (Crow, 1977; Maclean, 1977; White, 1978). This overnutrition has not only been associated with overweight/obesity, but also with a more rapid growth rate and maturation (Forbes, 1977; Tanner, Whitehouse, Marshall, Healy, & Goldstein, 1975; Van Biervliet & Wijn, 1978).

Influenced by these studies on the potentially detrimental effects of bottlefeeding and early introduction of solid foods, the feeding styles seem to be completing the cyclic pattern. A return to breastfeeding with a later introduction of solid foods has been noted (Andrew, Clancy, & Katz, 1980; Boulton & Coote, 1979; Nutt, 1979; Vandale, 1978). This trend in breastfeeding has mainly been noted in the middle to upper socioeconomic levels in mothers with higher education (Andrew et al., 1980; Boulton & Coote, 1979; Vandale, 1978).

In contrast to the research that implicates feeding practices in fostering the development of obesity with accompanying potential health hazards, other studies have contradicted this view. De Swiet, Fayers, and Cooper (1977) studied the effects of infant feeding on 758 infants who were both bottle- and breastfed. No significant difference was found in the weights of the infants in the two groups at ages six weeks or six months. However, by the age of six months only 1% of the infants were totally breastfed, and only 2% were totally bottlefed using a commercial formula. They concluded that there was insufficient evidence to support the association of bottlefeeding and early introduction of solids to obesity (De Swiet et al., 1977).

A study by Whitelaw (1978) on the prevalence and prognosis of obesity in infancy indicated that breastfed infants also became obese. The number of feedings for these infants was not given. When placed on a diet of solid foods and modified cow's milk (skim milk?), the obese breastfed infants became slim. Poskitt and Cole (1978) also studied the effects of infant feeding on childhood obesity. Of 203 children reviewed, 80 had been obese as infants. At five years of age, 27 of the 80 children were overweight. The overweight children were very likely to have overweight mothers, although this relationship was not seen in infancy (Poskitt & Cole, 1978). Studies by Dubois et al. (1979) and Himes (1979) on infant feeding and obesity also failed to support any significant difference in obesity between the groups that were bottlefed and breastfed. However, there was an indication that more specific research was needed in order to understand the mechanisms of infantile obesity (Dubois et al., 1979; Himes, 1979). Recommendations for breastfeeding, later introduction of solid foods, and sensitivity to infant satiety cues were not specifically challenged by the researchers (Dubois et al., 1979).

Reinforcement

The effect of the social, environmental, and cultural factors on the way people live is well-established. These influences can easily be seen in the methods of childrearing, infant feeding practices, and concepts of health within the various populations throughout the world. Quite basic to all people is the knowledge that survival and growth of an infant depends upon adequate nurturing. This nurturing behavior is demonstrated in numerous ways; a prominent aspect of which is directly related to infant nutrition.

In black ghettos, the feeding of high calorie solid foods and highly saturated fats is begun early. The rationale for this practice is the belief that obtaining a maximum growth in young children is a sign of good health (Neumann, 1977). This belief parallels the commonly accepted concept that fat equals health in infants and children.

Eating is said to be a social behavior (Rosenthal & McSweeney, 1979). Many social behaviors are learned and/or facilitated by modeling influences (Bandura, 1977; Rosenthal & McSweeney, 1979). During hospitalization, the caregivers of infants with chronic diarrhea and malabsorption often learn how to feed and care for their infants through the modeling processes of the nursing personnel. The learning which takes place is reinforced and carried over into the home environment. Once a strong schedule of reinforcement is established, it is difficult to extinguish (Bandura, 1969; Skinner, 1953; Williams, 1973).

The relationship between parental and offspring obesity has also been connected with modeling influences (Rosenthal & McSweeney, 1979). These environmental influences have been shown to play a major role in eating behavior (Crow, 1977; MacLean, 1977; Rodin, 1980; Weil, 1975) which has been noted to possibly contribute to the development and maintenance of overweight/obesity in some individuals (Rodin, 1980). According to Stunkard, 1980), society controls obesity to an unusual degree.

Behavior modification and the learning theories have given a plausible explanation for the acquisition as well as extinction of various behaviors (Stunkard, 1980). The methods used in behavior modification (Bandura, 1969) to change behavior are very similar to those set forth by Skinner (1953), but have been expanded somewhat in their application. One expansion includes modeling procedures coupled with reinforcement to modify existing patterns, or to promote acquisition of new patterns of behavior through the observation of other individual's behavior and the consequences of their behavior (Bandura, 1969). The reinforcement of observationally learned responses may be applied externally, internally (self-applied), or experienced vicariously (Bandura, 1969).

The other expansion of Skinner's (1953) learning theory that is found in behavior modification (Bandura, 1969) to change or alter behavior is the process of extinction. Extinction of a reinforced behavior has been said to take place when the specific behavior decreases and eventually disappears once the reinforcement is discontinued (Bandura, 1969; Skinner, 1953). However, Bandura (1969) has stated that extinguished behavior is not lost; it is rather displaced and can easily be recovered if the original reinforcement is reinstated. Observation of individual characteristics and variable behavior during extinction has supported the idea that extinction alone is not enough to ensure desired changes in response patterns. However, a combination of extinction of the undesired behavior with modeling and positive reinforcement of the desired behavior can hasten the extinction process (Bandura, 1969).

Studies of the use of behavior modification in the treatment of obesity have been conducted (Fullarton & Pasick, 1980; Jordan & Levitz, 1975; Merritt, 1980; Stuart & Guire, 1980; Stunkard, 1980; Thompson & Linscheid, 1976). Behavior modification has been shown to be among the most effective methods in the treatment of obesity in children as well as in adults (Merritt, 1980; Jordan & Levitz, 1975; Stuart & Guire, 1980).

Few studies have been reported concerning obesity in formerly malnourished infants. Quite incidentally, Burke and Dank (1966) mentioned that one of the infants in their case studies who had monosaccharide intolerance accompanied by malnutrition was "quite obese" (p. 1178) at 15 months of age. The rate of weight gain established during the recovery phase had continued, and the infant had no more reported problems with monosaccharide intolerance or malabsorption after seven months of age.

Roberts (1978), in her case studies of four malnourished infants, indicated that the infants became "very fat" (p. 196) and seemingly hindered their movements which was a direct contrast to their state of malnutrition. In the study, the males gained more weight than the females; however, by the age of three only a few of the children were still overweight (Roberts, 1978). The only other report of malnutrition with subsequent obesity was by Resnikoff (1980). The population surveyed was from Mauretanian Adrar, North Africa. Malnutrition was found predominantly in the female infants since priority care was given to the male infants. However, in the adult population, the women were noted to have a high incidence of obesity. Obesity was a symbol of wealth and equated with feminine beauty even though the incidence of hypertension and cerebrovascular accidents was greater in the women than in the men (Resnikoff, 1980).

Instrumentation

The use of growth charts as measuring tools for height, weight, and head circumference associated with various ages has existed for many years. This tool has been standardized by testing and modification using cross-sectional samples representing the U.S. population. Studies conducted with other samples and compared with the standardized tool have indicated similar results (Hamill, Drizd, Johnson, Reed, Roche, & Moore, 1979; Jelliffe, 1969; Karlberg, Engstrom, Lichtenstein, & Svennberg, 1968; Roche & Himes, 1980; Waterlow, Buzina, Keller, Lane, Nichaman, & Tanner, 1977).

Another anthropometric measurement which has been found useful in the assessment of nutritional status in pediatric practice has been the mid-arm circumference (Jelliffe, 1966). According to Jelliffe (1966), and Robinow and Jelliffe (1969), this mid-arm circumference has been correlated with the "muscle circumference" (p. 219) which when decreased is indicative of a protein-calorie malnutrition (PCM) in early childhood. In conjunction with the arm-circumference, the head/chest ratio, weight-for-height (length), and weight-for-head circumference are considered "year constant" (p. 181) or independent of a known precise age (Jelliffe, 1966, 1969; Jelliffe & Jelliffe, 1969; Robinow & Jelliffe, 1969). Additional surveys using the low arm circumference as a screening method for PCM were conducted by Burgess and Burgess (1969), Kanawati, Haddad, and McLaren (1969), and Robinow and Jelliffe (1969), in Tanzania, Lebanon, and Uganda, respectively. Similar results were obtained by the researchers and they agreed that this particular method of screening for PCM in early childhood was effective and practical (Jelliffe & Jelliffe, 1969).

Because weight, height, and chest circumference vary between sexes and with age, Kanawati and McLaren (1970) proposed the mid-arm circumference/head circumference ratio. They stated that between 3 and 48 months of age this ratio is essentially constant and does not vary with sex. In addition, the measurements were easily taken and could be directly interpreted (Kanawati & McLaren, 1970). Recommendation of the meaning of the mid-arm circumference/head circumference ratio was as follows: a ratio of >0.310 indicated the child was nutritionally healthy; 0.310-0.280 indicated mild PCM; 0.279-0.250 indicated moderate PCM: and <0.250 indicated severe PCM (Kanawati & McLaren, 1970). In 1971, Kanawati, McLaren, and Abu-Jawdeh conducted a study to test the tool (mid-arm/head circumference ratio) for use in the field. Analysis of the results obtained from this study showed a high correlation between height and head circumference as well as between arm circumference and weight (Kanawati et al., 1971).

Shakir (1975) compared the percentages (Boston) of weight for age standard with the mid-upper arm for age percentage standards on 777 children in Baghdad between 3 and 72 months of age. These comparisons were made with the purpose of screening for PCM. Results indicated that for children under 12 months of age, the application of the mid-upper arm circumference standard tended to misclassify some normal infants as malnourished (Shakir, 1975). Shakir (1975) also reported that the arm/head circumference ratio and the arm for height ratio results were not significantly different from the measurement of only the arm circumference. Therefore, Shakir (1975) concluded that perhaps the ratios were not necessary if the arm circumference alone could give the necessary health information regarding PCM.

Ghosh, Yayathi, and Yayathi (1976) tested 563 children who were attending an outpatient clinic and 203 children attending a nutrition clinic using a bangle with an internal diameter of 4.0 cm (12.6 cm circumference) along with weight and upper mid-arm circumference to screen for malnutrition.

The mid-arm circumference was measured using a fiberglass measuring tape as well as the bangle. The results of this study indicated that the measurement of the mid-arm circumference using either the measuring tape or the bangle was sufficient information for diagnosing PCM and adequately served the purpose of quick nutritional screening (Ghosh et al., 1976).

In 1977, Blankhart, Latham, and Schulpen reported on a nutritional study which was conducted in Kenya. The researchers described their use of the mid-upper arm circumference measurements to detect children with early PCM. These data were collected on approximately 4,000 children from zero to four years of age. During an eight month period, 91 children over six months of age were found to have low mid-upper arm circumference (less than 12 cm) and were rehabilitated at home. Blankhart et al. (1977) concluded that case finding PCM could be possible utilizing the upper-mid-arm circumference and amount of edema present in the children being screened. These reported findings (Blankhart et al., 1977) support the findings of all the previous studies on PCM and low mid-arm circumference.

Summary

This chapter included a review of the literature in the areas of chronic diarrhea, mono- and di-saccharide intolerance with the commonly practiced methods of treatment; infant and childhood obesity as it relates to health problems and infant nutrition and feeding practices as they relate to diarrhea and obesity. Also addressed was the interrelationship of culture, social environment, and reinforcement seen in the rehabilitation of FTT children by health care personnel and families. Finally, a description of the instrumentation used in this study was given.

CHAPTER 3

PROCEDURE FOR COLLECTION AND TREATMENT OF DATA

This study was nonexperimental and explanatory. A one-group design with repeated measures was used. The incidence of obesity in former FTT infants was studied in a retrospective method by gathering data from hospital records. Since the data were collected for each infant on a monthly basis over two years, the study was also longitudinal.

Setting

The study was conducted in regular county child health clinics, one county nutrition clinic and one hospital which are located in a metropolitan area containing more than one million persons in the southwestern United States. In the nutrition clinic, children and infants who have been diagnosed as having growth problems related to food intake are treated. In the health clinics, provisions are made for maintenance of health care in infants and children within the normal developmental limits of the population.

Population and Sample

Subjects for this study were children between the ages of 12 and 24 months who had attended either the nutrition clinic or regular child health clinics. From the nutrition clinic, the children within the specified age group had been hospitalized with the diagnosis of FTT between the first and third months of life and were of normal gestational age. Since many of these children were transferred to well child clinics once they had reached a normal weight, data from the second year were usually obtained from the records of those county clinics. The group was composed of subjects from the lower middle and lower socioeconomic levels.

The sample size consisted of 15 subjects. From the total population of FTT children who had been hospitalized, 50 were systematically selected. These children were those diagnosed in 1978 and cared for in the clinic until 24 months of age or until they were considered as thriving normally. Because the investigator was unable to obtain complete data on many of the subjects due to inconsistent record-keeping, the final sample consisted of 15 subjects. The information on normal infants used for comparison with the data on these subjects was obtained from standardized growth grids. These growth grid values were used to represent those of a group of thriving infants because of constraints on time and accessibility to clinic data on normal infants.

Protection of Human Subjects

No active participation by human subjects occurred in this study. The data necessary to complete this study were obtained from the hospital records only. The potential risk of disclosure of identification or improper release of data to the public was prevented in the following manner:

1. The hospital records remained in the hospital at all times.
2. Patient names were not used.
3. Patient hospital I.D. numbers were coded by assigning a series of random numbers to each of the charts. The code sheets were kept in a locked cabinet to which only the investigator had access.
4. The Human Subjects Policies and Procedures of Texas Woman's University were observed (Appendix A).

Instrument

The instrument to be used in this study was developed by the investigator and used to obtain specific demographic and medical data from the subjects' hospital records (Appendix B). "Content validity is concerned with the sampling adequacy of the content area being measured" (Polit & Hungler, 1978, p. 434). Therefore, the summary form of pertinent data was based on suggestions from the available literature.

For purposes of identification and grouping, patient hospital code, sex, race, economic status and date of birth were obtained. To investigate the variables included in this study the following data were obtained: the birth weight/height, age at onset of disease, failure-to-thrive (FTT) weight/height, head/arm circumference, "catch-up" weight/height and head/arm circumference, length of time followed for illness and number of visits (in order to determine an approximate number of reinforcement situations), and discharge height/weight. The growth charts which were used as a measuring device for height, weight, and head circumference were those established by the National Center for Health Statistics (Hamill, Drizd, Johnson, Reed, Roche, & Moore, 1979).

The reliability for the measuring devices was established. Guidelines for measurement and examination procedures for obtaining the data required on the growth charts were uniform (Jelliffe, 1969; Karlberg, Engstrom, Lichtenstein, & Svennberg, 1968). New standardized norms were developed by the National Center for Health Statistics (NCHS) based on a probability sample, or random sample as defined by Polit and Hungler (1978), of 20,000 subjects used to represent the population of almost 70 million children in the United States from 1-18 years of age (Hamill et al., 1979). To test the given standardized norms, a similar study was conducted by Roche and Himes (1980) using 818 normal American white children from 0-18 years of age. The results matched those of the NCHS.

In relation to international standards, Kanawati and McLaren (1970) developed a "thriving index" which included height, weight, head circumference, and mid-arm circumference. The sample consisted of 1,276 Lebanese children from the lower socioeconomic status; 1,231 children selected from a field study, and 45 children from a metabolic unit with an admission diagnosis of acute marasmus. The curve of the mean values for this group was lower than the standard values. However, "the differences between means of the ratios for the weight/age groups were significant at $p < 0.001$" (p. 574).

Although reliability for the investigator's instrument was not formally established, the data were collected only by the investigator. A uniform procedure was followed.

Data Collection

After approvals were obtained from Texas Woman's University and the participating medical facilities (Appendix A), data were collected by the investigator by surveying the hospital records of the group of children. The data spanned a 24 month period and were collected on a monthly basis.

Treatment of Data

The treatment of data for this study was as follows:

The group (former FTT children) was compared with the Ross (1980a,b) growth charts for the incidence of obesity at 12 and 24 months. Within this group, two levels were formed on the basis of the extraneous variable sex. The statistical procedure for comparing the group with the growth grids was the *t*-test for related samples which compares two related groups with the dependent variable. An analysis of variance with repeated measures based on the obesity ratio or dependent variable permitted the investigator to assess if the difference in the two groups was related to the independent variable, reinforcement, or if it was due to the difference within the levels of male and female. The independent variable reinforcement was measured by the length of time followed for illness and the number of visits made to the clinic during the period of illness. Correlation or degree of association between the reinforcement and the obesity ratio was determined by using the Pearson product-moment correlation coefficient (Polit & Hungler, 1978). The extraneous variables of race and socioeconomic status as they relate to the dependent variable obesity were evaluated using analysis of variance. This test served to compare two groups. Had there been a significant difference in obesity between males and females, then sex and race would have been analyzed using the obesity ratio. The statistical procedure for this analysis would have been a four by two analysis of variance.

CHAPTER 4

ANALYSIS OF DATA

A nonexperimental, explanatory study was conducted to ascertain the incidence of obesity in former FTT infants. In this chapter a quantitative description of the sample used in this study is presented. A descriptive and inferential statistical analysis is included as well as a summary of the findings.

Description of Sample

Fifteen children who were (presently) about 24 months of age and had been hospitalized for chronic diarrhea within the first through third months of life were systematically chosen, thus presenting a convenience sample. When broken down into two groups by sex, there were nine males and six females. The sample was also divided according to race. This division consisted of three groups: (1) black with 8 subjects, (2) white with 2 subjects and (3) Mexican-American with 5 subjects.

Findings

The findings of this study are presented as they relate to the hypotheses. Since a breakdown of variables in relation to obesity has been demonstrated in the literature, the specific findings of these particular variables of sex and race are also addressed. A summary of the data collected is found in Table 1. A breakdown of the subjects into three groups according to weight is shown in Table 2. The accepted level of significance for this study was $p \leq .05$.

H_o1: There will be no significant incidence of obesity in former FTT children 12 and 24 months of age as indicated by comparison with the growth grids of normal weight and height.

H_a1: There will be a significant incidence of obesity in former FTT children 12 and 24 months of age as indicated by comparison with the growth grids of normal weight and height.

A *t*-test for related samples was used to compare the 12 and 24 month centiles, resulting in a mean centile of 57.467 at 12 months and 66.64 at 24 months. The *t* value was -2.55 with a significance level of .024. Therefore, there was a significant difference between the weights and centiles at 12 and 24 months with 66% of the centiles falling in the overweight/obesity category.

H_o2: There will be no significant difference in the mean centiles of former FTT males and females at 12 months of age.

Table 1

Summary of Data Collected

	Race	Sex	FTT WT (kg)	FTT HT (cm)	12 Months HT (cm)	12 Months WT (kg)	12 Months Centile	24 Months HT (cm)	24 Months WT (kg)	24 Months Centile
1	Black	F	3.37	53.3	72.0	9.40	70	81.3	11.70	80
2	Mexican	M	3.44	54.5	73.7	10.14	77	83.8	13.07	90
3	Black	M	3.34	53.3	75.5	11.25	85	88.9	14.55	97
4	Mexican	F	3.29	48.0	75.6	10.34	60	84.5	15.11	94
5	Mexican	F	3.00	54.0	72.0	9.89	90	-	12.12	-
6	Black	F	2.31	50.0	70.0	8.07	40	87.0	13.02	80
7	White	M	-	-	70.0	8.24	40	81.3	12.05	77
8	Black	M	2.58	50.0	73.7	10.14	80	84.0	12.90	80
9	Black	M	3.08	52.1	80.0	10.96	50	83.8	12.04	70
10	Black	M	3.75	54.6	69.5	8.98	60	78.5	11.36	75
11	Mexican	M	-	-	68.0	8.00	50	76.2	10.00	50
12	Mexican	F	2.88	51.0	71.1	9.56	50	82.5	10.80	40
13	Black	F	2.93	45.0	68.6	6.73	10	78.7	9.04	20
14	White	M	2.39	47.0	67.3	7.39	35	77.5	9.66	25
15	Black	M	2.45	49.0	69.8	8.98	65	83.8	12.04	55
Mean			2.993	50.91	71.79	9.205	57.467	82.27	11.967	66.643
S.D.			1.563	3.067	3.42	1.313	21.494	3.614	1.67	24.762

Table 2

Classification of the 15 Subjects by Weight

	Obese	Overweight	Normal Weight
	1 black male	3 black males	1 black male
	1 Mexican male	1 white male	1 white male
			1 Mexican male
	1 black female	1 black female	1 black female
	2 Mexican females		1 Mexican female
Total	5	5	5

H_a2: There will be a significant difference in the mean centiles of former FTT males and females at 12 months of age.

An analysis of variance was used to evaluate this hypothesis. The mean for the males was 60.2 with a standard deviation of 17.9. The mean for the females was 53.5 with a 27.3 standard deviation. The mean square within these two groups was 484.38. The $\underline{F}$-ratio was .35 with a significance level of .56 which indicates no significant difference.

H_o3: There will be no significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 12 months of age.

H_a3: There will be a significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 12 months of age.

When the centiles were analyzed according to race the means were 57.5 for blacks, 37.5 for whites and 65.4 for Mexican-Americans. The standard deviations were 24.2 (N=8), 3.5 (N=2), and 17.6 (N=5) for each group, respectively. A resulting F-ratio of 1.25 with a significance level of .32 was found. Therefore the null hypothesis was accepted.

H_o4: There will be no significant difference in the mean centiles for weight of former FTT males and females at 24 months of age.

H_a4: There will be a significant difference in the mean centiles for weight of former FTT males and females at 24 months of age.

Evaluation of this hypothesis was by analysis of variance. The means for males (N=9) and females (N=5) were 68.8 and 62.8, respectively. The standard deviations were 22.2 and 31.3. This analysis of variance yielded a calculated F-ratio of .175 at a .68 level of significance. Again, the null hypothesis was accepted.

H_o5: There will be no significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 24 months of age.

H_a5: There will be a significant difference in the mean centiles of former FTT black, white, and Mexican-American children at 24 months of age.

Similarly, there was no significant difference when analyzed according to race, which resulted in an *F*-ratio of .427 at a .66 significance level.

H_o6: There will be no significant difference in the mean number of hospital days between former FTT males and females.

H_a6: There will be a significant difference in the mean number of hospital days between former FTT males and females.

This hypothesis was also evaluated by an analysis of variance with repeated measures. The mean number of hospital days for males (*N*=7) was 86.4 with a standard deviation of 38.8. For females (*N*=6), the mean number of days was 152.7 with a standard deviation of 85.4. The *F*-ratio was 3.43 with a level of significance of .09 indicating a rejection of the null hypothesis. A summary of these data is given in Table 3.

H_o7: There will be no significant difference in the mean number of hospital days for former FTT black, white, and Mexican-American children.

Table 3

Number of Hospital Days and Clinic Visits by Sex

Male		Female	
Hospital Days	Clinic Visits	Hospital Days	Clinic Visits
139	35	168	9
76	12	62	22
53	33	100	8
29	15	118	13
88	7	151	20
-	4	311	22
-	61		
92	6		
128	28		
Total 605 (N=7)	201 (N=9)	Total 916 (N=6)	94 (N=6)
Mean 86.43		Mean 152.6	
S.D. 38.84		S.D. 85.38	

H_a7: There will be a significant difference in the mean number of hospital days for former FTT black, white, and Mexican-American children.

When analyzed according to race the mean number of hospital days for black children was 131.1 with a standard deviation of 90.6 (N=7). The white children had a mean number of 72.5 and a standard deviation of 27.6 (N=2). The Mexican-American children had a mean of 114.5 days and 37.9 standard deviation (N=4). The F-ratio for the entire sample was .496 which was not significant at the level of .05. These data are summarized in Tables 4 and 5. An overall picture of the 12 and 24 month centiles and hospital days/ clinic visits along with race and sex is found in Table 6.

Table 4

Length of Hospitalization by Race

	Hospital Days		
	Black	White	Mexican
	168	53	139
	76	92	68
	118		100
	29		151
	88		
	311		
	128		
Total	918 (N=7)	145 (N=2)	458 (N=4)
Mean	131.143	72.50	114.50
S.D.	90.577	27.58	37.88

The degree of association between reinforcement and obesity was determined by using the Pearson product-moment correlation coefficient. Reinforcement was defined as the number of days hospitalized and the number of clinic visits attended (contacts with health care personnel). The centiles were used to represent the obesity ratio. The

Summary of the Statistical Significance of the Hypotheses Considered

	Hypotheses	Statistical Value	Statistical Level	p	Significance
H_o1:	Obesity in FTT children at 12 and 24 months of age	t = -2.55	.024	.05	Significant
H_o2:	No difference between sexes in mean centiles at 12 months of age	F-ratio = .35	.560	.05	Not Significant
H_o3:	No difference between races in mean centiles at 12 months of age	F-ratio = 1.25	.320	.05	Not Significant
H_o4:	No difference between sexes in mean centiles at 24 months of age	F-ratio = .175	.680	.05	Not Significant
H_o5:	No difference between races in mean centiles at 24 months of age	F-ratio = .427	.660	.05	Not Significant
H_o6:	No difference in mean hospital days between sexes	F-ratio = 3.43	.090	.05	Significant
H_o7:	No difference in mean hospital days between races	F-ratio = .496	.620	.05	Not Significant

Table 6

Numerical Summary of Weight and Reinforcement

	Race	Sex	12 Centile	24 Centile	Hospital Days (HD)	Clinic Visits (CV)	Total HD + CV
1	Black	F	70	80	168	9	177
2	Mexican	M	77	90	139	35	174
3	Black	M	85	97	76	12	88
4	Mexican	F	60	94	68	22	90
5	Mexican	F	90	-	100	8	108
6	Black	F	40	80	118	13	131
7	White	M	40	77	53	33	86
8	Black	M	80	80	29	15	44
9	Black	M	50	70	88	7	95
10	Black	M	60	75	-	4	+ 4
11	Mexican	M	50	50	-	61	+ 61
12	Mexican	F	50	40	151	20	171
13	Black	F	10	20	311	22	333
14	White	M	35	25	92	6	98
15	Black	M	65	55	128	28	156
Mean			57.467	66.643	117	19.667	134.692
S.D.			21.494	24.762	70.52	15.046	72.373

correlation coefficient for the centiles at 12 and 24 months was .736 (_N_=14) and was found significant at _p_ = .001. The degree of association between hospital days and the 12 month centile was also significant, _p_ = .033; the coefficient was -.523 (_N_=13). The negative correlation between the number of hospital days and 24 month centile was -.581 (_N_=12) and was also significant at the .024 level. The above data have been summarized in Table 7.

Table 7

Pearson Product-Moment Correlation Coefficients

	12 Centile	24 Centile
Hospital days	-.523 (N=13) p=.33	-.582 (N=12) p=.024
Clinic visits	-.140 (N=15) p=.308	-.097 (N=14) p=.371
24 Centile	.736 (N=14) p=.001	

Summary of Findings

In this chapter a descriptive and inferential statistical analysis of the data obtained for this study was presented. The study sample consisted of 15 former FTT children. Of these children, nine were male and six were female. When broken into groups according to race, there were eight black subjects, two white subjects, and five Mexican-American subjects.

Results of the *t*-tests indicated that there was a significant incidence of obesity at 24 months of age in these former FTT subjects when compared to the norm. There also was a highly significant negative correlation between the opportunities for reinforcement (or contacts with health care personnel as demonstrated by the number of hospital days and clinic visits) and obesity. In other words, the lower the centile, the higher the number of hospital days. The positive correlation of .736 between weight at 12 and 24 months of age was also significant (p=.001). Therefore, the overweight/obese children at 12 months have a high probability of being overweight/obese at 24 months of age.

The analysis of variance with repeated measures indicated that there were no significant differences in obesity between males and females or among the three ethnic groups studied at either 12 or 24 months of age. There also was no significant difference in the number of hospital days or contact with health care personnel between any of the groups mentioned above. The variation was greater within than between the groups.

CHAPTER 5

SUMMARY OF THE STUDY

The problem of this study was to investigate whether or not there was a significant incidence of obesity in former failure-to-thrive (FTT) children. In order to investigate the incidence of obesity in the subjects of this study, demographic data spanning approximately 24 months were collected from the subjects' medical records. The breakdown of variables in relation to obesity which were evaluated were sex, race, number of hospital days and number of clinic visits (or number of opportunities for reinforcement).

Summary

This study was nonexperimental and explanatory. A one-group design with repeated measures was implemented. The incidence of obesity in this particular sample was studied in a retrospective manner. These 15 children were approximately 24 months of age, were of normal gestational age, had been hospitalized during the first and third months of life due to FTT, had attended the nutrition and/or pediatric clinics in a county health system, and were from the lower socioeconomic level. Of these 15 subjects, 9 were male and 6 were female. This sample also included three races. There were eight black subjects, two white subjects, and five Mexican-American subjects.

An instrument was developed by the investigator which was used for obtaining specific demographic data. Standardized growth grids were used as a basis for comparing the FTT subjects with the normal thriving population because of constraints on time and accessibility to data on thriving children. A head/arm circumference ratio was also employed to ascertain the "index of thriving."

To analyze the first null hypothesis which stated that there will be no significant incidence of obesity in former FTT children between 12 and 24 months of age as indicated by comparision with the growth grid norms, a t value was calculated. The results indicated that there was a significant incidence of obesity in these subjects. When divided according to sex and race in relation to weight/height centiles for 12 and 24 months of age, the second through fifth null hypotheses were evaluated by analysis of variance with repeated measure design. These findings indicated no significant difference in obesity for males and females or among the races at either 12 or 24 months of age. The last two null hypotheses concerning the difference in the mean number of hospital days for sex and race were also evaluated by analysis of variance. Again there was no significant difference in the mean number of hospital days for either sex or race. A greater variation was observed within the groups rather than between them. A negative correlation between the 12 and 24 month centiles and number of hospital days was significant. There was also a significant, positive correlation between the 12 and 24 month weights.

Discussion of Findings

Diarrhea

In this study, there were more males (N=31) than females (N=19) who had chronic diarrhea and FTT. These findings support those of Newell, Dover, Clemmer, D'Alessandro, Dueñas, Gracian, and LeBlanc (1976), Plank and Milanesi (1979), and Jalili (1980). According to Newell et al. (1976) and Plank and Milanesi (1979) the average duration of diarrhea was longer in males than in females. These results did not coincide with the results of this particular study since the investigator noted that the average length of hospitalization was greater for the females than for the males.

Ghai, Jaiswal, and Seth (1971) and Vandale (1978) reported that there is a higher incidence of diarrhea in infants of the lower socioeconomic status. Vandale (1978), White (1978), and Nutt (1979) stated that mothers from the lower socioeconomic group do not commonly breast-feed their infants. An association between non breast-fed infants and the occurrence of diarrhea has been suggested (Bullen & Willis, 1971; Ghai et al., 1971; Macho, Güiraldes, Sorensen, Gutiérrez, Lobos, Harún, & del Pozo, 1979). The study sample for this investigation was from the lower socioeconomic status. Even though it was noted that none of the subjects had been breast-fed, these variables were not specifically evaluated.

Obesity

Stunkard, d'Aquili, Fox, and Filion (1972) and DuRant, Martin, Linder, and Weston (1980) reported that there was a prevalence of obesity in children from the lower socioeconomic level until adolescence for both the white and black populations. The Mexican-American population were shorter and lighter than the other two races during infancy. However, during childhood and adolescence the estimated fat areas of the Mexican-American children were equal to the national U.S. standards (Zavaleta & Malina, 1980).

Although the genetic factor influencing obesity is unknown (Weil, 1975), the suggested correlation between genetics and obesity was supported in various studies (Börjeson, 1976; Salans, 1980; Taitz, 1977; Weil, 1977). Other physiological factors which have been studied in conjunction with obesity are: (1) the development and proliferation of fat cells during a "critical period" within the first year of life and again during adolescence (Hirsch & Knittle, 1970) induced by an excessively high caloric diet (Ashwell, Durrant, & Garrow, 1977; Boulton, Dunlop, & Court, 1978; Dunlop, Court, Hobbs, & Boulton, 1978; Hirsch, 1975); and (2) the various coexistent health problems such as infections (Weil, 1975), respiratory illnesses (Hooper & Alexander, 1971), and possibly hypertension and atherosclerosis (Charney, Goodman, McGride, Lyon, & Pratt, 1976; Glueck & Tsang, 1979; Kannel & Gordon, 1980; Rimm & Gordon, 1980; Salans, 1980). A relationship between infantile, childhood, adolescent, and adult obesity has also been noted (Charney et al., 1976; Collipp, 1980; Johnston & Mack, 1978; Zack, Harlan, Leaverton, & Cornoni-Huntley, 1979).

The results of this study indicated that of the 15 subjects, 5 were obese, 5 were overweight, and 5 were normal weight. In these three categories, there were more black and Mexican-American children. However, there were more black and Mexican-American children than white in the setting for this study. These five children who were normal weight were noted to have been the sickest and had been followed the longest after hospitalization. In fact, at least four of the five children were still being followed at the time data were collected, possibly indicating that they had still not achieved a well status.

Reinforcement

For this study, the number of days spent in the hospital and the number of clinic visits were the basis of determining opportunities for reinforcement. The hypothesis was that the greater the number of reinforcement opportunities, the greater would be the correlation to obesity. Evaluation of this hypothesis indicated that there was a significant negative correlation. These findings appear to support the theories that social behaviors are learned and/or facilitated by modeling influences (Bandura, 1977; Rosenthal & McSweeney, 1979), and undergo a continuous shaping process which tend to become stronger when reinforced (Bandura, 1977; Skinner, 1953). The parents, health care givers and infants in this study received intermittent reinforcement from the caregivers, and weight gained during the hospitalization and clinic visits. This intermittent schedule of reinforcement is the most resistant to extinction (Skinner, 1953; Williams, 1973).

Results of case studies have been reported which linked failure-to-thrive (or malnutrition) to subsequent obesity (Burke & Danks, 1966; Resnikoff, 1980; Roberts, 1978). Obesity was reported as a sociocultural factor in one study (Resnikoff, 1980). The other researchers did not express any obvious sociocultural trend which led to obesity (Burke & Danks, 1966; Roberts, 1978).

Conclusions and Implications

A limited sample of 50 former FTT children of 24 months was systematically chosen. Due to the lack of consistency in the measurements used to follow these children, only 15 subjects were included in the study since they had the most complete data. Of these 15 subjects, 66% (N=10) were obese/overweight. The incidence of obesity/overweight was not observed in any one particular ethnic group. In addition, those children with an increased number of hospital days and/or clinic visits had the lowest centiles at 12 and 24 months of age. This result may imply that, since the sickest children were still being followed, the possibility for overweight/obesity may still exist. However, the obesity/overweight may not appear until the third or fourth year of life.

Therefore, based on the findings of this study and the literature reviewed the following conclusions were drawn:

1. Since the lower socioeconomic population has a higher incidence of not only diarrhea, but also obesity, and the incidence of both diarrhea and obesity is lower in breast-fed infants, it would seen advantageous for

health care personnel to encourage breast-feeding in the mothers of this particular population.

2. Although modeling behaviors and reinforcement are necessary tools implemented by health care personnel in the treatment and for the survival of these FTT infants, the extinction of the behavior which emphasizes the necessity and importance of frequent feedings should be initiated once the infant reaches normal weight for height or has "caught up." Otherwise, these former FTT children may have survived their initial sickness only to be predisposed to other health problems which coexist with obesity.

Recommendations for Further Study

Based on the conclusions and implications of this study, and due to the limited literature correlating malnutrition (or protein caloric malnutrition) and obesity in former FTT children, the following recommendations are made for further study:

1. A longitudinal study (to five years of age) to assess whether these children continue the obese/overweight trend, or whether the sicker children tend to become obese/overweight in midchildhood should be undertaken.
2. A better controlled study with greater consistency in measurements taken by health care workers should be done.

3. A larger sample should be obtained to see whether or not similar results or stronger correlations between FTT and obesity exist.
4. A study of the diet composition for possible predisposing factors, such as TPN, lipids, and formula additives should be undertaken.
5. A study of predisposing factors for obesity in the children's parents should also be undertaken.

APPENDIX A

AGENCIES' APPROVALS

TEXAS WOMAN'S UNIVERSITY
HOUSTON CAMPUS
HUMAN RESEARCH REVIEW COMMITTEE
REPORT

STUDENT'S NAME I. Michelle Rios

PROPOSAL TITLE An investigation of the incidence of obesity in infants recovered from chronic diarrhea as compared with the incidence in normal infants.

COMMENTS:

DATE: 29 July 1981

R. P. Bennett
~~Disapprove~~ Approve

~~Disapprove~~ Approve

Geneva R. Johnson
~~Disapprove~~ Approve

~~Disapprove~~ Approve

ls

Baylor College of Medicine
DEPARTMENT OF PEDIATRICS

September 29, 1981

Research Committee/s
Texas Women's University
1130 M.D. Anderson Blvd.
Houston, Texas 77025

Members of the Research Committee:

I have consented to support Michelle Rios in her research. This research could serve as a pilot study for further research in the area of obesity as it relates to failure-to-thrive due to organic causes.

The investigation is nonintrusive and anonimity of the clients will be maintained. There will be no interaction with the clients. The investigator will obtain all data for the study from patient charts.

Sincerely,

G.S. Gopalakrishna
G.S. Gopalakrishna, M.D.
Assistant Professor of Pediatrics
Section of Nutrition & GI

GSG/bwh

TEXAS MEDICAL CENTER • HOUSTON, TEXAS 77030

Baylor College of Medicine
DEPARTMENT OF PEDIATRICS • 713 790-4731

October 1, 1981

Harold Brown, M.D.
Chairman
Clinical Investigations Committee
Harris County Hospital District

Dear Dr. Brown:

I am pleased to approve the protocol entitled "An Investigation of the Incidence of Obesity in Infants Recovered from Chronic Diarrhea as Compared with the Incidence in Normal Infants" submitted by L. Michelle Rios, R.N., B.S.N. to be carried out at Jefferson Davis Hospital. It is my understanding that Dr. G. S. Gopalakrishna has been working with Ms. Rios regarding this protocol.

Sincerely yours,

Ralph D. Feigin

Ralph D. Feigin, M.D.
Physician-in-Chief, Pediatric Service
Harris County Hospital District
and
Professor and Chairman
Department of Pediatrics
Baylor College of Medicine

RDF:cb

TEXAS MEDICAL CENTER • HOUSTON, TEXAS 77030

HARRIS COUNTY HOSPITAL DISTRICT

DISTRICT ADMINISTRATION
726 GILLETTE
HOUSTON TEXAS 77019
751-8555

BEN TAUB GENERAL HOSPITAL
1502 TAUB LOOP
HOUSTON TEXAS 77025
791-7000

COMMUNITY HEALTH PROGRAMS
726 GILLETTE
HOUSTON, TEXAS 77019
751-8580

JEFFERSON DAVIS HOSPITAL
1801 ALLEN PARKWAY
HOUSTON TEXAS 77019
751-8000

P.O. BOX 66769 - HOUSTON, TEXAS 77006 (713) 751-8500

MEMORANDUM November 3, 1981

TO: L. Michelle Rios
c/o Ralph D. Feigin, M.D.
Pediatrics

FROM: George L. Jordan, Jr.,M.D.
Chief of the Medical Staff

Your protocol entitled, "An Investigation of the Incidence of Obesities in Infants Recovered from Chronic Diarrhea as Compared with the Incidence in Normal Infants," was reviewed by the Joint Conference Committee and approved at the October meeting.

GLJ:ms

APPENDIX B

DATA COLLECTION INSTRUMENTS

Data Collection Instrument

Hospital ______________________________

Physician______________________________

Patient code number______________________________

Sex: Male ____________ Female______________________________

Race ______________________________

Ecomonic status ______________________________

Date of birth ______________________________

Birth weight _______Birth height or first month check_______

Age at onset of disease ______________________________

FTT weight ____________ FTT height ______________

FTT head circumference ______ FTT arm circumference ________

"Catch-up" age ____"Catch-up weight____"Catch-up height_____

Head circumference___________ Arm circumference_____________

Length of time followed for illness______________________

Number of visits ______________________________

Discharge height_____________ Discharge weight _____________

Data Sheet

Date	Height	Weight	Ratio	Head Cirm.	Arm Cirm.	Ratio

LIST OF REFERENCES

Andrew, E. M., Clancy, K. L., & Katz, M. G. Infant feeding practices of families belonging to a prepaid group practice health care plan. Pediatrics, 1980, 65(5), 978-988.

Arasu, T. S., Wyllie, R., & Fitzgerald, J. F. Chronic diarrhea in infants and children. American Family Physician, 1979, 19(4), 87-89.

Ashwell, M., Durrant, M., & Garrow, J. S. How a "fat cell pool" hypothesis could account for the relationship between adipose tissue cellularity and the age of onset of obesity. Proceedings of the Nutrition Society, 1977, 36(3), IIIA.

Avery, G. B., Villavicencio, O., Lilly, J. R., & Randolph, J. G. Intractable diarrhea in early infancy. Pediatrics, 1968, 41(4), 712-722.

Bandura, A. Principles of behavior modification. New York: Holt, Rinehart, and Winston, Inc., 1969.

Bandura, A. Social learning theory. Englewood Cliffs, New Jersey: Prentice-Hall, 1977.

Beachler, C. Dietary management of diarrhea. Baylor College of Medicine lecture notes, January, 1976.

Bernfeld, J. Success and failure of treatment of the obese child: Influence of ethnic factors. In Z. Laron (Ed.), The adipose child. Basel (Switzerland): S. Karger, 1976.

Blankhart, D. M., Latham, M. C., & Schulpen, T. W. J. Low arm circumference reporting and nutrition rehabilitation of under fives. Journal of Tropical Pediatrics, 1977, 33(1), 8-11.

Blattner, R. J. Dietary management of diarrhea. Baylor College of Medicine Grand Rounds, August, 1975.

Börjeson, M. The aetiology of obesity in children: A study of 101 twin pairs. Acta Paediatrica Scandinavica, 1976, 65(3), 279-287.

Boulton, T. J. C., & Coote, L. M. Nutritional studies during early childhood. II. Feeding practices during infancy, and their relationship to socio-economic and cultural factors. Australian Paediatric Journal, 1979, 15(2), 81-86.

Boulton, T. J. C., Dunlop, M., & Court, J. M. The growth and development of fat cells in infancy. Pediatric Research, 1978, 12(9), 908-911.

Bray, G. A. Definition, measurement, and classification of the syndromes of obesity. International Journal of Obesity, 1978, 2(2), 99-112.

Brueton, M. J., Regusci, A., & Anderson, C. M. Nutritional deprivation during protracted diarrhea after acute gastroenteritis. Archives of Diseases in Childhood, 1976, 51(12), 989-990.

Bullen, C. L., & Willis, A. T. Resistance of the breast-fed infant to gastroenteritis. British Medical Journal, 1971, 3, 338-343.

Buntain, W. L., & Coran, A. G. The management of intractable diarrhea of infancy. Journal of the Medical Association of the State of Alabama, 1978, 48(2), 25-29.

Burgess, H. J. L., & Burgess, A. P. A modified standard for mid-upper arm circumference in young children. The Journal of Tropical Pediatrics, 1969, 15(4), 189-192.

Burke, V., & Danks, D. Monosaccharide malabsorption in young infants. The Lancet, 1966, 1, 1177-1180.

Carpenter, F. The Skinner primer. New York: The Free Press/McMillan Publishing Company, Inc., 1974.

Charney, E., Goodman, H. C., McBride, M., Lyon, B., & Pratt, R. Childhood antecedents of adult obesity. The New England Journal of Medicine, 1976, 295(1), 6-9.

Collipp, P. J. Obesity in childhood. In A. J. Stunkard (Ed.), Obesity. Philadelphia: W. B. Saunders Company, 1980.

Crow, R. A. An etiological study of the development of infant feeding. Journal of Advanced Nursing, 1977, 2(2), 99-109.

De Swiet, M., Fayers, P., & Cooper, L. Effect of feeding habit on weight in infancy. The Lancet, 1977, 1(8017), 892-894.

Development of adipose tissue in infancy. Nutrition Reviews, 1979, 37(6), 194-197.

DuRant, R. H., Martin, D. S., Linder, C. W., & Weston, W. The prevalence of obesity and thinness in children from a lower socioeconomic population receiving comprehensive health care. The American Journal of Clinical Nutrition, 1980, 33(9), 2002-2007.

Dubois, S., Hill, D. E., & Beaton, G. H. An examination of factors believed to be associated with infantile obesity. The American Journal of Clinical Nutrition, 1979, 32(10), 1997, 2004.

Dunlop, M., Court, J. M., Hobbs, J. B., & Boulton, T. J. C. Identification of small cells in fetal and infant adipose tissue. Pediatric Research, 1978, 12(9), 905-907.

Faust, I. M., Johnson, P. R., Stern, J. S., & Hirsch, J. Diet-induced adipocyte number increase in adult rats: A new model of obesity. American Journal of Physiology, 1978, 235(3), E279-286.

Fomon, S. J. Infant nutrition. Philadelphia: W. B. Saunders Company, 1974.

Food and Nutrition Board, National Research Council, & National Academy of Sciences. Fetal and infant nutrition and susceptibility to obesity. Nutrition Reviews, 1978, 36(4), 122-126.

Forbes, G. B. Nutrition and growth. The Journal of Pediatrics, 1977, 91(1), 40-42.

Fullarton, J. E., & Pasick, R. J. Obesity: A new social policy perspective. In G. A. Bray (Ed.). Obesity: Comparative methods of weight control. Westport, Connecticut: Technomic Publishing Company, Inc., 1980.

Ghai, O. P., Jaiswal, V. N., & Seth, V. Infantile diarrhea in relation to feeding practices. Indian Journal of Pediatrics, 1971, 38(284), 354-357.

Ghosh, S., Yayathi, M., & Yayathi, T. Quick nutritional screening by midarm circumference or a bangle. Indian Pediatrics, 1976, 13(12), 915-918.

Glueck, C. J., & Tsang, R. Pediatric nutrition: Potential relationship to the development of atherosclerosis. In M. Winick (Ed.), Nutrition: Pre- and postnatal development, Vol. 1. New York: Columbia University Plenum Press, 1979.

Goel, K., Lifshitz, F., Kahn, E., & Teichberg, S. Monosaccharide intolerance and soy-protein hypersensitivity in an infant with diarrhea. The Journal of Pediatrics, 1978, 93(4), 617-619.

Gracey, M., Burke, V., Thomas, J., & Stone, D. E. Effect of microorganisms isolated from the upper gut of malnourished children on intestinal sugar absorption in vivo. The American Journal of Clinical Nutrition, 1975, 28(8), 841-845.

Greene, H. L., McCabe, D. R., & Merenstein, G. B. Protracted diarrhea and malnutrition in infancy: Changes in intestinal morphology and disaccharidase activities during treatment with total intravenous nutrition or oral elemental diets. The Journal of Pediatrics, 1975, 87(5), 695-704.

Greene, H. L., Stifel, F. B., Hagler, L., & Herman, R. H. Comparison of the adaptive changes in disaccharidase, blycolitic enzyme and fructosediphosphatase activities after intravenous and oral glucose in normal men. The American Journal of Clinical Nutrition, 1975, 28(10), 1122-1125.

Hamill, P. V., Drizd, T. A., Johnson, C. L., Reed, R. B., Roche, A. F., & Moore, W. M. Physical growth: National center for health statistics percentiles. The American Journal of Clinical Nutrition, 1979, 32(3), 607-629.

Himes, J. H. Infant feeding practices and obesity. Journal of the American Dietetic Association, 1979, 75(2), 122-125.

Hirsch, J. Cell number and size as a determinant of subsequent obesity. In M. Winick (Ed.), Childhood obesity. New York: John Wiley & Sons, 1975.

Hirsch, J., & Knittle, J. L. Cellularity of obese and non-obese human adipose tissue. Federation Proceedings, 1970, 29(4), 1516-1521.

Hirschhorn, N. The management of acute diarrhea in children: An overview. Progress in Drug Research, 1975, 19, 527-541.

Hooper, P. D., & Alexander, E. L. Infant morbidity and obesity. The Practitioner, 1971, 207, 221-227.

Intestinal surface area and sugar malabsorption. Nutrition Reviews, 1978, 36(10), 293-295.

Jalili, F. Slick gut syndrome in 1979. Baylor College of Medicine Grand Rounds, September, 1980.

Jelliffe, D. B. The assessment of the nutritional status of the community. World Health Organization Monograph No. 53. Geneva, 1966.

Jelliffe, D. B. Field anthropometry independent of precise age. Journal of Pediatrics, 1969, 75(2), 334-335.

Jelliffe, D. B. Infantile overnutrition. British Medical Journal, 1973, 2(5865), 546.

Jelliffe, E. F. P., & Jelliffe, D. B. The arm circumference as a public health index of protein-calorie malnutrition of early childhood. The Journal of Tropical Pediatrics, 1969, 15(4), 179-188, 253-260.

Jelliffe, D. B., & Jelliffe, E. F. P. The quipu in measuring malnutrition. The American Journal of Clinical Nutrition, 1975, 28(3), 203-204.

Johnston, F. E., & Mack, R. W. Obesity in urban black adolescents of high and low relative weight at 1 year of age. American Journal of Diseases of Children, 1978, 132(9), 862-864.

Jordan, H. A., & Levitz, L. S. Behavior modification in the treatment of childhood obesity. In M. Winick (Ed.), Childhood obesity. New York: John Wiley & Sons, 1975.

Kanawati, A. A., Haddad, N., & McLaren, D. S. Preliminary results with mid-arm and muscle mid-arm circumferences used as nutritional screening procedures for pre-school children in Lebanon. The Journal of Tropical Pediatrics, 1969, 15(4), 233-237.

Kanawati, A. A., & McLaren, D. S. Assessment of marginal malnutrition. Nature, 1970, 228(November 7), 573-575.

Kanawati, A. A., McLaren, D. S., & Abu-Jawdeh, I. Failure to thrive in Lebanon. I. Experience with some simple somatic measurements. Acta Paediatrica Scandinavica, 1971, 60, 309-316.

Kannel, W. B., & Gordon, T. Physiological and medical concomitants of obesity: The Framingham study. In G. Bray (Ed.), Obesity in America. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1980.

Karlberg, P., Engstrom, I., Lichtenstein, H., & Svennberg, I. The development of children in a Swedish urban community. Acta Paediatrica Scandinavica Supplement, 1968, 187, 48-66.

Kilby, A. M., Dolby, J. M., Honow, P., & Walker-Smith, J. A. Duodenal bacterial flora in early stages of transient monosaccharide intolerance in infants. Archives of Diseases in Childhood, 1977, 52(3), 228-234.

Klish, W. J., Potts, E., Ferry, G. D., & Nichols, B. L. Modular formula: An approach to management of infants with specific or complex food intolerances. The Journal of Pediatrics, 1976, 88(6), 948-952.

Klish, W. J., Udall, J. N., Rodriquez, J. T., Singer, D. B., & Nichols, B. L. Intestinal surface area in infants with acquired monosaccharide intolerance. The Journal of Pediatrics, 1978, 92(4), 566-571.

Kohrs, M. B., Wang, L. L., Eklund, D., Paulsen, B., & O'Neal, R. The association of obesity with socioeconomic factors in Missouri. American Journal of Clinical Nutrition, 1979, 32(10), 2120-2128.

Larcher, V. F., Shepherd, R., Francis, D. E. M., & Harries, J. T. Protracted diarrhea in infancy. Archives of Diseases in Childhood, 1977, 52(8), 597-605.

Macho, L., Güiraldes, E., Sorensen, R., Gutiérrez, C., Lobos, H., Harún, A., & del Pozo, H. Intolerancia secundaria a monosacáridos en el síndrome diarréico de evolución prolongada. Revista Chilena de Pediatría, 1979, 50(1), 21-32.

MacLean, W. C., López de Romaña, G., Massa, E., & Graham, G. G. Nutritional management of chronic diarrhea and malnutrition: Primary reliance on oral feeding. The Journal of Pediatrics, 1980, 97(2), 316-323.

Maclean, G. D. An appraisal of the concepts of infant feeding and their application in practice. Journal of Advanced Nursing, 1977, 2(2), 111-126.

Merritt, R. J. Treatment of pediatric and adolescent obesity. In G. A. Bray (Ed.), Obesity: Comparative methods of weight control. Westport, Conn.: Technomic Publishing Company, Inc., 1980.

Moore, M. E., Stunkard, A. J., & Srole, L. Obesity, social class, and mental illness. The Journal of the American Medical Association, 1962, 181(11), 962-966.

Newmann, C. G. Obesity in pediatric practice: Obesity in the preschool and school-age child. Pediatric Clinics of North America, 1977, 24(1), 117-122.

Newell, K. W., Dover, A. S., Clemmer, D. I., D'Alessandro, A., Dueñas, A., Gracian, M., & LeBlanc, D. R. Bulletin of the Pan American Health Organization, 1976, 10, 43.

Nutt, H. H. Infant nutrition and obesity. Nursing Forum, 1979, 18(2), 131-157.

Oates, R. K. Infant-feeding practices. British Medical Journal, 1973, 2(June 30), 762-764.

Oken, B., Hartz, A., Giefer, E., & Rimm, A. A. Relation to socioeconomic status and obesity changes in 9046 women. Preventive Medicine, 1977, 6(6), 447-453.

Plank, S. J., & Milanesi, M. L. Sex differences in infantile diarrhea. Lancet, 1979, 1(8111), 334.

Polit, D., & Hungler, B. Nursing research: Principles and methods. Philadelphia: J. B. Lippincott Company, 1978.

Poskitt, E. M. E., & Cole, T. J. Nature, nurture, and childhood overweight. British Medical Journal, 1978, 1(6113), 603-605.

Resnikoff, S. Malnutrition et obesité: une situation paradoxale dans L'Adrar Mauritanien. Medecine Tropicale (Marseilles), 1980, 40(4), 419-423.

Rimm, A. A., & White, P. L. Obesity: Its risks and hazards. In G. Bray (Ed.), Obesity in America. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1980.

Roberts, A. M. Obesity in malnourished children. Nursing Times, 1978, 74(5), 194-197.

Robinow, M., & Jelliffe, D. B. The use of arm circumference in a field survey of early childhood malnutrition in Busoga, Uganda. The Journal of Tropical Pediatrics, 1969, 15(4), 217-221.

Roche, A. F., & Himes, J. H. Incremental growth charts. The American Journal of Clinical Nutrition, 1980, 33(9), 2041-2052.

Rodin, J. Pathogenesis of obesity: Energy intake and expenditure. In G. Bray (Ed.), Obesity in America. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1980.

Rosenthal, B., & McSweeney, F. K. Modeling influence on eating behavior. Addictive Behaviors, 1979, 4(3), 205-214.

Ross Laboratories. Boys: Birth to 36 months physical growth, NCHS percentiles. Columbus, Ohio: Author, 1980. (a)

Ross Laboratories. Girls: Birth to 36 months physical growth, NCHS percentiles. Columbus, Ohio: Author, 1980. (b)

Roy, C. C., Ste-Marie, M., Chartrand, L., Weber, A., Bard, H., & Doray, B. Correction of the malabsorption of the preterm infant with a medium chain triglyceride formula. The Journal of Pediatrics, 1975, 86(3), 446-450.

Salans, L. B. Natural history of obesity. In G. Bray (Ed.), Obesity in America. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1980.

Shakir, A. Arm circumference in the surveillance of protein-caloric malnutrition in Baghdad. The American Journal of Clinical Nutrition, 1975, 28(6), 661-665.

Shukla, A., Forsyth, H. A., Anderson, C. M., & Marwah, S. M. Infantile overnutrition in the first year of life: A field study in Dudley, Worcestershire. British Medical Journal, 1972, 4(December 2), 507-515.

Silverstone, J. T., Gordon, R. P., & Stunkard, A. J. Social factors in obesity in London. The Practitioner, 1969, 202(8 Suppl.), 682-688.

Skinner, B. F. Science and human behavior. New York: The McMillan Company, 1953.

Solimano, G., & Lederman, S. Nutritional in-hospital management of chronic diarrhea in children. In M. Winick (Ed.), Nutrition: Pre- and postnatal development, Vol. 1. New York: Plenum Press, 1979.

Stuart, R. B., & Guire, K. Some correlates of the maintenance of weight lost through behavior modification. In G. A. Bray (Ed.), Obesity: Comparative methods of weight control. Westport, Conn.: Technomic Publishing Company, Inc., 1980.

Stunkard, A. J. Behavioral treatment of obesity: The current status. In G. A. Bray (Ed.), Obesity: Comparative methods of weight control. Westport, Conn.: Technomic Publishing Company, Inc., 1980.

Stunkard, A. The social environment and the control of obesity. In A. J. Stunkard (Ed.), Obesity. Philadelphia: W. B. Saunders Company, 1980.

Stunkard, A. J., d'Aquili, E., Fox, S., & Filion, R.D.L. Influence of social class on obesity and thinness in children. The Journal of the American Medical Association, 1972, 221(6), 579-584.

Taitz, L. S. Infantile overnutrition among artificially fed infants in the Sheffield region. The British Medical Journal, 1971, 1(5744), 315-316.

Tanner, J. M., Whitehouse, R. H., Marshall, W. A., Healy, M. J. R., & Goldstein, H. Assessment of skeletal maturity and prediction of adult height. London: Academic Press, Inc., 1975.

Thompson, Jr., R. J., & Linscheid, T. R. Adult-child interaction analysis: Methodology and case application. Child Psychiatry and Human Development, 1976, 7(1), 31-42.

Tracey, V. V., De, N. C., & Harper, J. R. Obesity and respiratory infection in infants and young children. British Medical Journal, 1971, 1, 16-18.

Udall, J., in R. J. Blattner, Dietary management of diarrhea. Baylor College of Medicine Grand Rounds, August, 1975.

Van Biervliet, J.-P.G.M., & Wijn, J. F. Overalimentation and growth. The Journal of Pediatrics, 1978, 92(6), 1029-1030.

Vandale, S. Factores sociales y culturales que influyen en la alimentación del lactante menor en el medio urbano. Salud Pública de México, 1978, 20(2), 215-230.

Waterlow, J. C., Buzina, R., Keller, W., Lane, J. M., Nichaman, M. Z., & Tanner, J. M. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. Bulletin of the World Health Organization, 1977, 55(4), 489-498.

Weil, W. B. Infantile obesity. In M. Winich (Ed.), Childhood obesity. New York: John Wiley & Sons, 1975.

Weil, W. B. Current controversies in childhood obesity. The Journal of Pediatrics, 1977, 91(2), 175-187.

White, M. Infant feeding. Nursing Mirror, 1978, 146(3), 42-44.

Whitelaw, G. L. Prevalence and prognosis of obesity in infancy. In E. Cacciari, Z. Laron, & S. Raiti (Eds.), Obesity in childhood. London: Academic Press, 1978.

Wilcoxon, H. C. Historical introduction to the problem of reinforcement. In J. Tapp (Ed.), Reinforcement and behavior. New York: Academic Press, 1969.

Williams, J. L. Operant learning: Procedures for changing behavior. Monterey, Ca.: Brooks/Cole Publishing Company, 1973.

Wolff, O. H. Overfeeding during infancy. In L. Hambraeus (Ed.), Symposia of the Swedish Nutrition Foundation XIV, The Mother/Child Dyad--Nutritional Aspects. Stockholm, Sweden: Almquist and Wiksell International, 1977.

Zack, P. M., Harlan, W. R., Leaverton, P. E., & Cornani-Huntley, J. A longitudinal study of body fatness in childhood and adolescence. The Journal of Pediatrics, 1979, 95(1), 126-130.

Zavaleta, A. N., & Malina, R. M. Growth, fatness, and leanness in Mexican-American children. The American Journal of Clinical Nutrition, 1980, 33(9), 2008-2020.