AN EXPERIMENTAL STUDY ON THE RELATION OF THE NEWBORN FEEDING SCHEDULE IN THE HOSPITAL TO THE RESPONSE OF THE INFANTS AND TO THE ESTABLISHMENT OF LACTATION

by

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An Experimental Study of the Relation of the Newborn Feeding Schedule in the Hospital to the Response of the Infants and to the Establishment of Lactation.

Thesis directed by Associate Professor Maxine Berlinger

The study was designed to discover if mothers and newborns on self-demand infant feeding were more successful in establishing breast feeding than a comparable group of mothers and infants on routine scheduled feedings. The need for the study grew out of the question as to whether or not the flexible feeding schedule would help to promote a successful initiation of breast feeding during the hospital period.

The purposes of this study were (1) to determine select responses of newborn infants to self-demand feeding; (2) to determine specific effects of self-demand feeding on maternal lactation; (3) to provide information on self-demand feeding in the hospital; (4) to contribute data which may yield information to further nursing knowledge; and (5) to stimulate research on the effects of self-demand feeding in the hospital.

The experimental method was used to conduct the study utilizing the parallel group technique. Data were collected on six selected factors which were measures of the dependent variable, success at breast feeding. A pressure gauge instrument was developed, pretested, and used in this study to measure objectively the degree of breast engorgement present in the nursing mothers.

The numerical data obtained in the study were analyzed by statistical methods. The analysis of data for the

self-demand and scheduled groups revealed (1) no significant difference in degree of breast engorgement, (2) no significant difference in degree of breast engorgement between mothers who had not nursed an infant before and those who had previously nursed, (3) a higher percentage incidence of cracked nipples in the routine group of mothers, (4) a higher percentage incidence of continuation of breast feeding in the self-demand group, (5) a significantly higher incidence of complementary feeding in the routine group of infants, (6) no significant difference in weight loss of the infants, (7) a significantly higher regain of weight among the self-demand infants, and (8) significantly more successful nursing activity of infants while at the breast among the self-demand group.

This abstract of about 250 words is approved as to form and content. I recommend its publication.

Signed Maxine R. Berlinger
Instructor in charge of thesis

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CHAPTER I

I. THE PROBLEM INTRODUCED

For some time there has been an increased interest in and emphasis on self-demand feeding of the infant. The pioneer work of C. M. Davis (1928) had great influence on ushering in self-regulatory infant feeding.[1] This has created a special responsibility and opportunity for the nurse who often plays a significant part in teaching and encouraging the new mother regarding the feeding of her infant. Self-demand feeding in the hospital setting probably has not gained as widespread publicity or usage as self-demand feeding in the home, but it may be just as important, especially in initiating successful lactation in the breast feeding mother. It is necessary, therefore, to explore this possible importance in an objective, systematic manner.

Significance of the Study

Breast feeding has been a method of feeding since the creation of man. Its incidence has decreased since the

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[1] Sylvia Brody, Patterns of Mothering (New York: International Universities Press, Inc., 1956), p. 131.

advent of suitable artificial formulas. However, breast feeding is still the natural way. Mothers and hospitals became weighted down with schedules, and the central nursery with routine feeding schedules became the rule. The question of the effect of a rigid feeding routine on the infant's success at breast feeding grew out of informal observation of mothers and infants in several obstetric departments. Oftentimes a sleepy baby would be brought to the mother to eat at scheduled feeding times with no success resulting in a disturbed nurse, a discouraged mother, and an infant requiring later complementary feeding in the nursery. It appeared that by requiring an infant to adhere to the schedule of a hospital rather than his own built-in physiological mechanism, mothers and infants alike were actually being discouraged from pursuing this most natural method.

The nurse is often responsible for implementing the self-demand feeding routine in the hospital. The investigator was able to observe the transition from a rigid three or four hour schedule of feeding to a self-demand routine in a hospital where the results seemed very rewarding. No study was undertaken to substantiate these observations, but it certainly seemed that the incidence of such problems such as sleepy babies, failure of the infant to suck, discouraged

mothers, sore nipples, and other complications had decreased.

A study was undertaken which would measure the effects of self-demand feeding in the nursery because of the importance this might have on present attitudes toward self-demand feeding, and because of the lack of studies in the literature dealing specifically with self-demand versus rigid scheduled feedings in the hospital.

II. THE PROBLEM

Statement of the Problem

The study was designed to discover if mothers and newborns on self-demand infant feeding were more successful in establishing breast feeding than a comparable group of mothers and infants on scheduled feedings.

Purposes of the Study

The purposes of this study were: (1) to determine select responses of newborn infants to self-demand feeding; (2) to determine specific effects of self-demand feeding on maternal lactation; (3) to provide information on self-demand feeding in the hospital; (4) to contribute data which may yield information to further nursing knowledge; and (5) to stimulate research on the effects of self-demand feeding in the hospital.

Null Hypotheses

The following null hypotheses were tested:

1. Nursing mothers who are self-demand feeding their infants will not have a significantly less degree of engorgement of the breasts than nursing mothers on a routine schedule for infant feeding.
2. Breast feeding mothers nursing their infants on a flexible schedule will not have a significantly less number of cracked nipples than those on a rigid infant feeding schedule.
3. There will not be a significantly less frequency of discontinuation of nursing during the hospital period between mothers on self-demand infant feeding schedules and those on routine hospital schedules for feeding infants.
4. There will not be a significantly less incidence of complementary or supplementary feeding during the hospital period among infants on flexible feeding schedules than among infants on a routine hospital schedule for feeding.

5a. Breast fed infants placed on self-demand feedings in the hospital will not have a significantly less weight loss during that period than those on a routine schedule.

b. Breast fed infants placed on self-regulatory feedings in the hospital will not have a significantly greater regain in weight during that period than those on a rigid schedule.

6. Infants on self-demand feedings during the hospital period will not be significantly more active at sucking while at the breast, yet not ravenous, than infants on a strict hospital schedule.

III. DEFINITIONS OF TERMS USED

Neonate, Infant, Newborn

In this study the terms neonate, infant, and newborn all referred to any healthy, apparently normal, breast feeding baby weighing five pounds or over at birth. Infants taken to the mother to nurse were judged as healthy and apparently normal for attempting breast feeding.

Self-Demand, ad lib, Self-Regulation, Flexible Feeding Schedule

These terms were used synonymously as a method of infant feeding in which an attempt is made to recognize the individual variations in the infant's desire for food. The infant is allowed to feed within limits of two to five hours when hungry as opposed to strictly regulated hospital

feeding schedules.[2]

Strict, Rigid, or Inflexible Schedule, Routine Hospital Schedule, Traditional Hospital Schedule

These terms were used to denote a fixed time of feeding for infants in the hospital according to the hospital or nursery routine or doctor's orders. In this study, newborns on the routine feedings were taken to the mothers at 9 A.M., 1 P.M., 6 P.M., 9 P.M., 1 A.M., and 6 A.M.

Nursing

Nursing is a term as used in this study synonymously with breast feeding.

Success at Breast Feeding

Success is "resulting or terminating favorably as desired."[3] Success was determined by specific areas of measurement: a minimum of breast engorgement, absence of cracked nipples, continuation of breast feeding during the hospital stay, minimum weight loss and maximum weight regain

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[2]Richard W. Olmstead and Edith B. Jackson, "Self-Demand Feeding in the First Week of Life," Pediatrics, 6: 396, September, 1950.

[3]John P. Bethel (ed.), Webster's New Collegiate Dictionary (Springfield, Massachusetts: G.& C. Merriam Co., Publishers, 1958), p. 846.

of the infants, less need for complementary feeding of the infants, and active sucking activity of the infant with subsequent satisfaction while at the breast.

Complementary Feeding, Supplementary Feeding

Complementary and supplementary feeding as used in this study referred to any addition of water or glucose water to the infant's diet besides the breast milk.

Fissured or Cracked Nipple, Nipple Lesion

For purposes of measurement in this study, the terms cracked and fissured nipple or nipple lesion were used synonymously. According to Taber, a lesion is a "morbid change in tissue formation locally; an injury or wound."[4]

Engorgement or Overdistension of the Breasts

Engorgement is a retention of milk in the alveoli in addition to vascular and lymphatic stasis which occurs in relation to lactation.[5] The patient experiences discomfort and the breasts feel hard to the touch, permitting little

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[4]Clarence Wilbur Taber, Taber's Cyclopedic Medical Dictionary (eighth edition; Philadelphia: F.A. Davis Company, 1958), p. L-20.

[5]Michael Newton and Niles Rumely Newton, "Postpartum Engorgement of the Breast," American Journal of Obstetrics and Gynecology, 61:666, March, 1951.

depression of the tissue. In this study engorgement was measured objectively by an instrument designed to measure the amount of tissue pressure.[6]

IV. ASSUMPTIONS

A survey of the literature supported the following assumptions underlying the problem:

1. A small degree of breast engorgement and no cracked nipples signify success in breast feeding.
2. Continuation of breast feeding during the hospital stay is indicative of success.
3. Measures of a successfully nursing infant are weight gain, less need for complementary feeding, and remaining awake and actively sucking while at the breast with subsequent satisfaction.

V. SCOPE OF THE STUDY

Scope of the Study

1. The subjects for the study included a control group composed of mothers and infants on routine infant feeding schedules, and an experimental

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[6]Roger K. Salaman, "Pressure Gauge Model P-100," (Paper written on March 30, 1965, at Mesa Instruments, 421 South 80th Street, Boulder, Colorado).

group comprised of mother and newborn pairs on self-demand infant feeding schedules.

2. The subjects for the study included the number of breast feeding neonates and mothers presenting themselves in a fifty-six day period. The length of time used to obtain subjects for either the control group or experimental group was twenty-eight days. The study was started on April 14, 1965, and concluded on June 16, 1965.

3. Only healthy and apparently normal infants weighing five pounds or over were included in the study. The criteria for a healthy and apparently normal newborn were judged by the investigator with information obtained from the chart. Generally, infants taken to the mother to nurse were judged as healthy and apparently normal for attempting breast feeding.

4. Only those infants and mothers who stayed a minimum of five days were included in the study. These five days included the day of delivery.

5. The mothers and infants studied were in one hospital. Study of the control group of mothers and infants was completed before starting the study

of the experimental group.

6. The hospital used for the study was a private general hospital and patients admitted belonged to various social strata, religions, and races. It was felt that variables influencing self-demand feeding and the success of breast feeding were similar in the patients comprising the control and experimental groups.

VI. ORGANIZATION OF THE REMAINDER OF THE THESIS

This study was conducted to determine the relation of a self-demand infant feeding schedule to the establishment of lactation and to certain responses of the infant. In Chapter I, the proposed study was introduced. Chapter II, a survey of the literature is divided into two sections, the first of which concerns literature on self-demand infant feeding in general, and the second section which is concerned with self-demand infant feeding during the hospital period. A description of the methodology used in this investigation is given in Chapter III. Chapter IV contains a description of the instrument used to measure breast engorgement. In Chapter V, the analysis of the data collected may be found. The summary, recommendations, and conclusions based on this study are set forth in Chapter VI.

CHAPTER II

REVIEW OF THE LITERATURE

A survey of the literature was undertaken on the subject of self-demand feeding. The chapter is divided into three sections: Section I is a discussion of self-demand infant feeding, Section II pertains to self-demand feeding of newborns in the hospital, and Section III is a summary of the chapter. Literature was found on the broad aspect of self-demand infant feeding, however, information in relation to its application in the hospital is scarce.

I. SELF-DEMAND INFANT FEEDING

Literature reviewed indicated that self-demand feeding has been studied and articles written on its purposes, advantages, and disadvantages. Brody writes, "The pioneer experimentation of C. M. Davis (1928) has probably been of greatest influence on the change to permissiveness and self-regulation in the scheduling of infant feedings."[1] He did several studies which helped to usher in an attitude of

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[1]Sylvia Brody, Patterns of Mothering (New York: International Universities Press, Inc., 1956), p. 131.

trust in the infant, in that he might be depended upon to use discrimination in choosing how much to eat, what kinds of food to eat, and how often to eat.[2]

Brody states:

> Spock and Huschka (1938) stressed the value of flexible schedules in view of the intense satisfactions and dissatisfactions arising out of the first feeding experiences. They considered a good feeding to be a breast feeding given on demand which leaves both mother and infant satisfied.[3]

Dr. Benjamin Spock discusses the history of feeding schedules and also clarifies the term, self-demand feeding. Regular schedules probably originated as a result of medical scientists studying the feeding of babies at the end of the last century. It was a natural outcome that these scientists would set up some kind of system for infant feeding based on the average and teach it to other doctors and mothers. The structured scheduled feeding set up as an average became the rule for feeding.[4]

Consider how natural a flexible schedule is by thinking of a mother in a far away land who has never heard of a schedule, a pediatrician, or a cow. Her baby becomes hungry,

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[2] Ibid.

[3] Ibid., p. 132.

[4] Benjamin Spock, The Common Sense Book of Baby and Child Care (New York: Duell, Sloan, and Pearce, 1946), pp. 25-27.

she feeds him and he goes back to sleep. The rhythm of the baby's digestive system sets the schedule. Dr. Spock states that this is not an argument against reasonable regularity. It is not harmful for the baby or the mother to work around a flexible schedule. The mother must run the rest of the household by the clock and when the baby is ready to fit in, it will help everyone.[5]

In summary Spock states:

> The method of self-demand works particularly well in the early weeks of breast feeding, because, if the baby is getting only a small amount at each nursing, he naturally wakes and nurses often, and this is the best way to increase the quantity of milk.[6]

Aldrich and Aldrich state that the nursing baby demonstrates some of his growth needs in a very simple form such as the need for adequate food, for pleasant and comforting relations with his mother, and the need to time and control the amount of nursings. These needs should be kept in mind. One of the ways this can be done is to keep in tune with nature from the beginning and not ignore the timing of the hunger cry. The useful mechanism occurs at regular intervals, but little heed has been paid to its significance in the modern nursery or hospital where the clock takes

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[5] Ibid.

[6] Ibid., p. 30.

precedence over the perfectly designed timer within the infant.[7]

The authors do not condone routines entirely for they state that the first routines for infant care were urgently necessary to prevent disease and death and to raise health standards of children. Routines did accomplish this end to some extent, but as time went on this health-bettering program for children became a burden, and respect for the individual child was lost.[8]

Ideas presented in Dr. Ribble's book are based on a long series of studies of babies and their parents, covering approximately an eight year period. Many hundreds of babies were observed and studied. Dr. Ribble begins this discussion with the tale from ancient mythology of the giant who shaped people to fit the beds instead of supplying beds to fit the people. The process of preparing a mold to fit the average man and then pouring all mankind into the mold is still practiced. This motivation is often a love of organization rather than a desire for progress. The importance of routine in the life of the infant has always been recognized.

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[7]C. Anderson Aldrich and Mary M. Aldrich, Feeding Our Old Fashioned Children (New York: The Macmillan Company, 1941), p. 72.

[8]Ibid., p. 71.

However, this should not be confused with an artificial arbitrary schedule of activity imposed suddenly on the infant, for this can be damaging to his development. It should also be kept in mind that attention should be given to the routine which suits each infant, for no two babies are alike.[9]

Gesell and Ilg complement this discussion by Ribble. Infants are individuals from the moment of birth. Each infant has different constitutional traits and tendencies, largely inborn, that determine how, what, and to some extent when he will learn. Therefore, the child will go through an innate process of growth called maturation. In addition to maturation, the child comes into the social heritage of culture through the process of acculturation.[10]

Every infant from birth has distinctive drives and needs which must either be ignored, indulged, combatted, or controlled. One solution might be to adhere to a fixed feeding schedule, but difficulties ensue. The culture (parents) insists on feeding at a certain time; baby insists on sleeping instead. A second solution might be a self-

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[9]Margaret A. Ribble, The Rights of Infants (New York: Columbia University Press, 1943), pp. 60-71.

[10]Arnold Gesell and Frances L. Ilg, Child Development (New York: Harper & Brothers, 1949), pp. 39-46.

demand schedule. Here the culture (parents) can devise a flexible schedule adapted to the infant's needs as they arise. Reference is made to two kinds of time: organic time, based on the wisdom of the body, and clock time, based on astronomical science and cultural conventions. A rigid feeding schedule follows clock time; a flexible schedule follows organic time. It is to be emphasized, nevertheless, that the philosophy of self-regulation does not imply self indulgence or laissez faire. The culture may intervene, assist, direct, postpone, encourage, and discourage, but in relation to the child's level of maturity. It is a gradual process. The child is more able to accept postponement and restraint with increasing maturity.[11]

Melford Spiro's study presents evidence for some of the pitfalls of rigid scheduled feeding for infants. This information came about as a result of a research problem on culture and personality. The field work done in the Kibbutz was carried out in 1951 and 1952. All babies were fed on a schedule in a communal nature which resulted in certain negative consequences for the child. Since all babies were fed on a schedule, a baby might cry from hunger for a long time before being fed. Sometimes infants would cry themselves to

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[11] Ibid., pp. 47-59.

sleep. Sometimes it was necessary to awaken the infants for feeding, causing crying and irritability.[12] Again the disadvantages of a rigid feeding schedule can be seen.

Ausubel lists several advantages of self-demand over rigid feeding such as accounting for individual differences, allowing for fluctuations, and avoiding much unnecessary hunger and crying from ignoring the infant's hunger plea. He lists as disadvantages the possibility of self-demand feeding disrupting the household, and the fact that some parents are unable to differentiate the cries of their infant, so they over feed.[13]

To these disadvantages one can cite the following advice given by Nelson. "Successful management of infant feeding requires practical interpretation of specific nutritional needs and of widely varying limits of the normal baby's appetite and behavior with regard to his food."[14] It is important that the mother be helped to understand the infant's

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[12]Melford E. Spiro, Children of the Kibbutz (Cambridge: Harvard University Press, 1958), pp. 114-123.

[13]David P. Ausubel, Theory and Problems of Child Development (New York: Grune & Stratton, Inc., 1958), p. 242.

[14]Waldo E. Nelson, Textbook of Pediatrics (seventh edition; Philadelphia: W.B. Saunders Co., 1959), p. 112.

needs as well as her own, since the newborn period usually is a time of great emotional tension for the mother. Many mothers are uncertain about the extent to which the infant will determine his own routine. Demands may be somewhat irregular the first few weeks, but by one month a self-regulated schedule for the infant need not interfere with the rest of the family. Feedings can be moved ahead or delayed to avoid conflicts with the family mealtimes and activities, Then, it is also important to point out that the infant may cry for reasons other than hunger, and not to feed every time he cries.[15]

Paterson suggests it is wise to advise a mother to organize her day on a three to four hour feeding schedule, but to permit wide variations. The infant might be fed an hour early or an hour late depending on his desire for food. This achieves the effect of self-demand feeding, but also provides the mother with more structure than to just feed the baby when he is hungry.[16]

Bakwin argues that self-demand is not practical because it may be difficult to distinguish the hunger cry in

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[15] Ibid., p. 113.

[16] Donald Paterson and John Ferguson McCreary, Pediatrics (Philadelphia: J.B. Lippincott Co., 1956), p. 72.

young babies from the cry due to other causes, the baby's schedule may be too irregular for the rest of the household, and it might cause confusion and uncertainty in the young mother. This author feels that the infant is more flexible than the mother and can adjust readily to an imposed schedule.[17]

Great confusion has arisen over the term "self-demand," and some people feel this means the baby will be a tyrant over the household. Flexible schedule might be a better term to use. Whichever term is used, it does not mean letting an immature little person overrule the parents. It means guiding the infant and allowing the youngster to slip gradually into orderly behavior instead of being pushed abruptly into it. This need not exhaust or enslave a mother.[18]

Illingworth gives an account of the advantages of self-demand feeding and believes that on almost all accounts self-demand is preferable to rigid feeding. Self-demand feeding does not lead to poor habit formation. However, a rigid program may lead to psychological disturbances later,

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[17]Harry Bakwin, "Feeding Program for Infants," Federation Proceedings, 23:67, January-February, 1964.

[18]Edith B. Jackson, "Do You Really Understand 'Self-Demand'?," Reprint from Baby Talk Magazine. [n.d.]

though difficult to prove. An elastic schedule provides psychological advantages to the mother. With proper supervision by the doctor the mother can learn to interpret the various reasons for crying, and need not be disturbed by wondering whether or not to feed. An elastic schedule allows for compensatory increase of appetite after a period of defective weight gain, for instance, after illness. Self-demand is a help, not a hindrance in hospital routine in allowing better supervision of mothers while nursing. Experimentally, it has been shown that self-demand reduces the incidence of sore nipples and over distension of the breast in the mother, and it increases the incidence of full breast feeding and increases the weight gain in the child.[19] Reference is made to this study beginning on page twenty-nine of this paper.

According to Illingworth there are only two situations where a rigid schedule may work better. One occurs when an orderly and over-anxious mother finds a rigid schedule easier, and the other occurs with a woman of very low intelligence. The latter may make fewer mistakes with a rigid

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[19] Ronald S. Illingworth, The Normal Child (Boston: Little, Brown & Company, 1953), pp. 20-21.

schedule.[20]

The relation of sore or cracked nipples to the feeding schedule is discussed by Walser. He states:

> In many cases the mounting incidence of cracked and sore nipples is not because the nipple has too little rest between feedings, but because in many cases the baby is kept in the nursery too long after birth, and brought in so infrequently that a starving, ravenous baby results, and the mother's breast is damaged by the child's own efforts.[21]

It is felt that this is one of the main reasons for a lower incidence of sore and cracked nipples in mothers of self-demand fed babies since these infants don't wait as long to be fed when hungry and their sucking efforts will not be as ravenous, producing damage to the breast.

Markey writes that it is generally believed that lactation is stimulated by the sucking action of the infant and that the frequently stimulated breast responds more productively. "This is in keeping with Margaret Mead's study of primitive mothers who nurse all but constantly and, therefore, never suffer from cracked nipples or other distress because the satisfied infant doesn't have to draw so

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[20] Ibid., p. 21.

[21] Howard C. Walser, "Breast Feeding From the Obstetrician's Viewpoint," Psychosomatic Medicine, 7:174, May, 1945.

ravenously."[22]

Trainham, Pilafian, and Kraft report a case history of twins breast fed on a self-demand schedule during the first thirteen months of life. Both the mother and father were co-operative and sympathetic with the principles governing a self-demand schedule. The regime did introduce a number of problems such as the babies demanding to be fed at the same time which the mother sometimes allowed although it wasn't as satisfying for the babies and was fatiguing for the mother. Often there was a double frequent interruption of night sleeping in the first few weeks, and also the mother had difficulty in getting out for adequate exercise and recreation. However, in addition to the physiological advantages of breast milk, the mother was convinced that the psychological advantages to both her and the babies far outweighed the few disadvantages. The mother particularly felt satisfaction in knowing the babies were not denied food when hungry.[23]

The La Leche League organized in 1956 for the support

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[22]Oscar B. Markey, "The Human Breast in the First Year of Life," The Quarterly Journal of Child Behavior, 2:241, April-June, 1950.

[23]Genevieve Trainham, Grace Pilafian, and Ruth M. Kraft, "A Case History of Twins Breast Fed on a Self-Demand Regime," Journal of Pediatrics, 27:107-108, August, 1945.

and increased understanding of breast feeding recommends a self-demand feeding routine:

> The four-hour idea became firmly implanted in people's minds as a result of hospital schedules and formula feeding. Hospital schedules ended up that way because they were adapted to the convenience of the hospital and the nursing staff rather than the baby. Most babies know when they need to be fed so they should be the ones to decide, whether the interval is two hours, three hours, or longer.[24]

Pryor also advocates self-demand feeding for best initiation of breast feeding:

> Rooming-in mothers usually nurse a baby eight or nine times during the day, and sleep with the baby at the breast at night. Each feeding may last half an hour or more. This prolonged, liberal nursing is the best way to avoid breast troubles such as soreness, engorgement, and infection because it establishes an abundant, free-flowing milk supply from the beginning. This is nature's way to start breast feeding.[25]

The concept of self-demand feeding is nicely summarized by Gans:

> Common sense and simple observation of other mammals and their young shows that there cannot be any rule about either the amount or frequency of feeds. Baby whales, baby tigers, baby elephants; foals, kittens, lambs, and puppies, all will feed as long as they are hungry and will stop feeding when they have had enough. There is no

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[24]Marian Tompson, et al. (ed.), The Womanly Art of Breast-feeding (LaLeche League International: Interstate Printers and Publishers, Inc., 1963), p. 63.

[25]Karen Pryor, Nursing Your Baby (New York: Harper & Row, Publishers, 1963), pp. 171-172.

such thing as overfeeding--unless you use a gastric tube. When the infant refuses to take any more, he has had enough.

Similarly, rigid feeding times have given way to that very modern invention, demand feeding. Not in the least modern, of course, but merely a return to what mothers have practiced since there first were human infants to suckle; feed the baby when he is hungry and let him sleep when he wants to sleep. The only clock the baby knows is in its belly.

To sum up, the whole subject of infant feeding can be compressed into a single sentence: what he wants, as much as he wants, when he wants.[26]

II. SELF-DEMAND INFANT FEEDING IN THE HOSPITAL PERIOD

The experimental literature pertaining to self-demand feeding in the newborn hospital period was limited.

One article reviewed in the Nursing Outlook by Christine S. Smith gives an account of a change over from rigid feeding schedules used in the newborn nursery to demand feeding. The setting was a moderate sized hospital in Denver, Colorado, having approximately 250 deliveries a month. It was noted by the author and others that many newborn infants just were not ready to eat at the scheduled times. This often resulted in a sleepy baby, a distraught nurse, and an upset and discouraged mother. The nurses proposed demand

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[26]Bruno Gans, "Infant Feeding--Ancient and Modern," Nursing Times, 59:208-209, February 25, 1963.

feeding at a meeting of the medical staff, and although this was met with opposition at first, the change gradually came. The results were gratifying and the doctors were pleased. Nurses no longer had to give all morning care to all babies by a certain time; they were able to spend more time with infants who needed more attention and loving care, and they could spend more time in helping each individual mother. The mothers were more successful with feeding their infants. Sore nipples decreased. These findings, however, were merely observations and were not supported by research data.[27]

Simsarian and McLendon give an account of an infant breast fed on a self-demand schedule during the first twelve weeks of life. The infant was delivered in a hospital and was kept in the room with the mother because the mother and pediatrician believed that a baby during the first days of life needs the loving personalized care of the mother and to be put to breast when awake and hungry, and that the mother be given this opportunity if she desires. This infant demanded more frequent feedings in the first nine to ten days of life, but thereafter conformed roughly to the five to six feeding day usually planned. It wasn't necessary to "teach"

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[27]Christine S. Smith, "Demand Feeding in the Newborn Nursery," Nursing Outlook, 6:514-515, September, 1958.

this infant to nurse because he wasn't restricted in his first expressions of development. His initial weight loss was considered physiologic so, therefore, wasn't combated with the usual complementary solutions. The transition from hospital to home was easier for both mother and baby.[28]

> Raising a baby on this simple and ancient program of feeding him when hungry, such as was done in this instance, although it is receiving increasing recognition as a foundation stone of mental hygiene during infancy, is foreign to our clock-ruled society. At this time when the four-hour feeding schedule is conventional the mother who employs primitive methods encounters some of the difficulties involved in doing the unusual. Her guide becomes not the clock, but the baby's behavior.[29]

A further report given by Simsarian and McLendon regarded another child on self-demand feeding born to the same mother several years later. It was the authors' belief that babies are born twice. There is the physical or somatic birth in the delivery room and the psychic birth at home. In the usual hospital setting until the mother goes home she doesn't become acquainted with her infant except for the brief periods he is out feeding. Many modern hospitals require the mother and infant to wait for this psychic rebirth

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[28]Frances P. Simsarian and P.A. McLendon, "Feeding Behavior of an Infant During the First Twelve Weeks of Life on a Self-Demand Schedule," Journal of Pediatrics, 20:100-102, January, 1942.

[29]Ibid., p. 100.

at home. The mother is led to believe she doesn't have the strength or ability to care for herself or her infant. However, allowing the mother to care early for her infant, to manage the schedules, and to impress her with her responsibility for breast feeding can do much to foster her confidence in her own judgment and ability.[30]

Nyhan and Wessel undertook a study in 1954 at the Yale Rooming-in Project, New Haven, Connecticut, on one aspect of the influence of self-demand feeding, that of neonatal weight changes of four hundred normal infants. The series was composed of two hundred breast fed infants of which one hundred were on an ad lib feeding schedule, and the other one hundred on a conventional four hour schedule. The other two hundred were bottle fed and these infants were also sub-divided into two groups of one hundred each--one on a flexible and the other on a rigid schedule. Those infants on the flexible feeding schedule were in the rooming-in unit, and those on the conventional four hour schedule were in the central nursery. The weights and results were studied statistically. The maximal loss of the bottle fed rooming-in babies was significantly less than that of the bottle fed

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[30]Frances P. Simsarian and P.A. McLendon, "Further Records of the Self-Demand Schedule in Infant Feeding," Journal of Pediatrics, 27:113-114, August, 1945.

nursery babies. These differences were significant at the .05 level of confidence. The maximal loss among the breast fed nursery babies was likewise quite significantly greater than those of the breast fed rooming-in babies. These differences were significant at the .001 level. By the time of the six week postnatal visit, these previous significant differences no longer remained.[31]

In a study performed at the University of Colorado Medical Center twenty premature infants who were healthy and vigorous enough to express signs of hunger were permitted to regulate the amounts and intervals of their feeding under careful nursing and medical supervision. The weight gains were considered satisfactory as compared with rates of gain in utero during the last months of pregnancy, and by customary standards of extrauterine weight gain.[32] The nurses reported no increase in their work and, in fact, reported less tension when feeding infants on a self-regulatory regime than when attempting to meet an arbitrary schedule which couldn't

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[31]William L. Nyhan and Morris A. Wessel, "Neonatal Growth in Weight of Normal Infants on Four Different Feeding Regimens," Pediatrics, 14:442-447, November, 1954.

[32]Frank H. Horton, Lula O. Lubchenco, and Harry H. Gordon, "Self-Regulatory Feeding in a Premature Nursery," Yale Journal of Biology and Medicine, 24:263-264, February, 1952.

be kept because of the impossibility of feeding all infants at a designated time.[33]

An experimental study conducted by Illingworth and Stone in the maternity unit at the Jessop Hospital for Women, Sheffield, England, demonstrates some significant findings on self-demand breast feeding. These authors made mention that they were unable to find any experimental work on the relation of the feeding schedule to the establishment of lactation. Therefore, a controlled experiment was carried out with 106 babies fed on a rigid feeding schedule (every four hours), and 131 babies put on a self-demand schedule.

Among the more important findings bearing relation to this study are the following:

1) Many of the self-demand babies took more feedings. On the fifth day, 36 (28.6%) took eight feedings or more in a twenty-four hour period, compared to the regulated six feedings in the control group. The demand group took more frequent feedings between the fourth and seventh days.[34]

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[33] Ibid., p. 270.

[34] R.S. Illingworth and D.G.H. Stone, "Self-Demand Feeding in a Maternity Unit," The Lancet, 1:683, April 5, 1952.

2) The self-demand babies gained weight faster than those on the rigid schedule.[35]

3) There were more than twice as many cases of overdistention of the breast and soreness of the nipple in the rigid group as in the demand group. In the rigid group 27.4% of the mothers developed soreness of the nipples, compared with 12.9% in the self-demand group. Thirty-four per cent of the rigid group developed overdistention of the breast compared with 16.9% of the demand group.[36]

4) A significantly greater number of babies fed on a demand schedule (significant at .05 level) were fully breast fed on discharge from the hospital and at one month of age. Of the self-demand babies, 94.4% were fully breast fed on discharge, and 80.3% at one month of age, compared with 88.1% of rigidly fed babies fully breast fed on discharge and 64.5% at one month.[37]

The conclusion drawn from this study was that self-demand feeding had a more favorable effect on the establishment and

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[35] Ibid., p. 687. [36] Ibid. [37] Ibid.

maintenance of lactation than rigid feeding schedules. This was probably due to two main factors: better emptying of the breast on self-demand as a result of more frequent feeding, and a lowered incidence of sore nipples because the baby is less ravenous when fed.[38]

Another study at the Yale Rooming-in Project conducted by Olmsted and Jackson was concerned with the number of feedings required by the infants. Analysis of the feeding behavior of the babies supports a clinical impression that the third to the sixth postpartum days are the days of most frequent feedings for the majority of the babies. These results are in accordance with those obtained from Illingworth's and Stone's study. It was also noted from this study that the number of complementary and supplementary feedings declines after the second postpartum day. Although the number of feedings is increasing, the babies seem more satisfied to nurse at the breast and require less complement feeding.[39]

The relation of milk retention to the development of

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[38] Ibid.

[39] Richard W. Olmstead and Edith B. Jackson, "Self-Demand Feeding in the First Week of Life," Pediatrics, 6:396-401, September, 1950.

engorgement was studied by the Newtons. The purpose of their study was to investigate the part played by milk in addition to lymphatic and vascular stasis in the development of engorgement. For further detailed explanation of how the study was performed the reader may refer to the article designated in the footnote. The amount of milk left in the breasts increased with the degree of engorgement. This was determined by the application of a breast pump after nursing. From the study it was conceived by the Newtons that engorgement begins with retention of milk in the alveoli. The alveoli become distended and compress surrounding milk ducts. This subsequently leads to obstruction of the outflow of milk, further distention of the alveoli, and increased obstruction. If unrelieved, secondary vascular and lymphatic stasis occurs. One of the main causes for severe engorgement is due to the complex derangement of lactation in the first few days in our hospitals and culture.[40] "It seems likely that under a rooming-in system of infant care in which the baby is allowed to suck when he is hungry, milk is

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[40]Michael Newton and Niles Rumely Newton, "Postpartum Engorgement of the Breast," American Journal of Obstetrics and Gynecology, 61:664-667, March, 1951.

more adequately removed and less engorgement results."[41]

A paper prepared by Jackson, Wilkin, and Auerbach compared the duration of breast feeding in mothers participating in rooming-in with those whose infants were taken care of in the newborn nursery in the period from 1947 to 1949, at the Grace-New Haven Community Hospital, New Haven, Connecticut. When a statistical analysis was made of the difference of patterns of discontinuing breast feeding in rooming-in and the nursery for each year, statistically significant differences were found, the rooming-in group showing less cessation of nursing during the hospital period.[42] The authors state:

> When the total three year pattern for rooming-in is compared with the total nursery pattern, a statistically significant difference of less than 0.001 is shown. This again demonstrates that the patterns of discontinuing breast feeding are statistically significantly different between rooming-in and the nursery.[43]

The reason for this difference between the two groups is not explained, but undoubtedly the proximity of the baby

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[41] Ibid., p. 666.

[42] Edith B. Jackson, Louise C. Wilkin, and Harry Auerbach, "Statistical Report on Incidence and Duration of Breast Feeding in Relation to Personal-Social and Hospital Maternity Factors," Pediatrics, 17:705-706, May, 1956.

[43] Ibid.

to its mother in rooming-in, and the ease and frequency with which she can feed her infant are important factors in the success and duration of breast feeding.

III. SUMMARY

A survey of the literature with respect to self-demand feeding in infants was undertaken. From this survey, literature was obtained which supports the concept of self-demand feeding of the newborn. In the first section was a review of literature pertaining to self-demand feeding. Discussion of this subject emphasized that self-demand feeding lent itself to the infants' physiological and psychological needs more adequately than the rigid schedule. When flexible feeding is properly explained to the mother, her day runs more smoothly and naturally. In the second section was a review of literature bearing relation to self-demand feeding in the hospital period. Several studies were cited which give testimony to the idea of self-demand feeding during this period. Not only were advantages seen in relation to the infants such as increased weight gain, but also in relation to the mother. Several studies showed evidence of such advantages as lowered incidence of severe breast

engorgement and sore and cracked nipples. However, the evidence cited in this latter section is derived from only a few studies found available, therefore more research in this area is indicated.

CHAPTER III

METHODOLOGY

I. INTRODUCTION

The main purposes of this study were to determine the relation of self-demand feeding to the establishment of lactation and to specific responses of the infant. The need for the study was based upon (1) a survey of the literature which revealed lack of experimental evidence for the proponents of self-demand feeding in the hospital period, and (2) the necessity for supporting a program which might encourage and increase the incidence of the natural way of infant feeding, that of breast feeding. This chapter presents the methods used to conduct such a study and to analyze the data obtained.

II. THE EXPERIMENTAL METHOD

The experimental method was used to conduct this study, since it seemed the most appropriate method to collect, interpret, and analyze the data. Good states, "Experimental research, whether conducted in the classroom or laboratory, involves an attempt to control all essential

factors save a single variable which is manipulated with a view to determining and measuring the effect of its operation."[1] The experimental method may utilize one of several available techniques. One of these is the parallel-group technique.

The Parallel-Group Technique

Good writes:

> The parallel-group procedure represents an attempt to overcome the limitations of the one group method, since two or more groups, as nearly equivalent as possible in all respects are used at the same time. Under carefully controlled conditions, only a single variable is manipulated, namely, the factor which the experimenter varies for the two groups, whose effect he attempts to determine. To one group may be applied the experimental factor, with the parallel group serving as a control for comparative purposes.[2]

This technique seemed most applicable to the study conducted. The independent variable, or self-demand feeding, was introduced to the experimental group of infants and mothers in the selected hospital. The control group utilized the already existing hospital scheduled feeding plan for infants. The two groups were then compared for

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[1] Carter V. Good, A.S. Barr, and Douglas E. Scates, The Methodology of Educational Research (New York: D. Appleton-Century Co., 1936), p. 482.

[2] Ibid., pp. 493-494.

differences in the dependent variable which was the degree of successful breast feeding.

The study, although of the classical experimental design, was conducted in the context of the natural situation. It would have been rather difficult, if not impossible, to place breast feeding mothers and infants in a controlled laboratory setting, half on self-demand and the other half on a rigid schedule to study the effects. This would have given biased results to a greater extent than to have conducted the study as it exists in reality.

III. THE POPULATION

Selltiz states, "A population is the aggregate of all of the cases that conform to some designated set of specifications."[3] In this study population referred to all breast feeding mothers and infants.

The Sample

According to Selltiz, "A single member of a population is referred to as a population element. When we select some of the elements with the intention of finding out

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[3]Claire Selltiz, et al., Research Methods in Social Relations (Chicago: Holt, Rinehart and Winston, 1964), p. 509.

something about the population from which they are taken, we refer to that group of elements as a sample."[4]

Barr writes, "The chief concern in experimental work is the necessity of securing a sample which may be regarded as representative of the population from which it is drawn."[5]

To draw inferences about the characteristics of populations from samples, it is assumed that the members or elements of the sample are drawn at random from the population. The word random here refers to the idea of the equiprobability of each population member being included in the sample.[6] In this study the sample for each group consisted of the number of breast feeding subjects meeting the criteria who presented themselves within a twenty-eight day period. This method of procuring the sample for each group was used due to limited time of the investigator. Although this plan utilized subjects within a definite time span, it was considered random sampling since every potential breast feeding

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[4] Ibid., p. 510.

[5] Arvil S. Barr, Robert A. Davis, and Palmer O. Johnson, Educational Research and Appraisal (Philadelphia: J.B. Lippincott Company, 1953), p. 231.

[6] George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1959), p. 112.

mother had an equal opportunity to be a part of the sample depending on date of conception and date of delivery, and these are certainly random occurrences. Variables having possible influence on the study would be no different for patients delivering at various times of the year.

Criteria for the Selection of the Sample. The method used to obtain subjects for the sample was based on the following criteria and limitations.

1. The subjects for the study included a control group composed of mothers and infants on routine infant feeding schedules, and an experimental group comprised of mother and newborn pairs on self-demand infant feeding schedules.
2. The subjects for the study included the number of breast feeding neonates and mothers presenting themselves in a fifty-six day period. The length of time used to obtain subjects for either the control group or experimental group was twenty-eight days. The control group included twenty mother-infant pairs and the experimental group was comprised of seventeen mother-infant pairs.
3. Only healthy and apparently normal infants weighing five pounds or over were included in the study. The

criteria for a healthy and apparently normal newborn were judged by the investigator with information obtained from the chart. Generally, infants taken to the mother to nurse were judged as healthy and apparently normal for attempting breast feeding.

4. Only those infants and mothers who stayed a minimum of five days were included in the study. These five days included the day of delivery.
5. Mothers and infants were excluded from the study when at any time during the hospital period the infant received complementary artificial formula feedings.
6. The mothers and infants studied were in one hospital. Study of the control group of mothers and infants was completed before starting the study of the experimental group.
7. The hospital used for the study was a private general hospital with an average of 150 to 200 deliveries a month. There was a bed capacity of thirty-one to forty in the obstetrical unit.
8. Patients admitted to the selected hospital belonged to various social strata, religions, and races. It was felt that variables influencing self-demand feeding and the success of breast feeding were similar in

the patients comprising the control and experimental groups.

Similarity of the Control and the Experimental Groups

No attempt was made to match the subjects in the experimental and control groups because of the limitation imposed by time. Data were kept for both groups regarding factors such as parity, race, age, religion, education, delivery, and length of labor for purposes of comparison. (See Appendix B for a sample of the data record.) These factors were described and compared in terms of percentages. In addition, three variables judged to be relevant were statistically analyzed by application of the t test to determine if there were significant differences between the two groups. These variables were the ages of the mothers, the average duration of breast feeding for mothers who had previously nursed an infant, and the newborn infants' birth weights.

IV. PERMISSION TO CONDUCT THE STUDY

Before starting the study, permission was granted by the Graduate School, Department of Nursing, and from the director of nursing service in the hospital involved. Permission was also obtained from the physicians whose patients

were involved in the study, and by the patients themselves. (See Appendix D for sample letter to physicians.)

V. COLLECTION AND ANALYSIS OF DATA

Rummel states, "The design of almost any study requires that consideration be given to the general methods of analysis prior to collecting the data upon which the study is based."[7] A form was compiled for recording and collecting the data. See Appendix B. Pertinent history was recorded about each patient. This information, as mentioned previously, was described and percentage comparisons made between the two groups on the various factors. Three variables judged to be relevant were ages of the mothers, the average duration of breast feeding for mothers who had previously nursed an infant, and the newborn infants' birth weights. These variables were analyzed statistically by means of the *t* test to determine significant differences, if any, between the control and experimental groups.

In this study, the independent variable, or self-demand feeding was introduced to the experimental group of

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[7] J. Francis Rummel, *An Introduction to Research Procedures in Education* (New York: Harper & Brothers, Publishers, 1958), p. 131.

mothers and infants. The dependent variable to be measured was the degree of successful breast feeding. Six factors based on the literature were considered to indicate success in nursing. These were (1) a minimum of breast engorgement, (2) absence of cracked nipples, (3) continuation of breast feeding during the hospital stay, (4) less need for complementary feeding of the newborns, (5) minimum weight loss and maximum weight regain of the infants, and (6) active sucking activity of the infant with subsequent satisfaction while at the breast. The manner in which each of these six factors was measured in this study to determine the degree of success is presented in the remaining part of this chapter. Each of the six factors is discussed separately.

1) Degree of Breast Engorgement

The degree of engorgement was measured by a pressure gauge instrument specially designed for the investigator for the purposes of this study. The instrument was designed and constructed by Mr. Roger K. Salaman, Mesa Instruments, 421 South 80th Street, Boulder, Colorado, to allow for objective evaluation of breast pressure or engorgement. A preliminary study was conducted by the investigator with the use of the pressure gauge to determine optimum disk size and depth for readings of engorgement, and to test the tool for validity

and reliability. For a more detailed description of the instrument and the investigation conducted with the instrument to validate its use for this study, refer to Chapter IV. The instrument, Pressure Gauge Model P-101 consisted of two parts: a power supply to regulate the amount of voltage going to the instrument and the instrument or pressure gauge itself. The pressure gauge was enclosed in a metal case approximately 1 3/4 x 4 3/4 x 5 inches with a dial and indicator on the top to increase or decrease the amount of force. The dial numbers ranged from one to ten and the intervals were calibrated in tenths.

The bottom of the instrument had a plastic disk in an extended position, kept in the extended position by placing the indicator to supply sufficient current. The disk was then pressed into the tissue up to the desired depth as indicated by a plastic plate being flush with the surface of the tissue. The indicator on the dial was then moved down thereby reducing the force to a value equal to that exerted by the tissue being measured. At this point the disk released and returned to its neutral position. The dial reading at the point of release was the pressure reading.[8]

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[8]Roger K. Salaman, "Pressure Gauge Model P-100," (Paper written at Mesa Instruments, 421 South 80th Street, Boulder, Colorado, March 30, 1965).

For this study, eight measurements were taken by dividing the upper half of each breast into four quadrants, marking a site in each quadrant, and taking a pressure reading at each site within twenty-four hours of delivery and again on the third day postpartum which was the fourth hospital day. The readings taken on the fourth day were obtained between one and two hours after nursing. The difference at each site between the first and fourth day was found. The increases at each site were added and a mean increase found for each patient. After the mean increase between the first and fourth day for each patient in the control group was calculated, the mean increases for all patients in that group were added together to give an average increase figure for the control group. The same was done for the subjects in the experimental group. Standard deviations were computed for each group. To determine if the two groups of mothers varied significantly in the degree of breast tension or engorgement required application of the *t* test to ascertain acceptance or rejection of the null hypothesis at the .05 level of confidence using a one-tailed test.

2) Frequency of Cracked Nipples

Cracks and fissures of the nipples were determined by the investigator by daily inspection of the breasts, and by questioning the patient. The number of cracked nipples and the number of subjects manifesting these signs were calculated for each group. Tests of significance did not apply since the sample size and frequency of cracked nipples was small. Results were given in terms of a ratio and percentage.

3) Discontinuation of Breast Feeding during the Hospital Stay

This information was obtained from the mothers and/or hospital charts. The results were described relative to the incidence of discontinuation of nursing in the two groups of mothers. Tests to determine significance were not employed since the sample size and incidence of discontinuation were small.

Any mother-infant pair who discontinued nursing during the hospital period were used for the calculation of the above measurement, but were deleted as participants for the other five measurements taken in this study if the discontinuation occurred before the fifth hospital day. Since the infant would automatically be placed on formula feeding if the mother discontinued nursing, their measurements and

results in the other categories would alter the accuracy of the statistics of the study, thus they would not be included in the other measurements.

4) Incidence of Complementary Feeding in the Hospital

Complementary and supplementary feeding as used in this study referred to any addition of water, or glucose water to the infant's diet besides the breast milk. Although the addition of artificial formula would also fit in the category of supplementary or complementary feeding, babies who received formula were excluded from the study. All infants included in this study were not given any feeding in the first twelve hours of life. After the first twelve hours and up until twenty-four hours after birth, the infants were given glucose water. At twenty-four hours and thereafter, the infants were taken to the mother to breast feed and were only complemented with plain water feedings when necessary to satisfy hunger. This was in compliance with doctors' orders.

The time and amount of each feeding was recorded by nursery personnel on a worksheet used in the nursery. The investigator collected the data from this worksheet and from the infants' charts.

The number of complementary feedings and number of

total feedings for each day for each infant was figured. Since all infants in this study either received no feedings or only glucose water the first day, the day of birth was excluded for calculations of complementary feeding. Then the number of complementary feedings to the number of total feedings for each infant in both groups was calculated on a percentage basis for each day. A percentage of complementary feedings was then calculated for each day for each group. The percentages for the four days in each group were added and one average percentage for incidence of complementary feeding obtained in each group. Determination of significance at the 5 per cent level of confidence required calculation of the standard deviations for both groups and use of the one-tailed t test. In addition to determining statistical significance of the total incidence of complementary feeding during the hospital period between the control and experimental groups, significance was determined between the two groups for each day from day two through day five.

5) Weight Losses and Gains of Infants

A daily weight was taken of each infant by one of the nursery personnel and recorded. This information was then taken from the hospital chart or nursery worksheet by the

investigator. The weight losses of each of the infants since birth in relation to the birth weight were calculated in terms of percentage and added for the control group and experimental group separately. Analysis required calculation of the mean percentage loss and standard deviation for each group and determination of significance through use of the one-tailed t test. Significance was set at the .05 level.

In addition, the weight gain in relation to the lowest point in the hospital course was calculated on the basis of each infant's birth weight. Percentages were obtained from the ratio of regained weight to the birth weight. The mean percentage regain and standard deviations were calculated for both groups. A comparison was made of the control and experimental group by use of the one-tailed t test for significance at the .05 level.

6) Nursing Activity While at the Breast

An opinionnaire was devised for use by the mothers for their evaluation of the sucking activity of their infants. See Appendix B. The opinionnaire was given to each mother with additional explanation as needed. It was used by each mother over a twenty-four hour period beginning approximately at the 9 A.M. feeding on the fourth day and ending at the same time on the fifth day.

A hungry, yet not starved infant, was more likely to respond with vigorous sucking when offered the breast as contrasted with a sleepy, disinterested baby. The following six categories were used as a checklist as evidence of varying types of newborn activity while nursing and immediately thereafter:

1. Infant too sleepy to nurse.
2. Infant awake, but did not nurse.
3. Infant somewhat sleepy, nursed slightly, took twenty or less sucks with coaxing.
4. Infant nursed fairly well, took more than 20 sucks, some coaxing necessary.
5. Infant nursed quite well, vigorous sucking, satisfied after taken from breast.
6. Infant ravenous, continued desire to suck after taken from breast.

These categories were coded by the numbers, one through six, and the number of responses in each row tabulated for the two groups separately. Categories (4) and (5) denoted greater success in breast feeding while categories (1), (2), (3), and (6) denoted less success. For determination of statistical significance categories (4) and (5) were grouped together under the heading of success, and

categories (1), (2), (3), and (6) were grouped under the heading of less success. Categories (1), (2), and (3) were classified as being assessments of a less successfully nursing baby because of the little sucking activity, if any, while at the breast. Category (6) was also included under the less success classification since a ravenously hungry baby, not satisfied after taken from the breast could not be considered a successfully nursed infant, even though sucking activity while at the breast was good. Categories (4) and (5) represented an actively nursing infant who was satisfied after breast feeding. Chi square method of analysis with the .05 level of confidence was used to determine significance.

VI. SUMMARY

The methodology used for the collection and analysis of data was presented in this chapter. The experimental method used to conduct this investigation was described. Included was a discussion of the population and the sample for this study. The methods and procedures used to obtain the data on each of the six specific areas of measurement were discussed together with the method to analyze the data obtained on each.

CHAPTER IV

DESCRIPTION OF THE INSTRUMENT USED TO MEASURE BREAST ENGORGEMENT

I. INTRODUCTION OF THE PROBLEM

Breast engorgement and the problems which are created by this condition have received relatively limited consideration in the research literature of medicine and nursing. Such questions as what is the primary cause of breast engorgement and how can breast engorgement be measured objectively have been perplexing problems to some persons in the medical and nursing professions. With respect to the first question several theories were proposed in the literature, but relatively few studies were done to investigate and test the theories.[1] The second question has been met with

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[1]Nicholson Eastman and Louis M. Hellman, Williams Obstetrics (twelfth edition; New York: Appleton-Century-Crofts, Inc., 1961), p. 1039; Elise Fitzpatrick and Nicholson J. Eastman, Zabriskie's Obstetrics for Nurses (tenth edition; Philadelphia: J.B. Lippincott Company, 1960), p. 456; Michael Newton (Personal Letter written on March 1, 1965, University of Mississippi Medical Center, 2500 North State Street, Jackson, Mississippi, 39216); Michael Newton and Niles Rumely Newton, "Postpartum Engorgement of the Breast," American Journal of Obstetrics and Gynecology

frustrations by several investigators and the outcomes have left more desirable techniques to be devised.[2]

The need for studies directed to a better understanding of the causes, prevention, and treatment of this condition is emphasized by the Newtons:

> Postpartum engorgement of the breast is important because it can be extremely painful, because it may predispose to the development of nipple fissures and breast abscesses, and because it is associated with lactation failure. In spite of this the condition has received very little attention from investigators.[3]

The content of this chapter is presented in seven sections. In Section I was an introduction to the chapter. Section II is a review of anatomy and physiology of the breast. In Section III may be found the theories on the cause of breast engorgement. Section IV gives a summary of the techniques used to measure breast engorgement or enlargement. Substitution of numerical measurements for verbal

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61:664-667, March, 1951; Harold Waller, "The Early Failure of Breast Feeding," Archives of Disease in Childhood, 21:12, March, 1946.

[2]F.E. Hytten, "Clinical and Chemical Studies in Human Lactation--The Functional Capacity of the Breast," British Medical Journal, 1:913, April 17, 1954; Helen Ingleby, "Changes in Breast Volume in a Group of Normal Young Women," Bulletin of the International Association of Medical Museums, 29:87, April, 1949; Newton and Newton, op. cit., pp. 664-665; Waller, op. cit., p. 6.

[3]Newton and Newton, op. cit., p. 664.

descriptions are also included in this section. Section V is a description of the Pressure Gauge which was the instrument used as a method of determining objective measurement of breast engorgement in this study. The preliminary study conducted with the Pressure Gauge provides the content for Section VI. Section VII is a summary of the chapter.

II. ANATOMY AND PHYSIOLOGY OF THE BREAST

A review of the anatomy and physiology of the breast is important to increase understanding of the engorged and lactating breast.

The fully developed breasts or mammary glands are paired conical structures with their base at the chest wall and their apex at the nipple. The main parts of the breast are the glandular tissue or parenchyma and the supporting structures termed the stroma. The stroma consists of the dense interlobular connective tissue, containing the large blood vessels, nerves, and lymphatics.[4]

The breast is covered by skin which does not differ greatly from that of the adjacent part of the chest, although it may be thinner with apparent superficial veins.

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[4]Robert L. Egan, Mammography (Springfield, Illinois: Charles C. Thomas, Publisher, 1964), pp. 17-21.

At the apex of each breast is an area of deeper pigmented tissue, the areola, of which the surface may be characterized by rough elevations. These elevations are due to underlying sebaceous glands and are known as the glands of Montgomery. At the center of the areola is the nipple which varies in size and nature. It may be erect, flat, or retracted.[5]

Lewison states:

> The nipple, in addition to the ducts it transmits, contains fibrous tissue which gives it its form and in which run strands of smooth muscle. The function of this muscle is to erect the nipple under the mechanical stimulus of suckling.[6]

Underneath the skin surface of the breast is an area of subcutaneous fat about 0.5 to 2.5 centimeters in depth. Next in layer is the superficial fascia which forms an irregular boundary for the anterior surface of the glandular tissue. Underlying the superficial fascia is the glandular tissue which is then bounded posteriorly by the deep layer of superficial fascia. Between this deeper layer of the superficial fascia and the deep fascia of the pectoralis

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[5]Louis H. Jorstad and Meredith Jorstad Payne, Surgery of the Breast (St. Louis: The C.V. Mosby Company, 1964), p. 14.

[6]Edward F. Lewison, Breast Cancer (Baltimore: The Williams & Wilkins Company, 1955), p. 32.

major muscle is the retromammary space, which allows for considerable mobility of the breast over the underlying chest wall.[7]

The mammary gland consists of fifteen to twenty irregular lobes which converge in the nipple. The lobes are imperfectly separated by fibrous sheaths and these together form the supporting framework of the breast. Each lobe is drained by its own lactiferous duct.[8]

The glandular system of the breast is composed of two main structures, the acini or alveoli which are the secretory organs, and the ducts through which the secretions pass to the nipple. A cluster of acini surrounds the opening into the ducts. As has been mentioned, although the lobes are not discrete, a duct collects the secretion from a single lobe, which may contain multiple lobules.[9]

A duct as it reaches the nipple surface expands and is about 0.5 centimeters in length. Beneath the edge of the areola and downward into the breast each duct dilates into an oval shaped ampulla. From the ampulla, the duct continues for about 1 centimeter and then passes backward into

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[7]Egan, op. cit., p. 17. [8]Ibid., pp. 17-21.

[9]Max Cutler, Tumors of the Breast (Philadelphia: J.B. Lippincott Company, 1962), p. 4.

branches which lead to the clusters of acini.[10]

The hormones estrogen and progesterone secreted by the graafian follicle and corpus luteum of the ovary are primarily responsible for the growth of the mammary glands at puberty. "It is generally recognized that estrogen causes duct growth, while progesterone is concerned with development of the lobule-alveolar system."[11]

During pregnancy and lactation the glandular tissue of the breasts increases and most all tissue elements hypertrophy. Adipose tissue may decrease. The nipple and areola become more deeply pigmented and larger. The mammary gland which has an abundant vascular supply of both arteries and veins, also manifests prominence of the superficial veins at this time.[12]

In early pregnancy there is secretion of protein into the ducts. At the third or fourth month, fat becomes intermingled with the protein, and this secretion known as colostrum may be discharged from the nipple during pregnancy. Colostrum differs from breast milk in that it has a higher proportion of protein, less fat, and a higher calcium

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[10] Ibid., pp. 6-7.

[11] Ibid., p. 24.

[12] Lewison, op. cit., p. 71.

content.[13]

In the first few days after delivery, colostrum is secreted. On around the third or fourth day after delivery when the milk enters the mammary glands, the breasts become larger, firmer, and more tender. The congestion which usually subsides in a day or two is caused by increased amount of milk in the ducts and also from increased circulation in the blood vessels and lymphatics.[14]

The lactogenic hormone, also known as prolactin, secreted by the anterior lobe of the pituitary gland is primarily responsible for initiation of lactation. Cutler states, "In response to the sucking stimulus, the anterior pituitary gland secretes prolactin via a neural-hormonal mechanism which involves the hypothalamus."[15]

Milk secretion occurs continuously in the acini, but it does not flow easily from the acini into the ducts, and therefore, doesn't continually leak from the nipples. The milk first must be ejected from the acini to the ducts so

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[13]Helen Ingleby and Jacob Gershon-Cohen, Comparative Anatomy, Pathology and Roentgenology of the Breast (Philadelphia: University of Pennsylvania Press, 1960), p. 76.

[14]Fitzpatrick and Eastman, op. cit., p. 293.

[15]Cutler, op. cit., p. 26.

that the baby can obtain it. This is often called the "let-down" reflex. For this to occur oxytocin must be present. When the baby nurses, sensory impulses are transmitted through the somatic nerves to the hypothalamus, causing oxytocin secretion. Oxytocin flows in the blood to the breasts where it causes the myoepithelial cells that surround the outer surfaces of the acini to contract, thereby expressing the milk from the acini into the ducts. Psychological factors may promote or inhibit this let-down reflex as well as the infant's sucking activity.[16]

The preceding review written after reading literature on breast anatomy and physiology aided the author to better understand anatomy and physiology of the breast during lactation. It must be understood, however, that except for the gross structure of the breast, details of breast anatomy such as amount of glandular tissue in any one area cannot be generalized. Egan states:

> Wide variations occur in the radiographic appearance of normal breasts of different individuals, or of the the same individual at different times. Dissimilarities may appear in the breast of a patient, or in different

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[16]Arthur C. Guyton, Textbook of Medical Physiology (second edition; Philadelphia: W.B. Saunders Company, 1961), p. 1112.

areas of the same breast, emphasizing the functional nature of the organ.[17]

Figure 1, a drawing, demonstrates some of the more important anatomical structures of the breast.

III. THEORIES ON THE CAUSE OF BREAST ENGORGEMENT

To return to the first question posed at the beginning of this chapter regarding the primary cause of breast engorgement, Waller offers a theory. According to Waller a successful start in breast feeding depends on milk pressure within the breasts not rising to an excessive height. He describes a controlled experiment whereby half of the women used were taught the daily removal of colostrum during the last three months of pregnancy. The other half of the subjects were not taught this procedure. Both groups received identical management during the postpartum period. Excessive milk pressure occurred in 25 per cent of the experimental group who were taught the procedure and in 56 per cent of the control group. At the end of six months 83 per cent of the experimental group were still successfully breast feeding compared to only 42 per cent of the controls. It is believed that the results were due to preliminary

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[17]Egan, op. cit., p. 17.

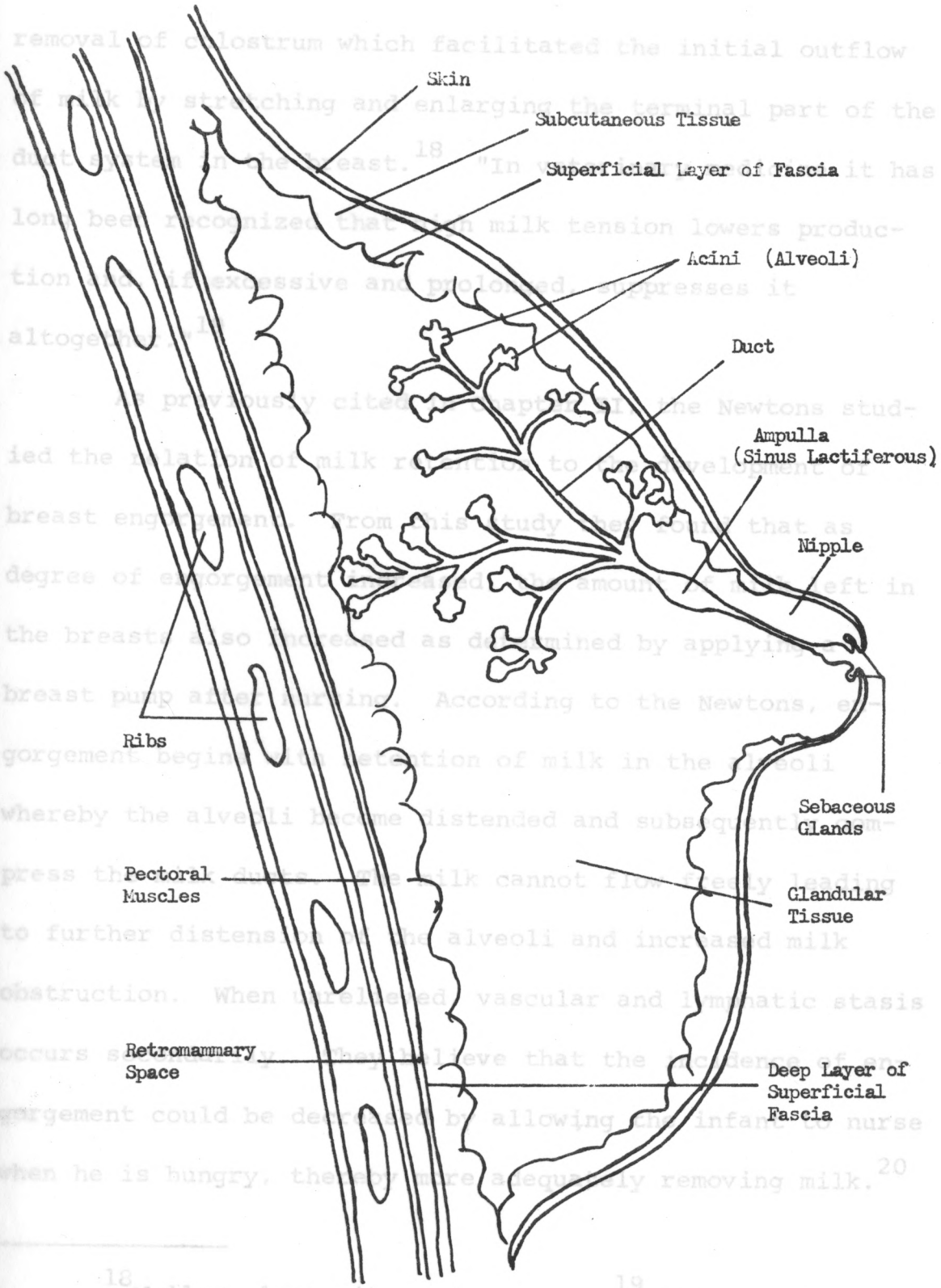

FIGURE 1

DRAWING OF THE ANATOMIC STRUCTURES
OF THE BREAST

removal of colostrum which facilitated the initial outflow of milk by stretching and enlarging the terminal part of the duct system in the breast.[18] "In veterinary medicine it has long been recognized that high milk tension lowers production and, if excessive and prolonged, suppresses it altogether."[19]

As previously cited in Chapter II, the Newtons studied the relation of milk retention to the development of breast engorgement. From this study they found that as degree of engorgement increased, the amount of milk left in the breasts also increased as determined by applying a breast pump after nursing. According to the Newtons, engorgement begins with retention of milk in the alveoli whereby the alveoli become distended and subsequently compress the milk ducts. The milk cannot flow freely leading to further distension of the alveoli and increased milk obstruction. When unrelieved, vascular and lymphatic stasis occurs secondarily. They believe that the incidence of engorgement could be decreased by allowing the infant to nurse when he is hungry, thereby more adequately removing milk.[20]

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[18] Waller, loc. cit.

[19] Ibid., p. 4.

[20] Newton and Newton, op. cit., pp. 664-667.

In a personal letter from Dr. Michael Newton regarding the author's thesis work, he stated, "I should add that, in my opinion, engorgement is primarily a matter of milk retained in the breast with vascular changes in edema being secondary."[21] If such is the case, it would seem profitable for nurses and doctors to encourage self-demand feeding to prevent or alleviate severe engorgement.

The primary cause of breast engorgement is a controversial subject and the view expressed by Fitzpatrick and Eastman is that "engorgement is an exaggeration of the normal venous and lymph stasis of the breasts which occurs in relation to lactation."[22] Eastman and Hellman add that "the disorder is a regular precursor of lactation. It is not due to any overdistention of the lacteal system with milk."[23]

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[21]Michael Newton, loc. cit. (See Appendix C.)

[22]Fitzpatrick and Eastman, op. cit., p. 456.

[23]Eastman and Hellman, loc. cit.

IV. TECHNIQUES USED TO MEASURE BREAST ENGORGEMENT OR ENLARGEMENT AND SUBSTITUTION OF NUMERICAL MEASUREMENTS FOR VERBAL DESCRIPTIONS

Techniques used to determine enlargement or engorgement of the breasts have been somewhat cumbersome and time consuming. In one attempt to measure breast engorgement, the Newtons set up a scale based on clinical estimation, and degrees of engorgement were recorded as 0, 1+, 2+, 3+, and 4+. No engorgement was considered to be present if the breasts were soft and mobile as is true before delivery. The breasts were very hard, lumpy, and tense for 4+ engorgement. The other degrees of engorgement ranged between these two extremes. They were able to confirm by actual circumferential measurements that their clinical estimates were reasonably reliable. For these the circumference of the chest just above the nipples was measured with the patient lying flat in bed. As the degree of breast engorgement increased, the average measurement of the chest also increased.[24]

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[24] Newton and Newton, op. cit., pp. 664-665.

It is true that the 0 to 4+ classification system of engorgement was a step in the right direction, for this method defined in words the characteristics of each category and then assigned numbers to each category. However, verbal definitions are not precise and any one description may mean different things to different people. In addition to this discrepancy, subjective evaluation by palpation is subject to human error and investigator's bias. Bross, in his book, supports this idea:

> It has long been recognized that words are inadequate tools for really precise description, that disagreements over definitions are likely to arise, and that manipulation of words is subject to a variety of pitfalls that are hard to avoid.[25]

It took thousands of years for man to arrive at numerical measurements as a substitute for verbal descriptions. Galileo transformed physics by doing just this. Since that time one field of science after another has been making the slow transition from words to numbers. There are even those scientists who regard this as the distinction between scientific and unscientific study.[26]

Lord Kelvin said:

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[25] Irwin D.J. Bross, Design for Decision (New York: The Macmillan Company, 1963), p. 40.

[26] Ibid.

> When you cannot measure what you are speaking about, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of a science, whatever the matter may be.[27]

In the study reported by Waller clinical judgment based on experience was also used to ascertain different degrees of breast tension. Before the start of the experiment several months were spent in assessing the appearance of the breasts, their tension to the sense of touch, the presence of edema, and the freedom of the outflow of milk.[28]

In 1954, F. E. Hytten in Aberdeen, Scotland, used a water displacement method for determining changes in breast size. Essentially this consisted of an apparatus shaped to fit closely to the average chest wall around the breast, the seal being ensured by an inflatable rubber ring at the periphery. With the subject sitting and the device held closely to the chest wall the apparatus would be filled with water through an opening at the top, and air escaping from a small hole adjacent to the other opening. When completely filled the water would be drained off through another tube, this volume of water being subtracted from the previously determined volume of the container. The results when

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[27] Ibid.

[28] Waller, op. cit., p. 6.

repeated were reproducible to within twenty to thirty milliliters, an error of about 5 per cent.[29]

Ingleby measured changes in breast volume during the sexual cycle with wax impressions taken from plaster casts of the breasts of a series of seventeen normal young women.[30]

> At first the paraffin models made from the casts were measured by means of contour lines which were projected onto squared paper. This procedure was accurate, but extremely tedious, and required much calculation. Later the casts were filled with paraffin and the base smoothed to approximate as far as possible the contour of the chest wall. To arrive at the volume in cubic centimeters the paraffin was weighed and multiplied by the factor 1.3, obtained by dividing a given weight of water by the weight of an equal volume of paraffin.[31]

It can be seen by these few available techniques reported that present methods of determining breast engorgement or enlargement are either subjective evaluations, cumbersome techniques, or very time consuming procedures. Thus, it seemed practical, if possible, to construct an instrument to measure the degree of breast tension to allow for objective evaluation of engorgement. This could possibly allow for earlier and more suitable treatment measures for the problems created by engorgement. This step could

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[29] Hytten, loc. cit.

[30] Ingleby, loc. cit.

[31] Ibid., p. 88.

also be considered in accord with scientific tradition summarized in the following thought cited by Waller:

> It would be of the greatest service to medicine if the determination became general to submit every minor problem of clinical work in which the conditions allow to methods by which an exact decision would be possible.
>
> Wilfred Trotter, Art and Science in Medicine.[32]

Such an instrument was designed for the author of this paper for the thesis investigation. It is based on a similar principle to that of the Schiotz tonometer used to measure ocular pressure.

One of the most important properties of glaucoma is the increased tension within the eye. This can be detected through the upper eyelid by an examiner who places his fingers on the eyeball while the patient looks down. However, a more exact measurement can be taken with the tonometer of which the most widely used instrument is that of Schiötz.[33] "The Schiötz tonometer was devised in 1905 and was slightly modified in 1924 by Hjalmar Schiötz. It is still the most widely used tonometer."[34]

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[32]Waller, op. cit., p. 1.

[33]Paul Weinstein and Julius Foldes, Glaucoma Pathology and Therapy (St. Louis: The C.V. Mosby Company, 1953), p. 16.

[34]H. Saul Sugar, The Glaucomas (second edition; New York: Hoeber & Harper, 1957), p. 79.

> The tonometer consists of a metal cylinder. The upper end accepts different weights (5.5 Gm., 7.5 Gm., 10 and 15 Gm.). The slightly concave undersurface is placed on the cornea. On the cylinder, there is a friction free mobile handle bar, which is held between the thumb and the middle finger and is placed perpendicularly on the center of the cornea. Within the cylinder, there is a freely moving small metal rod, the upper part of which moves a pointer across a millimeter scale at an oblique angle. This scale measures directly the impression of the cornea made by this apparatus. The hardness of the eyeball is in direct proportion to the impressibility of the cornea, and to the elongation of the pointer. . . . Before actual measurement, the tonometer is set at "zero" with the help of a metal "cornea." The final result is the average obtained after two or three measurements. . . . It is important that the tonometer is placed perpendicularly and exactly in the center of the cornea so that the axis of the eyeball and that of the tonometer form concentric rings.[35]

V. THE PRESSURE GAUGE MODEL P-100

The instrument described in this chapter and with which the following study was carried out was designed and constructed by Mr. Roger K. Salaman, Mesa Instruments, 421 South 80th Street, Boulder, Colorado. The instrument, Pressure Gauge Model P-100, consisted of two parts: a power supply to regulate the amount of voltage or current going to the instrument and the instrument or pressure gauge itself. The pressure gauge was enclosed in a metal case approximately 1 3/4 x 4 3/4 x 5 inches with a dial on the top to increase

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[35] Weinstein and Foldes, op. cit., pp. 16-18.

or decrease the amount of force. See Figure 2. The dial numbers ranged from one to ten and the intervals were calibrated in tenths. A description of the instrument follows as to purpose, principle, disk size, and operation.

Purpose

The pressure gauge is designed to measure cumulative pressure at a specified distance below a surface. The initial application consisted of determining the force at a prescribed depth below the skin.[36]

Principle

The principle of operation basically consists of determining the holding force of an electromagnet. When a current is supplied to a coil, a magnetic field is generated which exerts force on a conductor placed in the center of the coil. The amount of force is proportional to the applied current. In this instrument, the coil is energized and the core conductor is thereby held against a plug which has been inserted into the coil. If a specific force is applied to the core conductor the energizing current may be reduced to the point where the force due to the magnetic field is equal to that applied to the core (arising from the tissue). If the current is reduced slightly more, the core will be released from the plug. The current at this time is proportional to the applied force (pressure coming from the tissue).

This model was designed to measure pressures over an area from 0.3 to 2.4 centimeters with depths from 0 to 1.5 centimeters. The current can be varied from about 10 milliamperes to 1 ampere, depending upon the force requirement. The force ranged from 4 ounces to 9½

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[36]Roger K. Salaman, "Pressure Gauge Model P-100," (Paper written on March 30, 1965, at Mesa Instruments, 421 South 80th Street, Boulder, Colorado).

pounds of pressure. The instrument may be operated from either 6 or 12 volts DC with a greater pressure range possible when using the higher voltage.[37]

Disk Size

Three circular disk sizes were constructed from plastic material: 0.3, 1.2, and 2.4 centimeters in diameter. The size of the disk to be used in measurement depends upon the size of the pressure producing areas, and the comfort of the patient. In general, the disk size should be as large as possible, considering patient comfort and curvature of the testing area. If the disk is smaller than the pressure areas, the instrument may give different readings depending upon disk placement. That is, if the disk is over a pressure area, the reading will be large. If between areas, the reading will be small. The objective, therefore, is to increase the disk size so that the instrument reading will be constant over the testing surface. The reading will then be an average of the pressure over the disk area. The average of the test area may also be obtained by taking a sufficient number of readings over the area with a small disk and mathematically obtaining an average.

It appears from the measurements that the investigator made that the pressure producing areas in the breast are sufficiently separated that an impracticably large disk would be required to obtain a single measurement average. It is, therefore, necessary to take several measurements to determine a mathematical average.[38]

Operation

In operation, sufficient current is supplied to hold the plastic disk in the extended position. The disk is then screwed in or out to the desired depth. To obtain a measurement, the disk is kept in the extended position, and pressed into the tissue up to the desired depth as indicated by a plastic plate being flush with the surface. The current is then reduced by a control, thereby reducing the force to a value equal to that exerted by

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[37] Ibid.

[38] Ibid.

> the substance being measured. At this point, the disk will release and return to its neutral position. The dial reading at the point of release is proportional to the applied force, (force from the tissue).[39]

The following pages give illustrations of the instrument. Figure 2 is a drawing of the pressure gauge and Figure 3 is a drawing of the three disks.

VI. THE STUDY CONDUCTED WITH THE PRESSURE GAUGE

Purposes of the Study

A preliminary study was undertaken with the use of the instrument constructed to validate its use as a tool for subsequent thesis work. It was necessary to determine if and to what degree it would register differences in breast pressure between the day of delivery or the prelactation phase and the third postpartum day when lactation was becoming established. Since an instrument of this nature was new and breast physiology and anatomy in relation to the reaction of the instrument obscure, it was deemed advisable to test breast tensions with regard to various sizes of disks and depths of the disks.

The instrument was tested and showed itself to be a valuable tool for purposes of evaluating more objectively

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[39] Ibid.

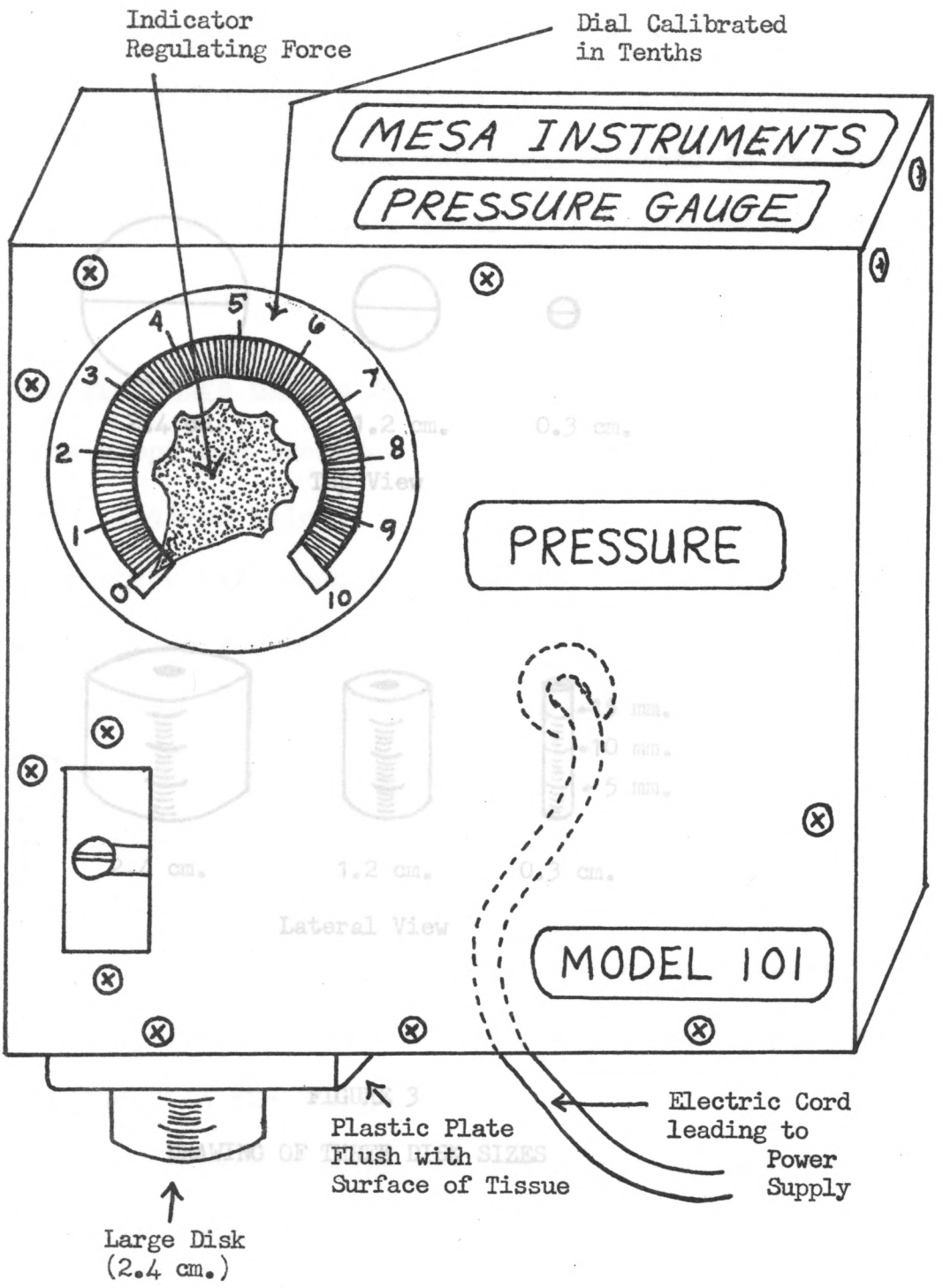
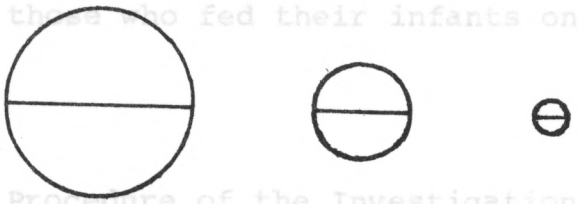
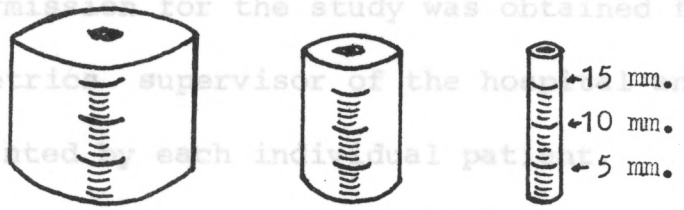


FIGURE 2

DRAWING OF THE PRESSURE GAUGE
(ACTUAL SIZE)



Top View



Lateral View

FIGURE 3

DRAWING OF THREE DISK SIZES

engorgement in mothers who are breast feeding. The instrument was used in this thesis study to determine if there was a significant difference in degree of breast engorgement between mothers who self-demand fed their infants in the hospital and those who fed their infants on a routine hospital schedule.

Scope and Procedure of the Investigation

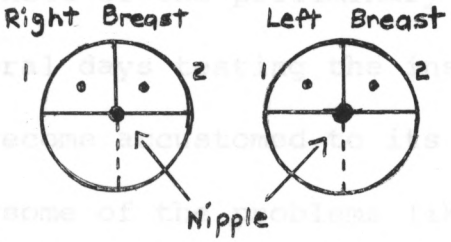
The scope and procedure as followed in this preliminary study is given below:

1. The study was conducted in a state teaching hospital. Permission for the study was obtained from the obstetrics supervisor of the hospital and was also granted by each individual patient.
2. The study began on March 18, 1965, and ended March 30, 1965. All breast feeding mothers whose infants were healthy and normal enough to attempt breast feeding were included in the study. Ten mothers were included in the study.
3. All the mothers taking part in the study were breast feeding their infants initially. One mother discontinued breast feeding on the day after delivery, but was included to demonstrate lack of engorgement with respect to the instrument. One of the other mothers,

a para five, did not demonstrate engorgement as indicated by instrument readings and by palpation.

4. The breasts were divided into quadrants and numbered, and the experimenter arbitrarily chose a mid-site in each of the two upper quadrants of each breast. This site was marked with a small black dot so that measurements taken on the third day would be done at the same site as on the first day. All measurements were taken with patients in a semi-recumbent position.

Example:



5. The series of breast measurements was taken on each patient within twenty-four hours after delivery and repeated again on the third day postpartum. In the preliminary study, the third day postpartum referred to the fourth hospital day. This ranged from sixty-four to eighty-two hours after delivery.

6. Breast pressure was measured within the first twenty-four hours at each specific site with each of the three disk sizes at three different depths. The disk sizes were 0.3, 1.2, and 2.4 centimeters in diameter ranging from smallest to largest respectively. The

depths tested were 5, 10, and 15 millimeters.

7. Certain informative data were kept on each patient. The information was obtained from the chart with the exception of one item which was the item about the number of previous infants breast fed when applicable. This information was obtained from the mother. (See Appendix A for data sheet.)

Findings Preliminary to the Investigation

Prior to the onset of the preliminary study the investigator spent several days testing the instrument on several patients to become accustomed to its nature and to become more aware of some of the problems likely to be encountered. During this time it was discovered that readings were reproducible. There was a very small degree of variability in readings (between 0.1 and 0.3) on the same site probably due to difference in the experimenter's manner of holding the instrument. It was also discovered that moving the instrument even one-half inch to an adjacent skin surface would produce a different reading, therefore, the procedure of marking particular sites was indicated. Originally readings were preferred from the two lower quadrants as well as the two upper, but this proved impossible for reasons of accuracy. Larger and pendulous breasts had to be displaced

upward for placement of the instrument and this gave varying inaccurate results apparently due to pulling of the tissue and tissue turgor.

Readings for various disk sizes and depths were different at the same site taken at the same time so they could not be compared. For example, with disk size 2.4 centimeters taken at a 10 millimeter depth the reading was 2.0 on the first day and 8.0 on the fourth day, a difference of 6.0, whereas the same disk size taken at a 15 millimeter depth gave a reading of 8.0 on the first day and 9.0 on the fourth day, a difference of only 1.0. It might be presumed that the large disk taken at a depth of 15 millimeters gave a reading of tissue resistance or normal turgor rather than engorgement on the first day because of its depth.

Analysis of the Data

An example of the worksheet with actual data, but with the name and hospital numbers changed can be seen in Appendix A. The numbers obtained for breast measurements were not analyzed by tests of statistical significance between the various depths and disk sizes, but were critically reviewed. The mean increase in breast pressure between day one and three with the three disk sizes and depths was determined and results shown by means of a graph. (See Figure

4, page eighty-seven.

A review of the various disk sizes and depths follows with the results observed and obtained. A conclusion was reached for each with the reason for such conclusion stated.

1) With disk size 0.3 centimeters at a 5 millimeter depth, no differences in readings were found between day one and three on any of the ten patients. The mean increase in breast pressure between the first and third days for the ten patients was zero.

   Conclusion: Reject disk size 0.3 centimeters at a 5 millimeter depth.

   Reason: It gave no evidence of change and increase in tissue pressure between day one and three when change was obvious to touch. It was apparently too superficial to give a reading.

2) With disk size 1.2 centimeters at a 5 millimeter depth, no differences in readings were found between day one and three on any of the ten patients. The mean increase in breast pressure between the first and third days for the ten patients was zero.

   Conclusion: Reject disk size 1.2 centimeters at a 5 millimeter depth.

   Reason: It gave no evidence of change and increase

in tissue pressure between day one and three when change was obvious to touch. The combination of disk size and depth apparently was too superficial with too little surface covered to give a reading.

3) With disk size 2.4 centimeters at a 5 millimeter depth, large differences between day one and three (up to 8.0 points) were found in only three patients. In one engorged patient, there was no change in reading. In four engorged patients the changes in readings were either very minor (up to 0.5 point) or not consistent. The two patients demonstrating no engorgement had no changes in readings. The mean increase in breast pressure between the first and third days for the ten patients was 2.48.

Conclusion: Reject disk size 2.4 centimeters at a 5 millimeter depth.

Reason: Differences in readings between day one and three were either not large, there were no differences, or changes were not consistent. Although surface area covered increased, depth was probably too superficial to give accurate readings.

4) With disk size 0.3 centimeters at a 10 millimeter depth, no changes in readings were observed between day one and three in three of the engorged nursing patients. Changes in readings were very minor in two patients (up to 0.5 points) and small in the other three patients (1.0-5.0 points). The two patients manifesting no engorgement had no changes in readings. The mean increase in breast pressure between the first and third days for the ten patients was 1.42.

   Conclusion: Reject disk size 0.3 centimeters at a 10 millimeter depth.

   Reason: Results were not consistent with changes observed by palpation in all of the patients, especially in the three engorged patients who had no changes in readings. Perhaps this disk size was too small to cover adequate surface area to give accurate and consistent tissue pressure readings.

5) With disk size 1.2 centimeters at a 10 millimeter depth, there was no difference in readings between day one and three on one engorged patient. One patient showed minor differences in readings (0.5 points) and the remaining six patients manifesting

engorgement showed differences from 0.5 points to 7.5 points. The two patients demonstrating no engorgement had no changes in readings. The mean increase in breast pressure between the first and third days for the ten patients was 2.03.

Conclusion: Reject disk size 1.2 centimeters at a 10 millimeter depth.

Reason: Significant differences between day one and three were not obtained on two of the nursing patients, both of whom manifested some engorgement. Differences on the other six patients were not consistently great enough between day one and three.

6) With disk size 2.4 centimeters at a 10 millimeter depth significant differences in readings between day one and three were obtained on eight patients. The two who showed no differences were the mother who discontinued nursing and the para five who manifested no engorgement as indicated by readings on the instrument and by palpation. The mean increase in breast pressure between the first and third days for the ten patients was 3.40.

Conclusion: Accept disk size 2.4 centimeters at a 10

millimeter depth.

Reason: Significant changes in readings were obtained on all engorged patients. Surface area of the disk and depth of the disk appear optimum for giving reading changes without producing discomfort to the patient.

7) With disk size 0.3 centimeters at a 15 millimeter depth, significant differences were noted between day one and three on five of the engorged patients. Three of the engorged patients were unable to tolerate the depth of 15 millimeters with the 0.3 centimeter disk or the investigator was unable to depress the tissue this far because of the patients' small breasts. The two patients manifesting no engorgement had no changes in readings. The mean increase in breast pressure between the first and third days for the ten patients was 1.69.

Conclusion: Reject disk size 0.3 centimeters at a 15 millimeter depth.

Reason: In some cases there was inability of small breasts to allow for depression of tissue this deep and/or inability of the patient to tolerate this depth because of engorgement

discomfort.

8) With disk size 1.2 centimeters at a 15 millimeter depth, again three of the patients were unable to tolerate the depth for the same reasons listed in (7). Significant differences between day one and three were noted on the other five engorged patients. There were no changes in readings for the two patients demonstrating no engorgement. The mean increase in breast pressure between the first and third days for the ten patients was 2.41.

Conclusion: Reject disk size 1.2 centimeters at a 15 millimeter depth.

Reason: Reject for the same reasons listed in (7).

9) With disk size 2.4 centimeters at a 15 millimeter depth, differences in readings were obtained between day one and three in five of the engorged patients. These differences were not as great as when using the 2.4 centimeter disk at a 10 millimeter depth, because when depressing the tissue 15 millimeters on day one, the experimenter obtained higher readings of pressure probably because of normal tissue turgor or resistance. Again, three patients were not able to tolerate this depth. The two patients demonstrating no

engorgement had no changes in readings. The mean increase in breast pressure between the first and third days for the ten patients was 1.93.

Conclusion: Reject disk size 2.4 centimeters at a 15 millimeter depth.

Reason: Reject for the same reasons listed in (7). In addition, with this disk size and depth, high readings were obtained on day one indicating that the readings taken were partially of normal tissue turgor, and not engorgement, since the latter was not present at that time.

Figure 4 shows the mean increase in pressure readings between the first and third days for the ten patients. The graph illustrates the average increase for each disk size at the three depths tested. Disk size 2.4 centimeters at a 10 millimeter depth showed the greatest average variation in pressure reading between day one and three.

In addition to analysis of the numerical readings other informative data kept about the patients were described. One must remember, however, that the size of the sample was small.

Six of the ten were primiparous patients, two of the

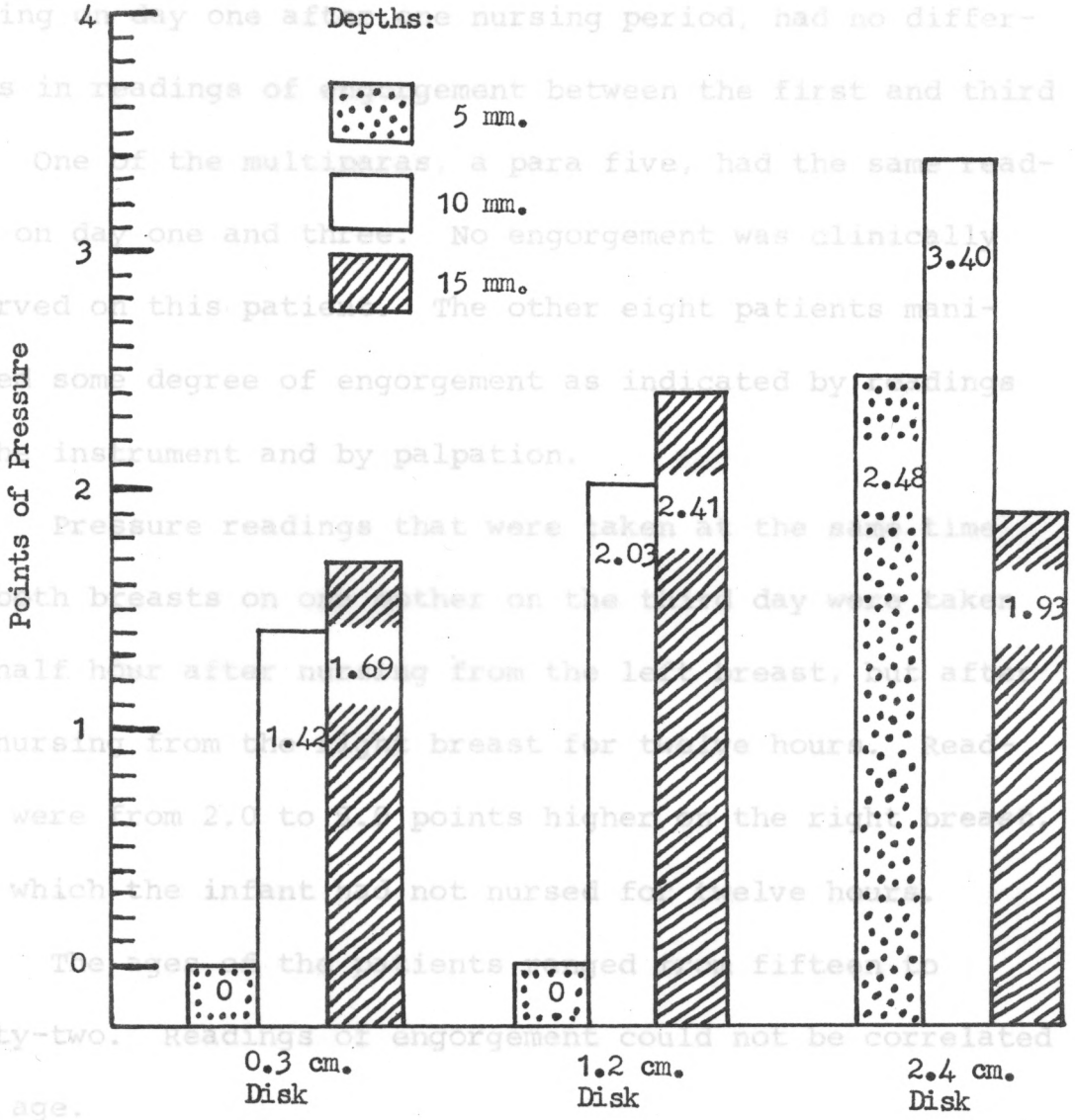


FIGURE 4

MEAN INCREASE IN BREAST PRESSURE BETWEEN DAY ONE AND THREE OF TEN BREAST FEEDING PATIENTS TAKEN WITH THREE DISK SIZES AT THREE DEPTHS

patients were para two, and the two remaining patients were para five.

The patient, a primipara, who discontinued breast feeding on day one after one nursing period, had no differences in readings of engorgement between the first and third day. One of the multiparas, a para five, had the same readings on day one and three. No engorgement was clinically observed on this patient. The other eight patients manifested some degree of engorgement as indicated by readings on the instrument and by palpation.

Pressure readings that were taken at the same time for both breasts on one mother on the third day were taken one-half hour after nursing from the left breast, but after not nursing from the right breast for twelve hours. Readings were from 2.0 to 5.0 points higher on the right breast, from which the infant had not nursed for twelve hours.

The ages of the patients ranged from fifteen to thirty-two. Readings of engorgement could not be correlated with age.

Of the nine patients who continued to breast feed during their hospital stay, three had had labor complications. Two had a prolonged second stage of labor, and the third had a third degree laceration of the perineum and

postpartum vulval hematoma. They did not suffer more or less engorgement (no higher or lower readings) than did the other five manifesting engorgement.

Seven of the patients were in rooming-in and the other three in semi-private rooms. Differences in engorgement were not noted between the rooming-in mothers and the mothers in the semi-private rooms. All infants were on self-regulatory feedings.

The four multiparas had all breast fed an infant or infants before. All had some degree of engorgement with the exception of the para five mentioned before. She had nursed her other four children each for a period of one year or more.

The birth weights of the infants varied considerably from four pounds, fifteen ounces up to eight pounds, thirteen ounces. One infant was in the four pound range, three were in the five pound range, two in the six pound range, two in the seven pound range, and two in the eight pound range. The patient, a para five, with no engorgement had the largest infant, an eight pound, thirteen ounce boy.

Nine of the infants had a good Apgar rating of between eight and ten. One premature infant had an Apgar rating of five at one minute after birth and seven at five

minutes after birth. His condition was considered good and he was transferred to the rooming-in unit. There were no neonatal complications.

Summary and Conclusions Concerning the Instrument

An instrument was tested for its validity and reliability in indicating breast pressure changes between day one and three in ten postpartum breast feeding patients. The instrument was also tested to indicate which disk size and what depth would be most satisfactory for indicating pressure changes in further work. It was concluded that disk size 2.4 centimeters at a 10 millimeter depth would be used for the thesis investigation because (1) it gave significant changes in readings between the first and third day in all of the engorged patients; (2) it apparently did not register significant degrees of normal tissue turgor to interfere with engorgement readings; (3) it gave the greatest mean increase in tissue pressure between the first and third day; (4) it caused no discomfort to any of the patients; and (5) it was tolerated by the breast tissue of all the patients studied. The instrument did register differences between the first and third day on the engorged patients and showed no difference in the two patients not manifesting engorgement. Results were reproducible for when the same site was retested,

results obtained were the same or similar (within 0.3 points).

Several refinements were made on the instrument Model P-100 before further work with it was done. The instrument did have a small degree of magnetism which prevented the disk from triggering with less force causing 0- readings. Another problem was that the degree of differential force was not equal for each of the numerical intervals, but this was corrected. With these two changes, readings always registered 0.1 or above negating zero readings, and the degree of force between each interval was evenly distributed. These changes did not basically alter the instrument. The refined instrument was Model P-101.

The tissue force in grams was calibrated for each of the numerical dial readings on the pressure gauge. Figure 5 is a plotted graph of the tissue force in grams versus the numerical dial readings on the pressure gauge for both Model P-100 and Model P-101. To obtain the tissue pressure per square centimeter, the tissue force must be divided by the area or size of the disk.

VII. FINAL SUMMARY

The preliminary investigation on which this chapter

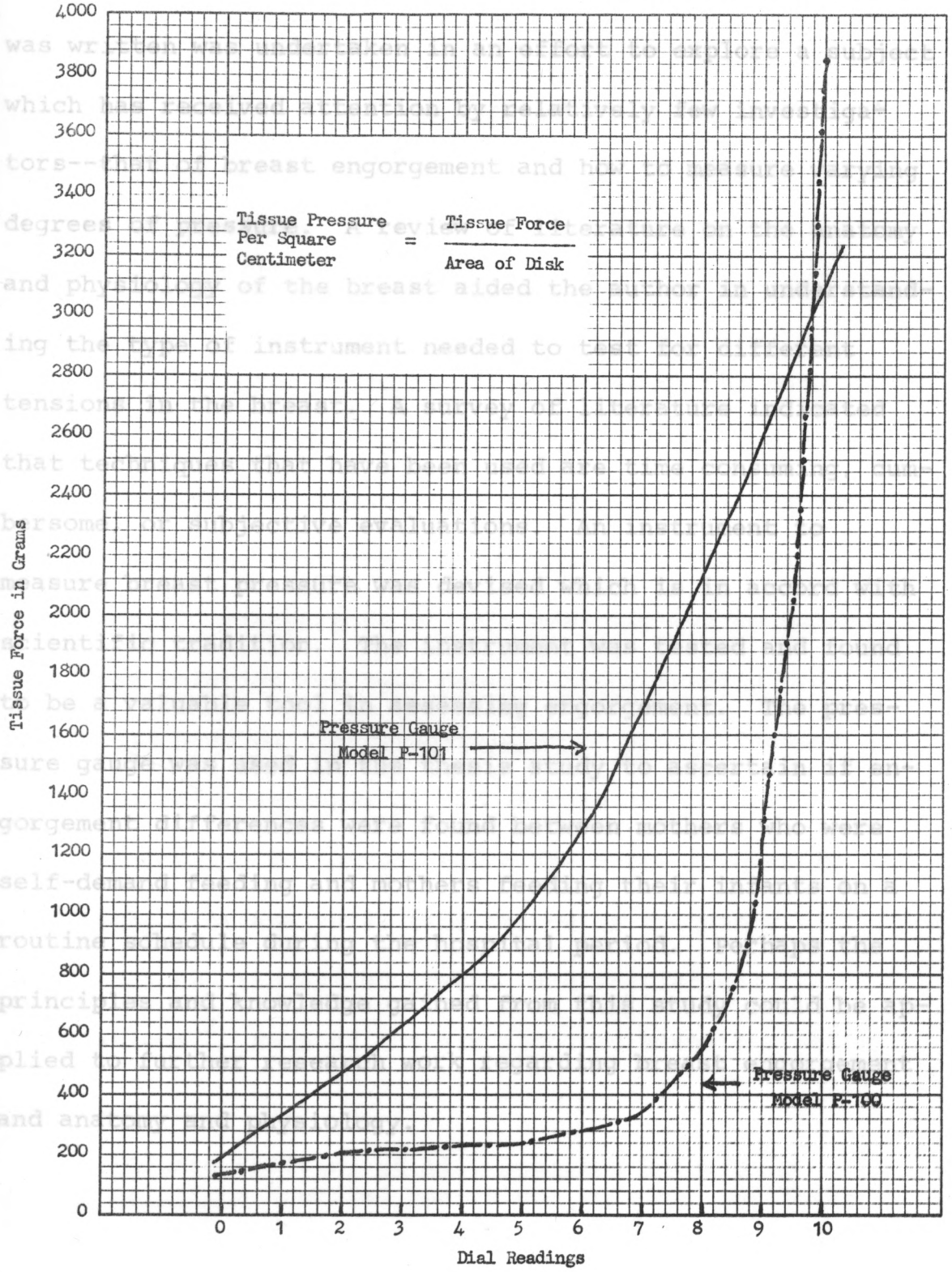


FIGURE 5

TISSUE FORCE IN GRAMS VERSUS NUMERICAL DIAL READINGS ON PRESSURE GAUGE MODEL P-100 AND MODEL P-101 (FROM ROGER K. SALAMAN, MESA INSTRUMENTS)

was written was undertaken in an effort to explore a subject which has received attention by relatively few investigators--that of breast engorgement and how to measure varying degrees of pressure. A review of literature on the anatomy and physiology of the breast aided the author in understanding the type of instrument needed to test for different tensions in the breast. A survey of literature indicated that techniques that have been used are time consuming, cumbersome, or subjective evaluations. An instrument to measure breast pressure was devised which is in accord with scientific tradition. The instrument was tested and found to be a valuable tool in assessing engorgement. The pressure gauge was used in the thesis study to ascertain if engorgement differences were found between mothers who were self-demand feeding and mothers feeding their infants on a routine schedule during the hospital period. Perhaps the principles and knowledge gained from this study could be applied to further research work regarding breast engorgement and anatomy and physiology.

CHAPTER V

ANALYSIS OF DATA

I. INTRODUCTION

This chapter contains the analysis of the data obtained in the study. Selltiz states, "It is the purpose of analysis to summarize the completed observations in such a manner that they yield answers to the research questions."[1] The purpose of this analysis was to determine what relation the self-demand infant feeding program would have on the establishment of breast feeding and on certain responses of the infants.

According to Rummel, there are three frequently used methods of analysis: tabulations or frequency distributions, tables and graphs, and statistical calculations.[2] Each of the six specific areas for which

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[1] Claire Selltiz, et al., Research Methods in Social Relations (revised one-volume edition; New York: Holt, Rinehart and Winston, 1964), p. 386.

[2] J. Francis Rummel, An Introduction to Research Procedures in Education (New York: Harper & Brothers, Publishers, 1958), p. 131.

a null hypothesis was proposed was analyzed according to one of the commonly used methods of analysis.

In order to better understand the analysis of data, the recorded information about the subjects was described to compare the control and experimental groups. Three variables judged to be relevant were statistically analyzed by means of the t test to determine if there were significant differences between the two groups. These variables were the ages of the mothers, the average duration of breast feeding for mothers who previously had nursed an infant, and the newborn infants' birth weights. In addition other variables were recorded and percentage calculations made for comparison of the two groups. The general areas in which information was obtained were the patient's history, present pregnancy and delivery, past history of infant feeding, and the newborn infant.

II. THE SAMPLE DESCRIBED

History of the Patients

Patients in the Control Group. There were twenty patients in the control group ranging in age from eighteen to forty-one with a mean age of 26.35 years and a median age of 25 years. Eighteen of the patients were Caucasian, one

was Negro, and one was Spanish American. All of the patients were married. In this group of patients, fourteen were Protestant, three were Catholic, and three were Jewish. Concerning education completed, one patient had finished the eleventh grade, seven had completed high school, and twelve had attended school beyond the high school level. Eighteen of the patients at present were homemakers and two were listed with occupations outside the home. The husbands of the patients were engaged in a variety of occupations and were classified into the following categories: unskilled--three, professional--six, and other--eleven. Refer to Table I for a summary of the history of the control group of mothers.

Patients in the Experimental Group. There were seventeen patients in the experimental group whose ages ranged from twenty-one to thirty-five. The mean age was 26.12 years and the median age was 25 years. Of this group, sixteen of the patients were Caucasian and one was Negro. All patients were married except one. Of these patients, fourteen were Protestants and three were Catholics. Three patients were high school graduates, and fourteen patients had pursued education beyond high school. Sixteen of this group of patients were housewives at the time of the study

TABLE I

HISTORY OF THE CONTROL GROUP OF PATIENTS

Patient Code	Age	Race	Marital Status	Religion	Education Completed	Patient's Present Occupation	Husband's Occupation
3C	18	Caucasian	Married	Catholic	High School	Housewife	Laborer
5C	29	Caucasian	Married	Protestant	High School	Housewife	Fireman
6C	23	Caucasian	Married	Protestant	Beyond High School	Housewife	Teacher
7C	34	Caucasian	Married	Protestant	Beyond High School	Teacher	Teacher
9C	25	Caucasian	Married	Jewish	High School	Housewife	Laborer
11C	25	Negro	Married	Protestant	High School	Housewife	Molder
12C	19	Caucasian	Married	Protestant	High School	Housewife	Mechanic
13C	25	Caucasian	Married	Protestant	High School	Housewife	Clerk
14C	19	Caucasian	Married	Protestant	Beyond High School	Housewife	Laborer
15C	31	Caucasian	Married	Jewish	Beyond High School	Housewife	Salesman
18C	41	Caucasian	Married	Catholic	Beyond High School	Housewife	T.V. Announcer
19C	22	Caucasian	Married	Protestant	Beyond High School	Housewife	Banker
27C	23	Caucasian	Married	Protestant	High School	Secretary	Office Manager
28C	25	Caucasian	Married	Jewish	Beyond High School	Housewife	Veterinarian
30C	30	Caucasian	Married	Protestant	Beyond High School	Housewife	Sales Supervisor
31C	28	Caucasian	Married	Protestant	Beyond High School	Housewife	Manager-Finance Co.
32C	28	Caucasian	Married	Protestant	Beyond High School	Housewife	Electrical Engineer
33C	34	Caucasian	Married	Protestant	Beyond High School	Housewife	Attorney
34C	26	Spanish American	Married	Catholic	Eleventh Grade	Housewife	Heavy Equipment Operator
35C	22	Caucasian	Married	Protestant	Beyond High School	Housewife	Civil Engineer

and one was listed as working outside the home. The occupations of the patients' husbands were grouped into the following categories: unskilled--one, professional--six, and other--nine. In Table II may be found the foregoing data of the experimental group of mothers.

The Two Groups Compared. The history of the twenty mothers in the control group and the seventeen mothers in the experimental group was compared. (See Table IV.) The ages of the patients in the two groups were similar as evidenced by a median age of twenty-five years for both groups and a mean age of 26.35 years for the control group and a mean age of 26.12 years for the experimental group.

In addition to calculating the mean and median age for both groups of mothers, the ages were analyzed to determine if there was a significant difference between the two groups. (See Table III.) The *t* test was performed and a value of 0.136 computed for *t*. To be significant at the .05 level, *t* must be 2.030 using a two-tailed test. The standard deviations calculated from the variances were 5.733 for the control group and 4.442 for the experimental group. In addition, the *F* test for the variances was computed and a value of 1.666 obtained. To be significant at the .05 level, *F* must be 2.91. Therefore, it must be concluded that the

TABLE II

HISTORY OF THE EXPERIMENTAL GROUP OF PATIENTS

Patient Code	Age	Race	Marital Status	Religion	Education Completed	Patient's Present Occupation	Husband's Occupation
1E	21	Caucasian	Married	Catholic	Beyond High School	Housewife	Clerk
2E	30	Caucasian	Married	Protestant	Beyond High School	Clerk	Office Supervisor
3E	25	Caucasian	Married	Catholic	Beyond High School	Housewife	Manager, Motor Co.
4E	28	Caucasian	Married	Protestant	Beyond High School	Housewife	Museum Curator
6E	24	Caucasian	Married	Protestant	Beyond High School	Housewife	Geologist
7E	22	Caucasian	Married	Protestant	High School	Housewife	Draftsman
8E	28	Caucasian	Married	Protestant	Beyond High School	Housewife	Engineer
11E	33	Caucasian	Married	Protestant	Beyond High School	Housewife	Attorney
13E	32	Caucasian	Married	Protestant	Beyond High School	Housewife	Dentist
17E	26	Negro	Married	Protestant	High School	Housewife	Laborer
18E	22	Caucasian	Married	Protestant	High School	Housewife	State Patrolman
19E	25	Caucasian	Single	Protestant	Beyond High School	Housewife	-----
21E	21	Caucasian	Married	Protestant	Beyond High School	Housewife	Programmer:Airlines
22E	35	Caucasian	Married	Catholic	Beyond High School	Housewife	Sales Representative
23E	21	Caucasian	Married	Protestant	Beyond High School	Housewife	College Student
24E	23	Caucasian	Married	Protestant	Beyond High School	Housewife	Salesman
25E	28	Caucasian	Married	Protestant	Beyond High School	Housewife	Engineer

TABLE III

AGES OF THE MOTHERS IN THE TWO GROUPS COMPARED

	Control	Experimental
Mean	26.35 years	26.117 years
Variance	32.871	19.735
Standard Deviation	5.733	4.442
Standard Error of the Difference of the Means	1.710	
Value of F	1.666*	
Value of t	0.136**	

*To be significant at the .05 level, F must equal or exceed 2.91 using the two-tailed test. (George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1959), pp. 310-313.)

**To be significant at the .05 level, t must equal or exceed 2.030 using the two-tailed test. (George W. Snedecor, Statistical Methods (Ames, Iowa: The Iowa State College Press, 1956), p. 46.)

TABLE IV

HISTORY OF THE EXPERIMENTAL AND CONTROL GROUPS COMPARED

	Control	Experimental
Age:		
Mean	26.35 years	26.12 years
Median	25.00 years	25.00 years
Race:		
Caucasian	90.0%	94.1%
Negro	5.0%	5.9%
Spanish American	5.0%	0.0%
Marital Status:		
Married	100.0%	94.1%
Religion:		
Protestant	70.0%	82.4%
Catholic	15.0%	17.6%
Jewish	15.0%	0.0%
Highest Education Completed:		
Eighth through Eleventh Grade	5.0%	0.0%
High School	35.0%	17.6%
Beyond High School	60.0%	82.4%
Patient's Present Occupation:		
Housewife	90.0%	94.1%
Outside Home	10.0%	5.9%
Husband's Occupation:		
Unskilled	15.0%	6.3%
Professional	30.0%	37.5%
Other (Miscellaneous)	55.0%	56.2%

two groups of patients did not differ significantly in age. The hypothesis that the two samples arose from the same population was accepted.

Ninety per cent of the control group were Caucasian while 94.1 per cent of the experimental group were of the same race. In the control group, 5 per cent were Negro, and in the experimental group 5.9 per cent were Negro. Five per cent of the control group was Spanish American. These percentages show that the two groups were similar with regard to race.

All patients in the control group were married. In the experimental group all were married except one.

With reference to religion, 70 per cent of the control group were Protestant as compared to 82.4 per cent in the experimental group. Fifteen per cent and 17.6 per cent were of the Catholic faith in the control and experimental groups respectively. Fifteen per cent of the control group were Jewish whereas none in the experimental group was of the Jewish faith.

When education of the patients was compared, there were some differences noted between the two groups. In the control group 5 per cent had completed education up through the eleventh grade only as compared to none in the

experimental group. Thirty-five per cent and 17.6 per cent had completed high school in the control and experimental groups respectively. The percentages for those in the control and experimental groups pursuing education beyond high school were 60 per cent and 82.4 per cent respectively.

Concerning the patients' present occupations, 90 per cent of the controls were housewives and 10 per cent had work outside the home. In the experimental group, 94.1 per cent were housewives and 5.9 per cent were employed outside the home.

The occupations of the husbands were similar for the the two groups. The control group had 30 per cent and the experimental group 37.5 per cent in professional employment. Fifty-five per cent of the control group and 56.2 per cent of the experimental group were employed in a variety of occupations. Those in unskilled occupations constituted 15 per cent of the control group and 6.3 per cent of the experimental group.

Present Pregnancy and Delivery of the Patients

Patients in the Control Group. In the control group there were nine primiparous patients and eleven multiparous patients. All of the patients in this group had received prenatal care for five months or more. Fifteen of

the women were under the care of an obstetrician for the antepartal period and then had a pediatrician assume medical charge of the infant after birth. Three mothers and their infants were under the care of a general practitioner and two attended the hospital clinic. The calculated length of pregnancy for the control group varied from thirty-eight to forty-two weeks. The length of labor for this group ranged from two hours to twelve and one-half hours. The average length of labor was 6.78 hours. Thirteen of the patients delivered spontaneously and seven were delivered using forceps. The anesthetics utilized for delivery with this group varied, but for purposes of classification, were grouped into three categories: regional, inhalation, and a combination of the two. Three patients received a type of regional anesthesia, sixteen received inhalation anesthesia, and one had a combination of the two. Two patients had complications of labor and delivery which were a persistent occiput posterior fetal position and a fourth degree laceration and extension of the episiotomy. With respect to the hospital room arrangement, sixteen patients were in two bed hospital rooms, two were in three bed rooms, and two were in a five bed ward. Table V summarizes in detail these facts describing the control group as to present pregnancy and

TABLE V

PRESENT PREGNANCY AND DELIVERY OF THE CONTROL GROUP OF PATIENTS

Patient Code	Gravida	Para	Length of Prenatal Care (Months)	Physician in Charge	Calculated Length of Pregnancy (Weeks)	Length of Labor (Hours)	Type of Delivery	Anesthesia	Complications	Hospital Room Arrangement
3C	2	2	7	Clinic	42	12.5	Spontaneous	Regional	None	5 Bed Ward
5C	4	4	5	G.P.	40	6.5	Spontaneous	Inhalation	None	2 Bed Room
6C	1	1	8	Ob.-Ped.	40	9.3	Spontaneous	Regional-Inhalation	None	2 Bed Room
7C	1	1	7	Ob.-Ped.	40	8.4	Forceps	Inhalation	None	2 Bed Room
9C	3	3	9	Ob.-Ped.	42	3.2	Spontaneous	Inhalation	None	2 Bed Room
11C	4	4	8	Ob.-Ped.	42	2.0	Spontaneous	Inhalation	None	2 Bed Room
12C	1	1	6	Clinic	41	5.8	Forceps	Inhalation	None	5 Bed Ward
13C	1	1	5	Ob.-Ped.	40	12.3	Spontaneous	Inhalation	None	2 Bed Room
14C	1	1	7	Ob.-Ped.	40	5.0	Spontaneous	Inhalation	None	2 Bed Room
15C	6	4	7	Ob.-Ped.	40	4.1	Forceps	Inhalation	*	2 Bed Room
18C	1	1	6	Ob.-Ped.	42	5.9	Forceps	Inhalation	None	2 Bed Room
19C	2	2	7	Ob.-Ped.	42	2.9	Forceps	Regional	None	2 Bed Room
27C	1	1	7	Ob.-Ped.	40	8.3	Forceps	Inhalation	None	2 Bed Room
28C	2	2	8	Ob.-Ped.	40	6.3	Spontaneous	Inhalation	None	2 Bed Room
30C	4	3	7	Ob.-Ped.	41	2.8	Spontaneous	Inhalation	**	2 Bed Room
31C	5	3	8	Ob.-Ped.	39	8.5	Spontaneous	Inhalation	None	3 Bed Room
32C	2	2	8	Ob.-Ped.	40	6.1	Spontaneous	Inhalation	None	2 Bed Room
33C	1	1	8	Ob.-Ped.	41	10.8	Forceps	Regional	None	3 Bed Room
34C	6	1	8	G.P.	38	11.0	Spontaneous	Inhalation	None	2 Bed Room
35C	3	4	7	G.P.	40	3.9	Spontaneous	Inhalation	None	2 Bed Room

Code: Ob.-Ped.= Obstetrician-Pediatrician
G.P.= General Practitioner
* Fourth Degree laceration and extension of the episiotomy
**Persistent occiput posterior fetal position

delivery.

Patients in the Experimental Group. The patients in the experimental group consisted of five primiparous patients and twelve multiparous patients. The length of antepartal care received by this group ranged from five months and more. Thirteen mothers and infants were under the care of an obstetrician and pediatrician, three were under care of a general practitioner, and one was under the care of physicians in the hospital clinic. The calculated length of pregnancy for this group was between thirty-eight and forty-two weeks. The length of labor ranged from two and one-half hours to twenty hours with an average of 5.75 hours. There were ten spontaneous and seven forceps deliveries. Anesthesia administered to the patients in this group was categorized into two main groups: regional and inhalation. Three patients received an inhalation anesthetic, and fourteen had a type or combination of two types of regional anesthetic. There were two maternal complications of labor and the puerperium in this group: a fourth degree laceration and extension of the episiotomy and femoral thrombophlebitis. With respect to hospital room arrangements, fourteen patients were in a two bed room, two in a three bed room, and one in a five bed ward. Refer to Table VI for a summary of the

TABLE VI

PRESENT PREGNANCY AND DELIVERY OF THE EXPERIMENTAL GROUP OF PATIENTS

Patient Code	Gravida	Para	Length of Prenatal Care (Months)	Physician in Charge	Calculated Length of Pregnancy (Weeks)	Length of Labor (Hours)	Type of Delivery	Anesthesia	Compli-cations	Hospital Room Arrange-ment
1E	1	1	8	Ob.-Ped.	40	4.9	Spontaneous	Inhalation	None	2 Bed Room
2E	2	2	8	G.P.	40	6.8	Spontaneous	Regional	None	3 Bed Room
3E	3	3	8	G.P.	40	6.0	Spontaneous	Regional	None	2 Bed Room
4E	2	2	8	Ob.-Ped.	40	3.6	Forceps	Regional	None	2 Bed Room
6E	2	2	8	Ob.-Ped.	39	6.3	Spontaneous	Regional	None	2 Bed Room
7E	1	1	8	Ob.-Ped.	40	20.0	Forceps	Regional	*	2 Bed Room
8E	1	1	8	Ob.-Ped.	38	2.3	Forceps	Regional	None	2 Bed Room
11E	2	2	8	Ob.-Ped.	41	4.3	Spontaneous	Regional	None	2 Bed Room
13E	2	2	7	Ob.-Ped.	42	4.9	Forceps	Regional	None	2 Bed Room
17E	4	4	1.5	G.P.	39	3.3	Spontaneous	Regional	**	2 Bed Room
18E	3	2	8	Ob.-Ped.	40	3.8	Spontaneous	Inhalation	None	2 Bed Room
19E	1	1	5	Clinic	40	6.7	Forceps	Regional	None	5 Bed Ward
21E	2	2	5	Ob.-Ped.	40	4.4	Spontaneous	Regional	None	2 Bed Room
22E	2	2	8	Ob.-Ped.	40	5.7	Spontaneous	Regional	None	2 Bed Room
23E	1	1	9	Ob.-Ped.	41	4.3	Forceps	Regional	None	2 Bed Room
24E	2	2	6	Ob.-Ped.	40	8.3	Spontaneous	Inhalation	None	3 Bed Room
25E	2	2	8	Ob.-Ped.	40	2.1	Forceps	Regional	None	2 Bed Room

Code: Ob.-Ped.= Obstetrician-Pediatrician
G.P.= General Practitioner
* Fourth Degree laceration and extension of the episiotomy
**Femoral thrombophlebitis

present pregnancy and delivery of the experimental group of patients.

Present Pregnancy and Delivery of the Two Groups Compared. The control and experimental groups were compared with respect to the data obtained on their present pregnancy and delivery by the calculation of percentages or means. See Table VII. With respect to parity, 45 per cent of the control group and 29.4 per cent of the experimental group were primiparous patients. The control and experimental groups were composed respectively of 55 and 70.6 per cent multiparous patients.

The average length of prenatal care for both groups was 7.15 months.

Seventy-five per cent of the control group and 76.5 per cent of the experimental group were under medical care of an obstetrician and later the infants were under care of a pediatrician. A general practitioner had care of 15 per cent of the control group and 17.6 per cent of the experimental group. Ten per cent of the patients in the control group were clinic patients and 5.9 per cent of the experimental group were under clinic care.

The average calculated length of pregnancy was similar for both groups--40.5 weeks for the control group and

TABLE VII

PRESENT PREGNANCY AND DELIVERY OF THE EXPERIMENTAL AND CONTROL GROUPS OF PATIENTS COMPARED

	Control	Experimental
Parity:		
Primipara	45.0%	29.4%
Multipara	55.0%	70.6%
Average Length of Prenatal Care:	7.15 months	7.15 months
Physician in Charge:		
Obstetrician-Pediatrician	75.0%	76.5%
General Practitioner	15.0%	17.6%
Clinic	10.0%	5.9%
Average Length of Pregnancy:	40.5 weeks	40.0 weeks
Average Length of Labor:	6.78 hours	5.75 hours
Type of Delivery:		
Spontaneous	65.0%	58.8%
Forceps	35.0%	41.2%
Type of Anesthesia for Delivery:		
Regional	15.0%	82.4%
Inhalation	80.0%	17.6%
Combination of Regional and Inhalation	5.0%	0.0%
Complications of Pregnancy, Labor, Delivery, or Puerperium	10.0%	11.8%
Hospital Room Arrangement:		
2 Bed Room	80.0%	82.3%
3 Bed Room	10.0%	11.8%
5 Bed Ward	10.0%	5.9%

40.0 weeks for the experimental group. For the patients in the control group, the average length of labor was 6.78 hours and for the experimental group was 5.75 hours.

Sixty-five per cent of the patients in the control group had a spontaneous delivery while 35 per cent had a forceps-facilitated delivery. Of the experimental patients, 58.8 per cent had a spontaneous delivery and 41.2 per cent had a forceps delivery.

Fifteen per cent of the control group and 82.4 per cent of the experimental group had some type of regional anesthetic. Inhalation anesthesia was administered to 80 per cent of the control patients and 17.6 per cent of the experimental patients. A combination of regional and inhalation anesthesia was administered to 5 per cent of the control group.

The incidence of complications of pregnancy, labor, delivery, or the puerperium was similar for both groups. Ten per cent of the control patients and 11.8 per cent of the experimental patients had complications. The type of complications manifested were not of a kind to directly have any influence on breast feeding and probably they had no influence on lactation whatsoever.

With respect to hospital room arrangements, 80 per

cent and 82.3 per cent of the patients in the control and experimental groups respectively had a two bed hospital room. Ten per cent of the control group and 11.8 per cent of the experimental group were in three bed rooms. Those in five bed wards comprised 10 per cent of the control group and 5.9 per cent of the experimental group.

Past History of Infant Feeding

Patients in the Control Group. Of the twenty mothers in the control group, ten had breast fed an infant or infants previously. Seven of these ten had nursed one infant before the present newborn, two had nursed two children before, and one had nursed three children. The duration of nursing for the previous infants breast fed among control mothers ranged from one month to eleven months. Five of these children were nursed two months or less. The ten mothers who had nursed previously had fourteen children among them who had breast fed and of these fourteen, five had received a complementary or supplementary formula feeding at least once daily during the period that the child was breast fed. Three of the five children receiving the supplementary formula feeding were given the daily supplement as a matter of convenience to the mother, and the remaining two had been given the additional formula out of necessity.

This information is presented in Table VIII.

Patients in the Experimental Group. There were ten mothers out of seventeen in the experimental group that had nursed an infant or infants previously. Nine patients had breast fed one child previously and one had nursed two children previously. The length of time that previous children of mothers in the experimental group had nursed ranged from one month to six and one-half months. Four of these previously breast fed children were nursed two months or less. Of the eleven children who had been nursed previously by the ten mothers in this group, four had received complementary or supplementary formula daily during the breast feeding period due to necessity. The foregoing data may be found in Table IX.

Past History of Infant Feeding for the Two Groups Compared. In comparing the two groups it can be seen that a similar percentage of infants and mothers breast fed previously in the two groups. (Refer to Table X.) In the control group, 63.6 per cent of the total number of previous children had been breast fed compared to 73.3 per cent in the experimental group. Fifty per cent of the control mothers and 58.8 per cent of the experimental mothers had

TABLE VIII

PAST HISTORY OF INFANT FEEDING FOR THE CONTROL GROUP OF PATIENTS

Patient Code	Number of Previous Infants Breast Fed	Duration of Each	Complementary or Supplementary Formula Used Daily
3C	1	2 months	No
5C	1	3 months	No
6C	0	--	--
7C	0	--	--
9C	1	3 months	No
11C	1	3 months	No
12C	0	--	--
13C	0	--	--
14C	0	--	--
15C	3	3 months	Yes
		3 months	Yes
		3 months	Yes
18C	0	--	--
19C	1	1.25 months	No
27C	0	--	--
28C	1	1 month	Yes
30C	2	6 months	No
		4 months	No
31C	2	1 month	Yes
		11 months	No
32C	1	1.25 months	No
33C	0	--	--
34C	0	--	--
35C	0	--	--

TABLE IX

PAST HISTORY OF INFANT FEEDING FOR THE EXPERIMENTAL GROUP OF PATIENTS

Patient Code	Number of Previous Infants Breast Fed	Duration of Each	Complementary or Supplementary Formula Used Daily
1E	0	--	--
2E	0	--	--
3E	1	3 months	No
4E	1	1 month	Yes
6E	1	5 months	No
7E	0	--	--
8E	0	--	--
11E	1	4 months	No
13E	1	6.5 months	No
17E	2	5 months	No
		2 months	Yes
18E	1	1 month	Yes
19E	0	--	--
21E	1	3 months	No
22E	0	--	--
23E	0	--	--
24E	1	1.5 months	Yes
25E	1	3 months	No

TABLE X

PAST HISTORY OF INFANT FEEDING COMPARED FOR CONTROL AND EXPERIMENTAL GROUPS

	Control	Experimental
Percentage of Previous Infants Breast Fed to Total Number Previous Children	63.6%	73.3%
Percentage of Mothers Who Previously Breast Fed	50.0%	58.8%
Average Duration of Breast Feeding for Previous Infants Nursing	3.25 months	3.18 months
Percentage Incidence of Complementary or Supplementary Formula Feeding Used Daily Among Previously Nursed Infants	35.7%	36.4%

nursed before. The control group had a slightly longer average duration of nursing for those previously breast feeding than the experimental group. The average duration was 3.25 months and 3.18 months respectively for the two groups. Of previously nursed infants, 35.7 per cent in the control group had received supplementary or complementary formula feedings daily as compared to 36.4 per cent in the experimental group.

The average duration of breast feeding with past infants among mothers who previously nursed was statistically analyzed by means of the t test. See Table XI. The variance was 6.788 for the control group and 3.214 for the experimental group. Computation of the F test gave a value of 2.11. This was not significant since F must equal 4.00 for the .05 level of confidence using the two-tailed test. Standard deviations were calculated from the variances. For the control group the standard deviation was 2.605 and for the experimental group 1.792. The standard error of the difference of the means was 0.922. The computed value of t was 0.076. To be significant at the .05 level using the two-tailed test, t must equal 2.069 or greater. It must be concluded that the average duration of breast feeding with past infants among mothers who previously nursed was not

TABLE XI

COMPARISON OF AVERAGE DURATION OF BREAST FEEDING WITH PAST INFANTS AMONG MOTHERS WHO PREVIOUSLY NURSED

	Control	Experimental
Mean	3.25 months	3.18 months
Variance	6.788	3.214
Standard Deviation	2.605	1.792
Standard Error of the Difference of the Means	0.922	
Value of *F*	2.11*	
Value of *t*	0.076**	

*To be significant at the .05 level, a value of 4.00 for *F* is required using the two-tailed test. (Ferguson, *loc. cit.*)

**To be significant at the .05 level, a value of 2.069 for *t* is required using the two-tailed test. (Snedecor, *loc. cit.*)

significantly different for the two groups.

The Newborn Infant

Infants in the Control Group. In the control group of twenty infants, twelve were male and eight were female. The birth weights ranged from five pounds, four ounces up to nine pounds, two ounces. The average weight for this group was seven pounds, two ounces. There were no fetal or neonatal complications. The Apgar ratings of the newborns in this group taken one minute after birth were seven and above for all of the infants except two whose initial ratings were four and seven. The mean Apgar rating for the control infants was 8.6. (See Table XII.)

The scoring system devised by Dr. Virginia Apgar is used by many hospitals to encourage close observation of the newborn in the delivery room. It does not always give a true picture of the condition of the infant, but it does give a quick appraisal. Each of five signs--heart rate, respiratory effort, muscle tone, reflex irritability, and color--is observed at one minute after delivery and evaluated according to a chart. The highest score is 10, which indicates the infant is in the best possible condition. The

TABLE XII

NEWBORN INFANTS IN CONTROL GROUP

Patient Code	Sex	Birth Weight (Pounds-Ounces)	Apgar Rating (1 minute after birth)	Compli-cations
3C	Male	7-8	9	None
5C	Female	5-8	8	None
6C	Male	8-0	7	None
7C	Male	6-14	6	None
9C	Male	7-4	9	None
11C	Male	9-2	9	None
12C	Male	5-9	4	None
13C	Female	7-0	10	None
14C	Male	6-6	9	None
15C	Female	6-3	9	None
18C	Male	6-12	9	None
19C	Female	8-4	9	None
27C	Male	7-3	9	None
28C	Male	7-3	9	None
30C	Female	9-0	9	None
31C	Female	7-9	9	None
32C	Male	7-5	9	None
33C	Female	7-4	10	None
34C	Female	5-4	10	None
35C	Male	8-4	9	None

more depressed the infant, the smaller the score.[3]

Infants in the Experimental Group. Eight female and nine male newborns comprised the experimental group of infants. Their birth weights ranged from six pounds, two ounces to nine pounds, five ounces. The mean weight for this group of infants was seven pounds, four ounces. The initial Apgar ratings taken one minute after birth ranged from six to ten. One infant had an initial Apgar rating of six and the other infants' ratings were all seven or above. The mean Apgar rating for this group was 8.8. There were no fetal or neonatal complications in the experimental group. Refer to Table XIII for a detailed description of the infants in the experimental group.

The Two Groups of Newborns Compared. The control group of newborns was comprised of 60 per cent male infants and the experimental group of 53 per cent male infants. Forty per cent of the controls and 47 per cent of the experimental subjects were female. The mean birth weight for both groups was almost identical being seven pounds, two

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[3]Mae M. Bookmiller and George L. Bowen, Textbook of Obstetrics and Obstetric Nursing (fourth edition; Philadelphia: W.B. Saunders Company, 1963), pp. 273-274.

TABLE XIII

NEWBORN INFANTS IN EXPERIMENTAL GROUP

Patient Code	Sex	Birth Weight (Pounds-Ounces)	Apgar Rating (1 minute after birth)	Complications
1E	Female	7-0	9	None
2E	Male	8-6	9	None
3E	Female	6-15	8	None
4E	Male	7-1	9	None
6E	Male	7-0	9	None
7E	Female	9-5	10	None
8E	Male	6-12	10	None
11E	Female	7-8	7	None
13E	Male	8-6	9	None
17E	Male	6-7	9	None
18E	Female	7-10	10	None
19E	Female	6-2	9	None
21E	Male	8-0	9	None
22E	Male	7-8	9	None
23E	Female	6-4	6	None
24E	Male	6-7	9	None
25E	Female	6-14	9	None

ounces for the control group and seven pounds, four ounces for the experimental group. The mean Apgar ratings for the two groups were also very similar being 8.6 for the control group and 8.8 for the experimental group. There were no complications in either the control or experimental group of infants. Refer to Table XIV for a summary of the above data.

In addition to calculation of the mean birth weight for each group, the weights were statistically analyzed to determine if there was significant difference between the two groups. See Table XV. The mean weight in ounces for the control group was 114.7 ounces and for the experimental group 116.29 ounces. Calculation of the variance for the control group was 257.27 and for the experimental group 189.47. The F test was applied to determine homogeneity of the two variances and a value of 1.36 obtained. F must equal or exceed 2.91 for significance at the .05 level. The standard deviations calculated from the variances were 160.398 for the control group and 137.649 for the experimental group. The standard error of the difference of the means was 4.962. The computed value of t was 0.320. This value was not significant since a value of 2.030 for t is required for significance at the .05 level using the two-tailed test. The conclusion was that the two groups of

TABLE XIV

CONTROL AND EXPERIMENTAL GROUPS
OF NEWBORNS COMPARED

	Control	Experimental
Sex:		
Male	60%	53%
Female	40%	47%
Mean Birth Weight:	7 lbs. 2 oz.	7 lbs. 4 oz.
Mean Apgar Rating:	8.6	8.8
Complications:	0	0

TABLE XV

COMPARISON OF THE NEWBORN WEIGHTS OF THE CONTROL AND EXPERIMENTAL GROUPS

	Control	Experimental
Mean	114.7 ounces	116.29 ounces
Variance	257.27	189.47
Standard Deviation	160.398	137.649
Standard Error of the Difference of the Means	4.962	
Value of F	1.36 *	
Value of t	0.320 **	

*To be significant at the .05 level, F must equal or exceed 2.91 using the two-tailed test. (Ferguson, loc. cit.)

**To be significant at the .05 level, t must equal or exceed 2.030 using the two-tailed test. (Snedecor, loc. cit.)

infants did not significantly differ in birth weight.

III. THE INVESTIGATION

In the previous section the subjects in the control and experimental groups were compared with respect to pertinent history, present pregnancy and delivery, past history of infant feeding, and the newborn infant. Calculation of means, standard deviations, and variances, with computation of the t test were done on the following variables judged to be relevant, and found to be statistically not significant at the .05 level of confidence. The three variables were ages of the mothers, the average duration of breast feeding for mothers who previously nursed an infant, and the newborn infants' birth weights. Percentage determinations were also made of the other recorded variables and the two groups were found to be similar in almost all aspects. Therefore, the variables that were compared, being similar for the two groups, made negligible contributions to the outcome of this study. Differences in the two groups on the six selected areas of measurement could be attributed to the independent variable which was the demand feeding program introduced to the experimental group. Following is an analysis of the six factors which were measures of the

dependent variable, degree of success in breast feeding.

Degree of Breast Engorgement

Null Hypothesis 1

Nursing mothers who are self-demand feeding their infants will not have a significantly less degree of engorgement of the breasts than nursing mothers on a routine schedule for infant feeding.

Report of the Findings. The degree of breast engorgement or pressure was ascertained by means of an instrument, Pressure Gauge Model P-101, to obtain objective numerical measurement. For description of the instrument, refer to Chapter IV. For purposes of this investigation, eight readings of pressure were taken by dividing the upper half of each breast into four quadrants, marking a site in each quadrant, and taking the measurement at each site within twenty-four hours of delivery and again on the third day postpartum which was the fourth hospital day. Readings on the fourth day were determined on all patients between one and two hours after nursing. The differences between pressure readings taken on day one and four were calculated and a mean increase for each patient obtained.

The average pressure reading within twenty-four hours

of delivery for the control group was 1.087 and for the experimental group 1.169. The average pressure reading on hospital day four was 2.510 for the control group and 3.167 for the experimental group.

The mean increase for the control group of patients was 1.423 which was equal to 380 grams of tissue force. The mean increase for the experimental subjects was 1.998 which was equal to 460 grams of tissue force. Refer to Fig. 5, page ninety-two. From this sample, it can be seen that the control group or the mothers on the routine schedule had less increase in pressure by the fourth hospital day than the mothers feeding their infants on demand. The original prediction was that demand feeding would cause less engorgement or pressure by allowing more adequate and frequent emptying of milk from the breast.

The one-tailed t test was employed to determine significance. See Table XVI. The variances were 0.732 for the control group and 1.419 for the experimental group. Standard deviations were calculated from the variances and found to be 0.855 for the control group and 1.191 for the experimental group. The standard error of the difference of the means was 0.343. The value of t was computed at 1.676. To be significant at the .05 level, a value of 1.690 for t

TABLE XVI

COMPARISON OF BREAST PRESSURE READINGS WITH PRESSURE GAUGE BETWEEN MOTHERS ON SELF-DEMAND AND ON ROUTINE INFANT FEEDING SCHEDULES IN THE HOSPITAL

	Control	Experimental
Average Pressure Within 24 Hours of Delivery	1.087	1.169
Average Pressure on Hospital Day #4	2.510	3.167
Average Increase in Pressure Between Day #1 and Day #4	1.423	1.998
Variance	0.732	1.419
Standard Deviation	0.855	1.191
Standard Error of the Difference of the Means	0.343	
Value of *t*	1.676*	

* *t* = 1.676. To be significant at the .05 level *t* must equal 1.690 or greater using the one-tailed test. ($.05 < p < .10$) (Snedecor, *loc. cit.*)

is required. The null hypothesis must be accepted.

It was questioned as to whether mothers who nursed previously might have less engorgement than those who had never nursed an infant before. Therefore, the average increase in breast pressure for mothers who had previously nursed an infant was calculated for the control and experimental group separately and compared with the average increase in each respective group for those who had never breast fed before. The average increase in breast pressure for the control group among mothers who previously breast fed was 1.490 and among mothers who had not previously breast fed was 1.348. In the experimental group the average increase in breast pressure was 1.663 for mothers who had previously nursed and 2.477 for mothers who had not previously nursed. These results can be seen in Table XVII. Although the experimental subjects who had nursed previously had a lower average increase in breast pressure than those not previously nursing, the control subjects who had previously nursed had a higher average breast pressure than those who had not nursed an infant before. The results were statistically analyzed and the t test applied. (See Tables XVIII and XIX.)

In the control group the variance was 0.848 for the

TABLE XVII

AVERAGE INCREASE IN BREAST PRESSURE AS MEASURED BY PRESSURE GAUGE AMONG MOTHERS NOT PREVIOUSLY NURSING AND AMONG MOTHERS PREVIOUSLY NURSING IN THE CONTROL AND EXPERIMENTAL GROUPS

	Control	Experimental
Average Increase in Breast Pressure Among Mothers Who Previously Nursed	1.490	1.663
Average Increase in Breast Pressure Among Mothers Who Had Not Previously Nursed	1.348	2.477

TABLE XVIII

COMPARISON OF AVERAGE INCREASE IN BREAST PRESSURE AS MEASURED BY PRESSURE GAUGE BETWEEN CONTROL MOTHERS WHO HAD AND HAD NOT PREVIOUSLY NURSED AN INFANT

	Nursed an Infant Before	Had not Nursed an Infant Before
Mean	1.490	1.348
Variance	0.848	0.680
Standard Deviation	0.921	0.824
Standard Error of the Difference of the Means	0.403	
Value of *t*	0.352*	

* To be significant at the .05 level, a value of 1.740 for *t* using a one-tailed test is required. (Snedecor, *loc. cit.*)

TABLE XIX

COMPARISON OF AVERAGE INCREASE IN BREAST PRESSURE AS MEASURED BY PRESSURE GAUGE BETWEEN EXPERIMENTAL GROUP OF MOTHERS WHO HAD AND HAD NOT PREVIOUSLY NURSED AN INFANT

	Nursed an Infant Before	Had not Nursed an Infant Before
Mean	1.663	2.477
Variance	1.094	1.688
Standard Deviation	1.045	1.299
Standard Error of the Difference of the Means	0.569	
Value of t	1.431*	

*To be significant at the .05 level, a value of 1.753 for t is required. ($.05 < p < .10$) (Snedecor, loc. cit.) (One-tailed test.)

group who had nursed an infant before and 0.680 for the mothers who had not nursed an infant previously. Standard deviations were calculated from the variances and were 0.921 for the group nursing before and 0.824 for the group not previously nursing. The standard error of the difference of the means was 0.403. The value of $\underline{t}$ was 0.352. This was not significant since $\underline{t}$ must be 1.740 at the .05 level using a one-tailed test. The conclusion was that there was no significant difference and certainly no less degree of engorgement between control mothers who had nursed an infant before and those who had not nursed previously.

In analyzing the experimental group, the variance for mothers who had nursed an infant previously was 1.094 and the variance for those who had not breast fed before was 1.688. Standard deviations were calculated from the variances. For mothers nursing previously, the standard deviation was 1.045 and for mothers never nursing an infant before the standard deviation was 1.299. The standard error of the difference of the means was 0.569. The computed value of $\underline{t}$ was 1.431. To be significant at the .05 level using a one-tailed test, a value of 1.753 for $\underline{t}$ is required. It was concluded that there was no significantly less degree of engorgement between the experimental group of mothers who

had previously breast fed and those who had not nursed previously.

From this sample it was concluded that whether or not a woman had nursed previously did not affect breast pressure during the engorgement phase of lactation.

Conclusion. The tested hypothesis, 1, was accepted at the .05 level of confidence using the one-tailed t test.

Hypothesis Derived from Findings of the Study. The experimenter, from the clinical investigation, was able to offer a somewhat different idea regarding breast engorgement than was found in the literature. The following is a discussion of the experimenter's concept.

Each individual patient may possess a different degree of breast tissue elasticity. Greater tissue elasticity would allow for more expansion with subsequent softness whereas less tissue elasticity would lead to less expansion with increasing hardness. Capacity of the breast may thus differ.

In addition, some patients have a higher degree of breast tissue turgor normally so that the normal must be compared to the engorged breast. What may seem to be a severely engorged breast in one patient may actually be no

more engorged than one for another patient who normally had less tissue resistance and when engorged did not become as hard to the sense of touch.

It is known that the amount of gland tissue and vascularity varies in each breast and for each individual patient.[3] Psychological factors may also play a part in the degree of engorgement.[4] With this combination of variables--degree of overlying breast tissue elasticity, normal tissue turgor, amount of gland tissue and vascularity--it is apparent why breast engorgement has been difficult to assess objectively. The instrument, it was felt, did take all of these variables into consideration and gave an objective reading.

Therefore, from the results of this study it might be asked if the frequency of feeding or the adequacy with which the breast is emptied really has as much influence on the degree of pressure present during the engorgement phase as has been supposed. Only one study in the reviewed literature

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[3]Robert L. Egan, Mammography (Springfield, Illinois: Charles C. Thomas, Publisher, 1964), p. 17.

[4]Arthur C. Guyton, Textbook of Medical Physiology (second edition; Philadelphia: W.B. Saunders Company, 1961), p. 1112.

was found which actually made an investigation of the relation of engorgement to amount of milk retained in the breast. This study by the Newtons, however, utilized a somewhat subjective method for assessing the degree of engorgement, that of clinical estimation.[5]

The concept furthered by this author is that degree of engorgement will vary according to the previously mentioned variables--psychological factors, degree of tissue elasticity, amount of normal tissue turgor, and amount of gland tissue and vascularity, and not according to the type of feeding schedule or number of previous infants nursed.

Incidence of Cracked Nipples

Null Hypothesis 2

Breast feeding mothers nursing their infants on a flexible schedule will not have a significantly less number of cracked nipples than those on a rigid infant feeding schedule.

Report of the Findings. Statistical tests to determine significance between frequency of cracked nipples in

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[5]Michael Newton and Niles Rumely Newton, "Postpartum Engorgement of the Breast," American Journal of Obstetrics and Gynecology, 61:664-667, March 1951.

the demand and rigid feeding groups were not employed since the sample size and incidence of cracked nipples was small. Among the seventeen mothers in the experimental group, there were no nipple lesions or fissures. Two mothers of the nineteen in the control group manifested nipple lesions. One mother in the control group was excluded from this measurement since she discontinued nursing on the second day. Both mothers each had one cracked nipple which was evidenced by bleeding and slight inflammation. One occurred on the third hospital day and was healed by the time of discharge. The other patient's sign of a fissured nipple occurred on the day of discharge. The method of treatment for the nipple lesions for both mothers was the application of an ointment. The occurrence of cracked nipples for the control group was 10.5 per cent compared with no incidence in the experimental group.

The null hypothesis regarding the incidence of cracked nipples among the control and experimental group can be neither accepted nor rejected due to inability to apply the findings to a test of statistical analysis. Although the results did not yield to statistical tests it should be noted that the incidence of cracked nipples occurred in the control or routine feeding group. Results can be seen in

Table XX.

Conclusion. Breast feeding mothers nursing their infants on a flexible feeding schedule had a lower percentage incidence of cracked nipples than those on a rigid schedule.

Discontinuation of Breast Feeding During the Hospital Stay

Null Hypothesis 3

There will not be a significantly less frequency of discontinuation of nursing during the hospital period between mothers on self-demand infant feeding schedules and those on routine hospital schedules for feeding infants.

Report of the Findings. The results were described regarding the frequency of discontinuation of nursing in demand and routine feeding groups. Significance was not determined by statistical tests since the sample size was small and the incidence of discontinuation of breast feeding was not large. All mothers in the experimental group who declared their intentions to breast feed and began nursing, continued to do so during the hospital period. Two mothers in the control or routine feeding group discontinued nursing after declaring their intentions to nurse and after actual breast feeding had been initiated. Both mothers

TABLE XX

RATIO AND PERCENTAGE OF CRACKED NIPPLES TO TOTAL NUMBER OF BREAST FEEDING MOTHERS IN DEMAND AND ROUTINE FEEDING GROUPS

	Control (Routine)	Experimental (Demand)
Fissured or Cracked Nipples	2/19 (10.5%)	0/17 (0.0%)

discontinuing breast feeding did so as an elective measure as there were no medical indications. Neither mother had breast fed an infant previously. One mother discontinued nursing on the second hospital day so was included for the calculation of this measurement, but excluded from the other five areas of assessment. The other mother did not decide to discontinue nursing until the afternoon of the fifth hospital day after which time the other five areas of measurement were already accurately calculated, therefore this mother and infant pair were included in the study with regard to the other areas of measurement. Thus in the other five measurements of the dependent variable nineteen mother and infant pairs comprised the control group and seventeen pairs comprised the experimental group.

The null hypothesis concerning the incidence of discontinuing breast feeding during the hospital period could not be accepted or rejected since statistical tests to determine significance could not be applied. It was noted, however, that the discontinuation of nursing occurred in the control group, whereas no discontinuation of breast feeding occurred in the experimental group. These results cannot be generalized beyond the confines of this study since the sample size was small.

Results can be seen in the graph as illustrated in Figure 6. There was a 10 per cent incidence of discontinuation of nursing by the fifth hospital day in the control group. On the fifth hospital day 90 per cent of the control or rigid group were still breast feeding compared to 100 per cent in the experimental or demand group.

Conclusion. There was a lower percentage incidence of discontinuation of nursing during the hospital period among mothers on self-demand infant feeding schedules than among those on routine hospital schedules for feeding infants.

Incidence of Complementary Feeding in the Hospital

Null Hypothesis 4

There will not be a significantly less incidence of complementary or supplementary feeding during the hospital period among infants on flexible feeding schedules than among infants on a routine hospital schedule for feeding.

Report of the Findings. All feedings that the infants received were recorded on a worksheet by nursery personnel assigned to the infants. The time, type of feeding, and amount taken by the infant were all recorded.

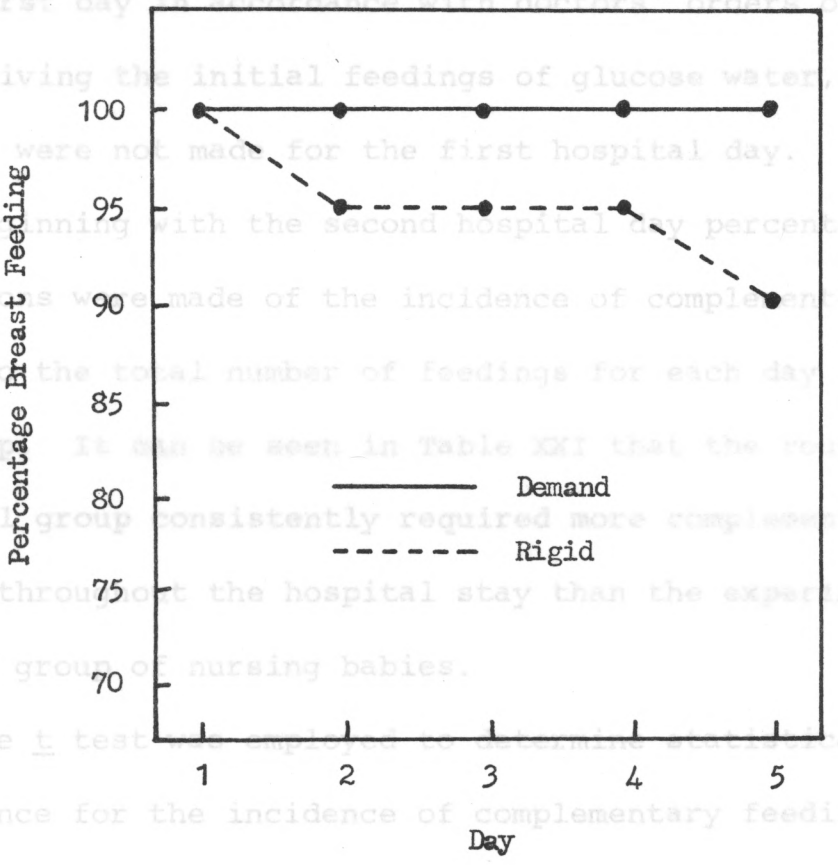


FIGURE 6

PERCENTAGE COMPARISON OF DEMAND AND RIGID FEEDING SCHEDULES IN INFANTS STARTED AND DISCHARGED FROM THE HOSPITAL ON BREAST FEEDING

The number of complementary feedings and the number of total feedings for each day for every infant was figured first on a ratio basis and then calculated as a percentage. Since all infants in the study either did not begin feeding on the first day in accordance with doctors' orders or they were receiving the initial feedings of glucose water, calculations were not made for the first hospital day.

Beginning with the second hospital day percentage determinations were made of the incidence of complementary feeding to the total number of feedings for each day for each group. It can be seen in Table XXI that the routine or control group consistently required more complementary feedings throughout the hospital stay than the experimental or demand group of nursing babies.

The t test was employed to determine statistical significance for the incidence of complementary feeding between the control and experimental group for each day separately, two through five, and for the total for the four days. (Refer to Table XXII.)

Starting with the second day, the routine group had a frequency of 99.12 per cent and the demand group 92.388 per cent of complementary feedings. Calculated from the variances, the standard deviation of the control group was 3.831

TABLE XXI

PERCENTAGE INCIDENCE OF COMPLEMENTARY AND SUPPLEMENTARY FEEDINGS TO TOTAL NUMBER OF FEEDINGS PER DAY IN NEWBORNS FED ON TWO REGIMES--DEMAND AND ROUTINE

	Day 2	Day 3	Day 4	Day 5	Average for Days 2 Through 5
Routine Group	99.1%	93.0%	29.2%	16.7%	59.5%
Demand Group	92.4%	78.4%	12.3%	3.9%	46.8%

TABLE XXII

COMPARISON OF THE INCIDENCE OF COMPLEMENTARY FEEDINGS BETWEEN CONTROL AND EXPERIMENTAL GROUPS

	Day				
	2	3	4	5	2 through 5
$\bar{C}$ (Control)	99.12%	92.984%	29.194%	16.68%	59.516%
$\bar{E}$ (Experimental)	92.388%	78.400%	12.329%	3.92%	46.753%
S_c	3.831	12.800	24.546	22.229	10.849
S_e	9.621	22.498	17.339	16.177	9.507
$S_{\bar{C}-\bar{E}}$	2.392	6.019	7.165	6.550	3.419
t	2.814*	2.423*	2.354*	1.948*	3.733*
p	.0025<p<.005	.005< p< .0125	.005< p< .0125	.025 <p< .05	p< .0005

*To be significant at the .05 level, a value of 1.690 is required for t using a one-tailed test. (Snedecor, loc. cit.)

and 9.621 for the experimental group. The standard error of the difference of the means was 2.392. The computed value of t was 2.814. Using a one-tailed test, this placed the significance at better than the .005 level.

On the third day, 92.984 per cent of the control group and 78.400 per cent of the experimental group required complementary feedings. The standard deviations determined from the variances were 12.80 for the control group and 22.498 for the experimental group. The standard error of the difference of the means was 6.019. The value of t obtained was 2.423. The difference between the two groups was significant at better than the .0125 level of confidence using the one-tailed test.

On the fourth day, 29.194 per cent of the control infants contrasted to 12.329 per cent of the experimental infants received complementary feedings. The standard deviations calculated from the variances were 24.546 and 17.339 for the control and experimental groups respectively. The standard error of the difference of the means was 7.165. When the t test was applied a value of 2.354 was obtained. Using the one-tailed test, this placed the significance at $.005 < p < .0125$.

By the fifth day 16.68 per cent of the routine group

and only 3.92 per cent of the demand group were taking complementary feedings. From the variances, the standard deviations were determined at 22.229 for the control group and 16.177 for the experimental group. The standard error of the difference of the means was 6.550. The computed value of t was 1.948. Using the one-tailed test, this value of t was significant at the .05 level.

In considering the total average percentage incidence of complementary feeding for the second through the fifth day, the control group had a frequency of 59.516 per cent and the experimental group 46.753 per cent. The standard deviations calculated from the variances were 10.849 for the control group and 9.507 for the experimental group. The standard error of the difference of the means was 3.419. The computed value of t was 3.733. This value was significant at better than the .0005 level using the one-tailed test.

Conclusion. The t test was applied to determine statistical significance of the total average percentage incidence of complementary feeding for the second through the fifth day for the control and experimental groups. The value of t obtained was 3.733 which was significant at better than the .0005 level of confidence.

In addition, the t test was employed to determine significance between the control and experimental groups on the incidence of complementary feeding for each day separately, two through five. All values of t for each of the days were significant at the .05 level or better.

The tested hypothesis, 4, is rejected.

Weight Losses and Gains of Infants

Null Hypothesis 5

a. Breast fed infants placed on demand feedings in the hospital will not have a significantly less weight loss during that period than those on a routine schedule.

b. Breast fed infants placed on self-regulatory feedings in the hospital will not have a significantly greater regain of weight during that period than those on a rigid schedule.

Report of the Findings. The daily weights for each of the infants in the control and experimental groups were recorded from the nursery worksheet. Weights for the infants were routinely taken at the same period of each day.

Two determinations were required for analysis. The first required calculating the weight loss on the fifth day in relation to the birth weight of each infant. None of the

infants studied had regained their birth weight by the time of discharge so all had losses in relation to the birth weight. A percentage of weight loss in ounces to original birth weight in ounces was calculated. The percentages for each group were added and a mean per cent weight loss calculated for the control and experimental groups. The mean weight loss for the control group was 7.583 per cent and for the experimental group 6.877 per cent. The standard deviation calculated from the variance for the control group was 2.214 and for the experimental group 2.704. The standard error of the difference of the means was 0.820. Calculation of $\underline{t}$ gave a value of 0.860. To be significant at the .05 level $\underline{t}$ must equal or exceed 1.690. The value of $\underline{t}$ obtained was placed at $.10 < p < .20$. (See Table XXIII.)

The second calculation required computing the differences between the lowest weight of the infant and the weight gain by the fifth hospital day. This gain was recorded on a percentage basis in relation to the birth weight. Four newborns out of nineteen in the control group and nine out of seventeen in the experimental group regained some weight during the five hospital days. This was representative of 21 per cent in the control group and 53 per cent in the experimental group regaining weight by the fifth day. The

TABLE XXIII

COMPARISON OF WEIGHT LOSS IN RELATION TO BIRTH WEIGHT BETWEEN CONTROL AND EXPERIMENTAL GROUPS OF INFANTS

	Control	Experimental
Mean (Percentage Weight Loss to Birth Weight in Ounces)	7.583%	6.877%
Standard Deviation	2.214	2.704
Standard Error of the difference of the means	0.820	
Value of t	0.860*	
p	$.10 < p < .20$	

*To be significant at the .05 level, a value of 1.690 for t is required. (Snedecor, loc. cit.)
(Using a one-tailed test.)

nine infants in the experimental group who regained weight, gained a total of sixteen ounces together. The four infants in the control group gained 4.5 ounces altogether. The mean per cent of weight regained in the control group was .197 and in the experimental group was .808 per cent. The standard deviation calculated from the variance for the control group was 0.487 and for the experimental group was 1.054. The standard error of the difference of the means was 0.269. The value of t was calculated at 2.272. This placed the results significant at better than the .025 level. (Refer to Table XXIV.) The findings in percentages for infant weight gains and losses are presented in Table XXV.

Conclusion. The tested hypothesis, 5a. was accepted at the .05 level of confidence.

The tested hypothesis, 5b. was rejected at the .05 level of confidence.

Nursing Activity While at the Breast

Null Hypothesis 6

Infants on self-demand feedings during the hospital period will not be significantly more active at sucking while at the breast, yet not ravenous, than infants on a

TABLE XXIV

COMPARISON OF WEIGHT REGAINED IN RELATION TO BIRTH WEIGHT BETWEEN CONTROL AND EXPERIMENTAL GROUPS OF INFANTS

	Control	Experimental
Mean (Percentage Weight Oz. Regain to Birth Weight)	.197%	.808%
Standard Deviation	.487	1.054
Standard Error of the Difference of the Means	0.269	
Value of *t*	2.272*	
p	.0125 < p < .025	

*To be significant at the .05 level, a value of 1.690 for *t* is required. (Snedecor, *loc. cit.*) (Using a one-tailed test.)

TABLE XXV

WEIGHT LOSSES AND GAINS IN RELATION TO BIRTH WEIGHT OF INFANTS ON TWO TYPES OF FEEDING SCHEDULE--DEMAND AND ROUTINE

	Control (Routine)	Experimental (Demand)
Mean Percentage of Weight Loss Since Birth in Ounces	7.583%	6.877%
Percentage of Infants Regaining Weight During Hospital Period	21.0%	53.0%
Mean Percentage of Weight Gain Since Lowest Point in Ounces	.197%	.808%

strict hospital feeding schedule.

Report of the Findings. The opinionnaire devised to evaluate the infant's sucking activity was utilized by the mothers in both groups over a twenty-four hour period beginning approximately at the 9 A.M. feedings on the fourth day and ending at the same period of time on the fifth day. The tallied responses of the mothers for the control and experimental groups are presented in Table XXVI. Percentage of responses for each category are also given.

Under category (1), "infant too sleepy to nurse," there were no responses for the experimental group, and six responses for the control group, an incidence of 0 per cent and 4.5 per cent respectively. There were no responses in either group to category (2), "infant awake, but did not nurse." In category (3), "infant somewhat sleepy, nursed slightly, took 20 or less sucks with coaxing," both groups each had four responses which gave an incidence of 3.0 per cent for the control group and 3.2 per cent for the experimental group. Under category (4), "infant nursed fairly well, took more than 20 sucks, some coaxing necessary," there were thirteen responses in the demand group or 10.5 per cent and twenty-five responses in the routine group which

TABLE XXVI

RESPONSES OF TWO GROUPS OF BREAST FEEDING MOTHERS ON DEMAND OR RIGID FEEDING SCHEDULES AS TO SUCKING ACTIVITY OF THEIR INFANTS OVER TWENTY-FOUR HOUR PERIOD

	Number of Responses	
Categories	Control (Rigid)	Experimental (Demand)
1) Infant too sleepy to nurse	6 (4.5%)	0 (0.0%)
2) Infant awake, but did not nurse	0 (0.0%)	0 (0.0%)
3) Infant somewhat sleepy, nursed slightly, took 20 or less sucks with coaxing	4 (3.0%)	4 (3.2%)
4) Infant nursed fairly well, took more than 20 sucks, some coaxing necessary	25 (18.8%)	13 (10.5%)
5) Infant nursed quite well, vigorous sucking, satisfied after taken from breast	75 (56.4%)	99 (79.8%)
6) Infant ravenous, continued desire to suck after taken from breast	23 (17.3%)	8 (6.5%)
Totals	133	124

was an incidence of 18.8 per cent. To category (5), "infant nursed quite well, vigorous sucking, satisfied after taken from breast," the control group gave seventy-five responses which was an incidence of 56.4 per cent, and the experimental group, ninety-nine responses, an incidence of 79.8 per cent. In category (6), there were twenty-three responses in the control group and eight responses in the experimental group. This corresponded to 17.3 per cent and 6.5 per cent respectively. Category (6) stated: "infant ravenous, continued desire to suck after taken from breast."

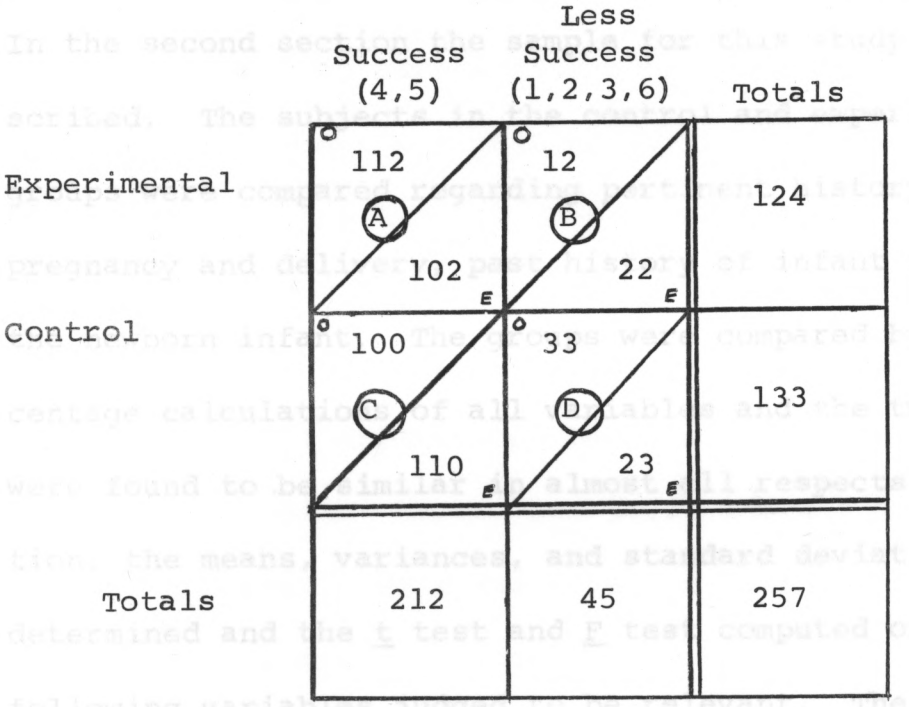
As was previously described in the chapter on methodology, categories (4) and (5) were denoted as success categories and categories (1), (2), (3), and (6) were grouped together as less successful nursing activity.

Chi square method of analysis was employed to determine significance between the two groups of infants. See Table XXVII. The value of χ^2 when calculated was 10.78. To be significant at the 5 per cent level of confidence the value of χ^2 must be 3.84 or greater with one degree of freedom. The computed value of χ^2, 10.78, was placed at $.001 < p < .01$.

Conclusion. Hypothesis 6 after being tested was rejected at the .05 level of confidence.

TABLE XXVII

CHI SQUARE ANALYSIS OF INFANTS' NURSING ACTIVITY WHILE AT THE BREAST



Cell	O	E	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$		
A	112	102	10	100	$\frac{100}{102}$	=	.9804
B	12	22	-10	100	$\frac{100}{22}$	=	4.5455
C	100	110	-10	100	$\frac{100}{110}$	=	.9091
D	33	23	10	100	$\frac{100}{23}$	=	4.3478
					χ^2	=	10.7828*

(* $.001 < p < .01$) Ferguson, op. cit., p. 309.

IV. SUMMARY

This chapter has presented the analysis of data obtained in the study. The first section was an introduction. In the second section the sample for this study was described. The subjects in the control and experimental groups were compared regarding pertinent history, present pregnancy and delivery, past history of infant feeding, and the newborn infant. The groups were compared by making percentage calculations of all variables and the two groups were found to be similar in almost all respects. In addition, the means, variances, and standard deviations were determined and the t test and F test computed on the three following variables judged to be relevant. The differences were statistically not significant at the .05 level of confidence using the two-tailed test. The three variables were the ages of the mothers, the average duration of breast feeding for mothers who had previously nursed an infant, and the newborns' birth weights. Since the variables compared were similar for the two groups, it must be concluded that they made negligible contributions to the outcome of the study.

The next section included a report of the findings of the investigation and an analysis of the data. The

hypotheses When tested for the selected areas of measurements of the dependent variable were accepted or rejected at the .05 level of confidence using a one-tailed test. Findings:

1. By means of the t test it was found that nursing mothers who were self-demand feeding their infants did not have a significantly less degree of engorgement of the breasts than nursing mothers on a routine schedule for infant feeding.
   a. There was not a significantly less degree of breast engorgement between mothers who had nursed an infant before and those who had not previously nursed. This was true for both the control and experimental groups.
2. There was a higher percentage incidence of cracked nipples during the hospital period in the control or routine group of breast feeding mothers than in the experimental or demand group.
3. There was a higher percentage of mothers discontinuing breast feeding during the hospital period in the control group on routine infant feedings than in the experimental group on self-demand infant feedings.
4. As determined by the t test, there was a significantly lower incidence of complementary feeding during

the hospital period among infants in the experimental or demand group than among those in the control or routine group.

5. When the t test was computed:
   a. There was no significantly less weight loss during the hospital period between the breast fed infants on a demand schedule and those on a routine schedule.
   b. Nursing infants on self-regulatory feedings in the hospital had a significantly greater regain of weight during that period than those on a rigid schedule.
6. By chi square method of analysis it was determined that infants on self-demand feedings during the hospital period were significantly more active at sucking while at the breast, yet not ravenous, than infants on a strict hospital schedule.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The study was designed to discover if mothers and newborns on self-demand infant feeding were more successful in establishing breast feeding than a comparable group of mothers and infants on scheduled feedings. The need for the study arose from the question on whether or not the flexible feeding schedule would help to promote a successful initiation of breast feeding during the hospital period.

The purposes of this study were (1) to determine select responses of newborn infants to self-demand feeding; (2) to determine specific effects of self-demand feeding on maternal lactation; (3) to provide information on self-demand feeding in the hospital; (4) to contribute data which may yield information to further nursing knowledge; and (5) to stimulate research on the effects of self-demand feeding in the hospital.

A review of the literature was undertaken to provide an understanding of the purposes, advantages, and

disadvantages of self-demand infant feeding. The literature surveyed supported the concept of self-demand infant feeding. Few studies of newborn self-demand feeding in the hospital were found which indicated a need for more research in this area.

A pressure gauge instrument was developed, pretested, and used in this study to measure objectively the degree of breast engorgement present in the nursing mothers. A data form was compiled for recording all data obtained in the study.

The experimental method was used to conduct the study utilizing the parallel-group technique. The independent variable or self-demand infant feeding was introduced to the experimental group of mothers and infants while the control group utilized the pre-existing hospital scheduled feeding plan. Data were collected on six selected factors which were measures of the dependent variable, success at breast feeding. These factors were (1) degree of breast engorgement, (2) incidence of cracked nipples, (3) incidence of continuation of breast feeding during the hospital stay, (4) need for complementary feeding of the newborn, (5) weight loss and weight regain of the infants, and (6) sucking activity of the infant while at the breast.

The control and experimental groups of mothers and infants were described and variables compared by calculation of percentages. Several variables judged to be relevant were statistically analyzed. Since both groups were similar, it was concluded that the variables made negligible contributions to the outcome of the study.

The numerical data obtained in the study were analyzed by statistical methods. Significance was placed at the .05 level of confidence. The analysis of data for the control and experimental groups revealed (1) no statistically significant difference in degree of breast engorgement, (2) no statistically significant difference in degree of breast engorgement between mothers who had not nursed an infant before and those who had previously nursed, (3) a higher percentage incidence of cracked nipples in the control group, (4) a higher percentage incidence of continuation of breast feeding in the experimental group, (5) a statistically significantly higher incidence of complementary feeding in the control group of infants ($p < .0005$), (6) no statistically significant difference in weight loss of the infants, (7) a significantly higher regain of weight among the experimental infants ($.0125 < p < .025$), and (8) significantly more

successful nursing activity of infants while at the breast among the experimental group, ($.001 < p < .01$).

II. CONCLUSIONS

The following conclusions were made on the basis of the data obtained in this investigation.

1. Nursing mothers who self-demand fed their infants did not have significantly less breast engorgement than nursing mothers on a routine schedule for infant feeding.
2. Breast feeding mothers who had nursed an infant before did not have significantly less breast engorgement than those who had not nursed previously.
3. Breast feeding mothers nursing their infants on a flexible schedule had a lower percentage incidence of cracked nipples than those on a rigid schedule.
4. There was a lower percentage incidence of discontinuation of nursing during the hospital period among mothers on self-demand infant feeding schedules than among those on routine hospital schedules for feeding infants.
5. There was a significantly lower incidence of complementary feeding during the hospital period among

infants on flexible feeding schedules than among infants on a routine hospital schedule for feeding.

6. Breast fed infants placed on demand feedings in the hospital did not have a significantly less weight loss during that period than those on a routine schedule.
7. Breast fed infants placed on self-regulatory feedings in the hospital had a significantly greater regain in weight during that period than those on a rigid schedule.
8. Infants on self-demand feedings during the hospital period manifested significantly more successful nursing activity while at the breast than infants on a strict hospital schedule.

It may thus be concluded that, in general, nursing mothers and infants on a flexible infant feeding schedule were more successful in the early attempts at breast feeding than those on the routine schedule.

III. RECOMMENDATIONS

As an outgrowth of this study the following recommendations were made:

1. That a study employing the same research design and

methods as this one, be done with a larger sample and over a longer period of time.

2. That a more extensive investigation be undertaken with the pressure gauge instrument testing breast pressure at frequent intervals throughout the day during the prelactation phase and during the engorgement phase of lactation to gain better understanding of breast physiology.
3. That a study be undertaken to determine the effects of the self-demand infant feeding schedule on nursing service personnel in the nursery and postpartum units of the maternity division of a hospital.
4. That a follow-up study based on an investigation similar to this one be undertaken to determine the relation of the type of feeding schedule to success in breast feeding after the mother and infant leave the hospital for home. (Continuation of breast feeding, incidence of complementary feeding, incidence of cracked nipples.)

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Adler, Henry L. and Edward B. Roessler. Introduction to Probability and Statistics. San Francisco: W.H. Freeman and Company, 1960.

Ausubel, David P. Theory and Problems of Child Development. New York: Grune & Stratton, Inc., 1958.

Barr, Arvil S., Robert A. Davis, and Palmer O. Johnson. Educational Research and Appraisal. Philadelphia: J.B. Lippincott Company, 1953.

Bethel, John P. (ed.). Webster's New Collegiate Dictionary. Springfield, Massachusetts: G. & C. Merriam Co., Publishers, 1958.

Bookmiller, Mae M., and George L. Bowen. Textbook of Obstetrics and Obstetric Nursing. Fourth edition. Philadelphia: W.B. Saunders Company, 1963.

Brody, Sylvia. Patterns of Mothering. New York: International Universities Press, Inc., 1956.

Bross, Irwin D.J. Design for Decision. New York: The Macmillan Company, 1963.

Campbell, William Giles. Form and Style in Thesis Writing. Boston: Houghton Mifflin Company, 1954.

Cutler, Max. Tumors of the Breast. Philadelphia: J.B. Lippincott Company, 1962.

Eastman, Nicholson, and Louis M. Hellman. Williams Obstetrics. Twelfth edition. New York: Appleton-Century-Crofts, Inc., 1961.

Edwards, Allen L. Statistical Methods for the Behavioral Sciences. New York: Rinehart & Company, Inc., 1956.

Egan, Robert L. Mammography. Springfield, Illinois: Charles C. Thomas, Publisher, 1964.

Ferguson, George A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, Inc., 1959.

Fitzpatrick, Elise, and Nicholson J. Eastman. Zabriskie's Obstetrics for Nurses. Tenth edition. Philadelphia: J.B. Lippincott Company, 1960.

Gesell, Arnold and Frances L. Ilg. Child Development. New York: Harper & Brothers, 1949.

Good, Carter V., A.S. Barr, and Douglas E. Scates. The Methodology of Educational Research. New York: D. Appleton-Century Company, 1936.

Guyton, Arthur C. Textbook of Medical Physiology. Second edition. Philadelphia: W.B. Saunders Company, 1961.

Illingworth, Ronald S. The Normal Child. Boston: Little, Brown & Company, 1953.

Ingleby, Helen, and Jacob Gershon-Cohen. Comparative Anatomy, Pathology and Roentgenology of the Breast. Philadelphia: University of Pennsylvania Press, 1960.

Jorstad, Louis H. and Meredith Jorstad Payne. Surgery of the Breast. St. Louis: The C.V. Mosby Company, 1964.

Langley, L.L., E. Cheraskin, and Ruth Sleeper. Dynamic Anatomy and Physiology. New York: McGraw-Hill Book Company, Inc., 1958.

Lewison, Edward F. Breast Cancer and its Diagnosis and Treatment. Baltimore: The Williams & Wilkins Company, 1955.

Mainland, Donald. Elementary Medical Statistics. Second edition. Philadelphia: W.B. Saunders Company, 1963.

Nelson, Waldo E. Textbook of Pediatrics. Philadelphia: W.B. Saunders Co., 1959.

Paterson, Donald, and John Ferguson McCreary. Pediatrics. Philadelphia: J.B. Lippincott Co., 1956.

Pryor, Karen. Nursing Your Baby. New York: Harper & Row, Publishers, 1963.

Rand, Winifred, Mary E. Sweeny, and E. Lee Vincent. Growth and Development of the Young Child. Fourth edition. Philadelphia: W.B. Saunders Company, 1946.

Ribble, Margaret A. The Rights of Infants. New York: Columbia University Press, 1943.

Rob, Charles, and Rodney Smith (ed.). Clinical Surgery, General Principles and Breast. Washington, D.C.: Butterworth & Co., 1964.

Rummel, J. Francis. An Introduction to Research Procedures in Education. New York: Harper & Brothers, Publishers, 1958.

Selltiz, Claire, et al. Research Methods in Social Relations. Chicago: Holt, Rinehart and Winston, 1964.

Smith, G. Milton. A Simplified Guide to Statistics for Psychology and Education. Third edition. New York: Holt, Rinehart and Winston, Inc., 1964.

Snedecor, George W. Statistical Methods. Fifth edition. Ames, Iowa: Iowa State College Press, 1956.

Spiro, Melford E. Children of the Kibbutz. Cambridge: Harvard University Press, 1958.

Spock, Benjamin. The Common Sense Book of Baby and Child Care. New York: Duell, Sloan, and Pearce, 1946.

Sugar, H. Saul. The Glaucomas. Second edition. New York: Hoeber & Harper, 1957.

Taber, Clarence Wilbur. Taber's Cyclopedic Medical Dictionary. Eighth edition. Philadelphia: F.A. Davis Company, 1958.

Tompson, Marian, et al. (ed.). The Womanly Art of Breastfeeding. La Leche League International: Interstate Printers and Publishers, Inc., 1963.

Townsend, John C. Introduction to Experimental Method. New York: McGraw-Hill Book Company, Inc., 1953.

Weinstein, Paul and Julius Foldes. Glaucoma Pathology and Therapy. St. Louis: The C.V. Mosby Company, 1953.

B. PERIODICALS

Bakwin, Harry. "Feeding Program for Infants," Federation Proceedings, 23:66-68, January-February, 1964.

Gans, Bruno. "Infant Feeding--Ancient and Modern," Nursing Times, 59:207-209, February 15, 1963.

Horton, Frank H., Lula O. Lubchenco, and Harry H. Gordon. "Self-Regulatory Feeding in a Premature Nursery," Yale Journal of Biology and Medicine, 24:263-272, February, 1952.

Hytten, F.E. "Clinical and Chemical Studies in Human Lactation--The Functional Capacity of the Breast," British Medical Journal, 1:912-915, April 17, 1954.

Illingworth, R.S., and D.G.H. Stone. "Self-Demand Feeding in a Maternity Unit," The Lancet, 1:683-687, April 5, 1952.

Ingleby, Helen. "Changes in Breast Volume in a Group of Normal Young Women," Bulletin of the International Association of Medical Museums, 29:87-92, April, 1949.

Jackson, Edith B. "Do You Really Understand 'Self-Demand'?," Reprint from Baby Talk Magazine, [n.d.].

_____, Louise C. Wilkin, and Harry Auerbach. "Statistical Report on Incidence and Duration of Breast Feeding in Relation to Personal-Social and Hospital Maternity Factors," Pediatrics, 17:700-713, May, 1956.

Kron, Reuben E., Marvin Stein, and Katherine E. Goddard. "A Method of Measuring Sucking Behavior of Newborn Infants," Psychosomatic Medicine, 25:181-191, March-April, 1963.

Markey, Oscar B. "The Human Breast in the First Year of Life," The Quarterly Journal of Child Behavior, 2:241, April-June, 1950.

Newton, Michael and Niles Rumely Newton. "The Normal Course and Management of Lactation," Clinical Obstetrics and Gynecology 5:44-61, March, 1962.

_____. "Postpartum Engorgement of the Breast," American Journal of Obstetrics and Gynecology, 61:664-667, March, 1951.

Nyhan, William L. and Morris A. Wessel. "Neonatal Growth in Weight of Normal Infants on Four Different Feeding Regimens," Pediatrics, 14:442-447, November, 1954.

O'Keefe, Margaret. "Breast Feeding--Advice from a Nurse-Mother," American Journal of Nursing, 63:61-64, December, 1963.

Olmsted, Richard W. and Edith B. Jackson. "Self-Demand Feeding in the First Week of Life," Pediatrics, 6:396-401, September, 1950.

Riker, Audrey Palm. "Successful Breast Feeding," American Journal of Nursing, 60:1443-1446, October, 1960.

Sarto, Sister Joseph. "Breast Feeding--Preparation, Practice, and Professional Help," American Journal of Nursing, 63:58-60, December, 1963.

Simsarian, Frances P., and P.A. McLendon. "Feeding Behavior of an Infant During the First Twelve Weeks of Life on a Self-Demand Schedule," Journal of Pediatrics, 20:93-103, January, 1942.

_____. "Further Records of the Self-Demand Schedule in Infant Feeding," Journal of Pediatrics, 27:109-114, August, 1945.

Smith, Christine S. "Demand Feeding in the Newborn Nursery," Nursing Outlook, 6:514-515, September, 1958.

Trainham, Genevieve, Grace Pilafian, and Ruth M. Kraft. "A Case History of Twins Breast Fed on a Self-Demand Regime," Journal of Pediatrics, 27:97-108, August, 1945.

Waller, Harold. "The Early Failure of Breast Feeding," Archives of Disease in Childhood, 21:1-12, March, 1946.

Walser, Howard C. "Breast Feeding From the Obstetrician's Viewpoint," Psychosomatic Medicine, 7:174, May, 1945.

C. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

Fries, Margaret E. "The Importance of Mother and Baby Rooming Together," Problems of Early Infancy, pp. 54-56. Transactions of the First Conference, March 3-4, 1947. New York: Josiah Macy, Jr. Foundation, 1951.

D. UNPUBLISHED MATERIALS

Newton, Michael. Personal Letter Written on March 1, 1965; University of Mississippi Medical Center, 2500 North State Street, Jackson, Mississippi, 39216.

Salaman, Roger K. "Pressure Gauge Model P-100," Paper written at Mesa Instruments, 421 South 80th Street, Boulder, Colorado, March 30, 1965.

APPENDIX A

Form Used to Record Data for Preliminary Study with Pressure Gauge

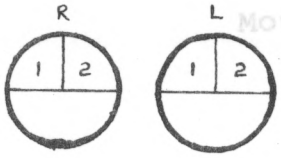
BREAST MEASUREMENTS

		Right Breast				Left Breast			
		Quadrants 1		2		1		2	
Depth	Disk Size	Day 1	Day 3	Day 1	Day 3	Day 1	Day 3	Day 1	Day 3
5 mm.	0.3 cm.	0-	0-	0-	0-	0-	0-	0-	0-
	1.2 cm.	0-	0-	0-	0-	0-	0-	0-	0-
	2.4 cm.	0-	8.0	0-	7.2	0-	6.0	0-	6.5
10 mm. (1 cm.)	0.3 cm.	0-	0-	0-	0-	0-	0-	0-	0-
	1.2 cm.	0-	0-	0-	0-	0-	0-	0-	0-
	2.4 cm.	2.0	8.0	0+	7.2	4.0	6.5	0+	3.5
15 mm. (1.5 cm.)	0.3 cm.	0-	2.0	0-	1.7	0-	0-	0-	0-
	1.2 cm.	0-	8.0	0-	7.5	0-	6.0	0-	6.0
	2.4 cm.	8.0	9.0	5.2	7.5	8.0	9.0	4.0	7.5

Time taken after Nursing: Day 1 3-18-65 (2 P.M.)

Day 3 3-21-65 (2 P.M.)

(12 hours after nursing from (R) breast.
½ hour after nursing from (L) breast.)



Patient's Name Doe, Mrs. Helen Chart No. 333333

Age 17 Gravida † Para †

Delivery Date 3-18-66 Time 9:36 (A.M.) P.M.

Complications Prolonged 2nd Stage Labor (1 hr. - 36 min.)

Present Hospital Room Arrangement:
Private
Semi-private
3 Bed Room
4 Bed Room
Rooming In ✓

Number of Previous Infants Breast Fed 0

Infant:

Sex Female Birth Weight 7 lbs. - 8⅔ ozs. Chart No. 111111

Apgar Rating 8 at one minute

Condition Apparently good

Complications Fetal - Knot in cord - amniotic fluid meconium stained.

Neonatal - None.

APPENDIX B

Form Used to Record Data About Mother and Infant

DATA ON MOTHER AND INFANT No._____

PATIENT'S HISTORY

Patient's Name_____ Patient's Chart No._____

Age_____ Race_____ Marital Status: S M W D Sep.

Religion_____ Culture_____

Education Completed_____

Husband's Occupation_____

Patient's Occupation_____

Family's Economic Status_____ (Income per annum)

PRESENT PREGNANCY AND DELIVERY

Gravida_____ Para_____ Length of Prenatal Care_____

Physician in Charge: Obstetrician_____ General Practitioner_____ Clinic___
Pediatrician_____

Length of Pregnancy_____ Length of Labor_____

Delivery Date_____ Time_____ A.M. P.M.

Delivery: Spontaneous_____ Forceps_____

Anesthesia_____

Complications_____

Present Hospital Room Arrangement:

Private	_____
Semi-private (2 bed room)	_____
3 bed room	_____
4 bed room	_____
Rooming-in	_____
Other	_____

PAST HISTORY OF INFANT FEEDING

Number of previous infants breast fed_____

Number of Previous Infants breast fed-- Date of Birth and Birth Weight.	Duration	Complement or Supplement Formula used Daily.

INFANT

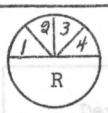
Sex_____ Birth Weight_____ Chart No._____

Apgar Rating_____ Condition_____

Complications_____

MEASUREMENTS No. _____

BREAST PRESSURE READINGS

 	RIGHT BREAST				LEFT BREAST			
	QUADRANTS							
	1	2	3	4	1	2	3	4
Day # 3								
Within 24 Hours of Delivery								
Increase in Measurement								

Date and Time Taken: Day # 1 _____

Day # 3 _____

Time Taken After Nursing on Day # 3; Right Breast: _____

Left Breast: _____

Engorgement Noted by Palpation: Yes _____

No _____

Average Increase for Both Breasts: _____

INCIDENCE OF SORE OR CRACKED NIPPLES _____

Day of First Appearance _____

Treatment _____

At Time of Discharge: Subsided _____

Healing _____

Other _____

BREAST FEEDING:

Day: 1 2 3 4 5

Discontinued: _____

Reason: Medical _____

Elective _____

MEASUREMENTS No. _____

INFANT FEEDINGS:

Time, Type, and Amount of Infant Feedings

Day # 1	Day # 2	Day # 3	Day # 4	Day # 5

INFANT'S WEIGHT:

Day # 1 _____ Day # 2 _____ Day # 3 _____ Day # 4 _____ Day # 5 _____

Weight Gain or Loss Since Birth: _____

Weight Gain Since Lowest Point: _____

MOTHERS' OPINIONNAIRE No._____

This opinionnaire is designed to study feeding patterns of newborn babies in relation to feeding schedules. The sheet is numbered so as to aid the investigator in coding the results. You need not sign your name, and your identity remains anonymous.

Place one check mark (√) in the category which best describes your reaction to your infant's sucking activity for each of the feeding periods for one day. Mark in the time of day that your infant completes each feeding. In column number 1 is an example of how you are to fill out this sheet. In this example the infant completed his feeding at 7:30 A.M. and the mother evaluated her infant as being somewhat sleepy, nursing slightly, and taking 20 or less sucks during the feeding with coaxing. Thus, a check mark has been placed opposite the number 3 category. If you have questions or are uncertain as to how to complete this sheet or any particular feeding, please write your questions in the space provided and the investigator will be happy to help you when she is present. Your cooperation in this project is greatly appreciated.

Categories	Time Feedings Were Completed									
	7:30 A.M.									
1) Infant too sleepy to nurse.										
2) Infant awake, but did not nurse.										
3) Infant somewhat sleepy, nursed slightly, took 20 or less sucks with coaxing.	√									
4) Infant nursed fairly well, took more than 20 sucks, some coaxing necessary.										
5) Infant nursed quite well, vigorous sucking, satisfied after taken from breast.										
6) Infant ravenous, continued desire to suck after taken from breast.										
Questions and Comments.										

APPENDIX C

Sample Letter Written to Michael Newton, M.D.

and

Sample Letter Received from Michael Newton, M.D.

UNIVERSITY OF COLORADO
MEDICAL CENTER

4200 East Ninth Avenue
Denver, Colorado 80220

School of Nursing

820 Dexter Street, Apt. 14
Denver, Colorado 80220
February 19, 1965

Michael Newton, M.D.
Department of Obstetrics and Gynecology
University of Mississippi School of Medicine
Jackson, Mississippi

Dear Dr. Newton:

In an article written by you and Dr. Niles Newton entitled, "Postpartum Engorgement of the Breast," and published in March, 1951, in the American Journal of Obstetrics and Gynecology you made mention of a scale used to grade breast engorgement. This scale as used in your study treated breast engorgement as 0, 1+, 2+, 3+, and 4+.

As a graduate student at the University of Colorado School of Nursing, I am making preparations to conduct a study in self-demand feeding of the newborn in the hospital for the initiation of successful breast feeding and establishment of lactation. This study will constitute the research for my Master's thesis. Among various measurements that will be taken is the degree of breast engorgement in relation to the type of feeding regime, either self-demand or rigid. Would it be possible for you to send to me information regarding the description of the character of the breast for each of the five classifications of breast engorgement, 0, 1+, 2+, 3+, 4+, that you mentioned in your article?

Dr. Edith Jackson, who is at the University of Colorado Medical Center in Denver, suggested I write to you. I have

discussed the subject of my research proposal with her and she thought you might be able to give me more help.

I would appreciate hearing from you regarding this matter. Thank you.

Sincerely yours,

(Miss) Natalie Jean Geissler, R.N.
Graduate Student
University of Colorado
School of Nursing

THE UNIVERSITY OF MISSISSIPPI MEDICAL CENTER
2500 North State Street
JACKSON, MISSISSIPPI 39216

School of Medicine
Department of Obstetrics and Gynecology

Area Code 601
366-2681

March 1, 1965

Miss Natalie Jean Geissler
820 Dexter Street - Apartment 14
Denver, Colorado 80220

Dear Miss Geissler:

I am afraid I cannot add a great deal to what was written in the 1951 article on "Postpartum Engorgement of the Breast" as regards the actual measurement of engorgement. Initially, as I recall it, we decided to set up a 0 to 4+ scale, based on clinical judgment. We were able to confirm, by actual circumferential measurements, that our clinical estimates were reasonably reliable. The same thing could be done by any experienced observer. I would have been happy to send you a reprint of the article, but, as far as I can tell, we have only one left.

The degree of engorgement of the breast postpartum has been used by many investigators in clinical studies on lactation, particularly with the use of oxytocin to produce milk-ejection. Most of the studies I have read rely on clinical judgment, unsupported by actual measurements. In 1954 Hytten, in Aberdeen, Scotland, used a water displacement method for determining changes in breast size (British Medical Journal 1: 912, 1954). This undoubtedly would be cumbersome, but is one method of measuring engorgement. I should add that, in my opinion, engorgement is primarily a matter of milk retained in the breast with vascular changes in edema being secondary.

Your study is of great interest and I wish you well with it. Investigations of lactation are particularly difficult, because emotional factors are of so much importance. It is also difficult to organize the personnel taking care of the mothers and babies so that you have truly comparable series.

If I can be of any further help, please write me.

Sincerely yours,

Michael Newton

Michael Newton, M. D.
Professor and Chairman

MN:eb

APPENDIX D

Sample Letter Written to Physicians for Permission to Conduct the Study

4200 East Ninth Avenue
Denver, Colorado 80220
April 9, 1965

Dear Doctor:

As a graduate student at the University of Colorado School of Nursing, I have been given permission to do an experimental study for the Master's thesis at _____ _____ _____ Hospital. This study is an investigation of newborn feeding schedules in relation to the establishment of lactation. Two factors will be considered: a brief opinionnaire on the nursing activity of infants, and the measurement of breast engorgement. The measurement of breast engorgement would be ascertained by means of an instrument (pressure gauge) to determine degrees of breast pressure. The principle of the pressure gauge is similar to that of the tonometer. In a study carried out at the _____ Hospital to test this instrument, patients indicated that the instrument caused no discomfort. Permission would also be obtained from each patient before including her in the study.

If you have any questions regarding the above please contact me. I will be in _____ _____ _____ Hospital on the maternity unit each morning of the week. I would appreciate permission to use this patient in the study. If so, please sign your name below.

Sincerely yours,

(Miss) Natalie Jean Geissler, R.N.
Graduate Student

_____, Physician

APPENDIX E

Formulas Used in Statistical Tests

FORMULAS USED IN STATISTICAL TESTS

1. Formula for calculation of the mean:*

$$\bar{X} = \frac{\Sigma X}{n}$$

2. Formula for calculation of the variance:**

$$s^2 = \frac{\Sigma x^2}{n-1}$$

3. Formula for calculation of the standard deviation:**

$$s = \sqrt{\frac{\Sigma x^2}{n-1}}$$

4. Formula for the calculation of F:**

$$F = \frac{s_1^2}{s_2^2} \quad \text{or} \quad F = \frac{s_2^2}{s_1^2} \qquad \left(\frac{\text{Larger}}{\text{Smaller}}\right)$$

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*George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1959), p. 37.

**Allen L. Edwards, Statistical Methods for the Behavioral Sciences (New York: Rinehart & Company, Inc., 1956), pp. 40, 41, 272, 273.

5. Formula for the calculation of t:***

$$t = \frac{\bar{X} - \bar{Y}}{\sqrt{\left(\frac{\Sigma x^2 + \Sigma y^2}{n_x + n_y - 2}\right)\left(\frac{n_x + n_y}{n_x \cdot n_y}\right)}}$$

6. Formula for the calculation of the standard error of the difference of the means:***

$$s_{\bar{x} - \bar{y}} = \sqrt{\left(\frac{\Sigma x^2 + \Sigma y^2}{n_x + n_y - 2}\right)\left(\frac{n_x + n_y}{n_x \cdot n_y}\right)}$$

7. Formula for calculation of chi square:*

$$\chi^2 = \frac{(O - E)^2}{E}$$

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*George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1959), p. 158.

***G. Milton Smith, A Simplified Guide to Statistics for Psychology and Education (third edition; New York: Holt, Rinehart and Winston, Inc., 1964), p. 89.

APPENDIX F

TABULATION OF ORIGINAL DATA

TABLE XXVIII

PERCENTAGE INCIDENCE OF COMPLEMENTARY FEEDINGS TO TOTAL NUMBER OF FEEDINGS FOR EACH DAY FOR NEWBORNS IN THE CONTROL GROUP

Infant	Per cent				
	Day 2	Day 3	Day 4	Day 5	Total Day 2 Through 5
3C	100	100	0	0	50.0
5C	100	100	50	16.7	66.7
6C	100	100	66.7	0	66.7
7C	100	100	0	0	50.0
9C	100	83.3	33.3	0	54.2
11C	100	100	16.7	16.7	58.4
12C	100	100	50.0	66.7	79.2
13C	100	100	33.3	33.3	66.7
14C	100	66.7	0	0	41.7
15C	100	66.7	0	0	41.7
18C	83.3	100	71.4	50	76.2
19C	100	83.3	0	16.7	50.0
27C	100	100	16.7	66.7	70.9
28C	100	100	50.0	16.7	66.7
30C	100	66.7	33.3	16.7	54.2
31C	100	100	33.3	0	58.3
32C	100	100	50	16.7	66.7
33C	100	100	50	0	62.5
34C	100	100	0	0	50.0

TABLE XXIX

PERCENTAGE INCIDENCE OF COMPLEMENTARY FEEDINGS TO TOTAL NUMBER OF FEEDINGS FOR EACH DAY FOR NEWBORNS IN THE EXPERIMENTAL GROUP

Infant	Per cent				
	Day 2	Day 3	Day 4	Day 5	Total Day 2 Through 5
1E	100	83.3	0	0	45.8
2E	100	66.7	0	0	41.7
3E	75	42.9	0	0	29.5
4E	80	100	33.3	0	53.3
6E	80	83.3	0	0	40.8
7E	100	100	50	0	62.5
8E	100	100	33.3	0	58.3
11E	83.3	66.7	0	0	37.5
13E	83.3	66.7	42.9	0	48.2
17E	100	83.3	16.7	0	50.0
18E	83.3	83.3	0	66.7	58.3
19E	85.7	100	0	0	46.4
21E	100	40	0	0	35.0
22E	100	33.3	0	0	33.3
23E	100	100	16.7	0	54.2
24E	100	83.3	0	0	45.8
25E	100	100	16.7	0	54.2

TABLE XXX

AVERAGE PRESSURE READINGS AS MEASURED WITH PRESSURE GAUGE AMONG MOTHERS IN THE CONTROL GROUP

Patient	Average Pressure Within 24 Hours of Delivery	Average Pressure on Day 4	Average Increase in Pressure
*3C	0.650	1.400	0.75
*5C	0.512	1.600	1.09
6C	1.587	2.762	1.18
7C	1.487	2.512	1.03
*9C	0.662	2.275	1.61
*11C	1.275	3.312	2.04
12C	1.050	1.125	0.08
13C	1.512	4.675	3.16
14C	2.012	3.087	1.08
*15C	1.787	2.387	0.60
18C	0.662	1.837	1.18
*19C	0.237	1.762	1.53
27C	1.212	3.062	1.85
*28C	1.087	1.900	0.81
*30C	0.700	4.175	3.48
*31C	1.612	3.937	2.33
*32C	1.075	1.737	0.66
33C	0.775	2.237	1.46
34C	0.800	1.912	1.11

*Had nursed an infant before.

TABLE XXXI

AVERAGE PRESSURE READINGS AS MEASURED WITH PRESSURE GAUGE AMONG MOTHERS IN THE EXPERIMENTAL GROUP

Patient	Average Pressure Within 24 Hours of Delivery	Average Pressure on Day 4	Average Increase in Pressure
1E	1.230	2.330	1.10
2E	0.990	4.700	3.71
*3E	1.225	2.675	1.45
*4E	1.537	1.825	0.29
*6E	0.712	1.750	1.04
7E	1.487	4.225	2.74
8E	1.137	4.812	3.68
*11E	1.350	5.075	3.73
*13E	1.100	2.100	1.00
*17E	1.475	4.275	2.80
*18E	0.812	2.400	1.59
19E	0.825	1.287	0.46
*21E	1.087	3.637	2.55
22E	1.137	4.625	3.49
23E	1.362	3.525	2.16
*24E	1.962	3.262	1.28
*25E	0.450	1.350	0.90

*Had nursed an infant before.

TABLE XXXII

WEIGHTS IN POUNDS AND OUNCES FOR NEWBORNS IN THE CONTROL GROUP

Infant	Day 1	Day 2	Day 3	Day 4	Day 5
3C	7-8	7-8	7-3	7-0	6-15
5C	5-8	5-6	5-2	4-15½	4-14
6C	8-0	7-13	7-11	7-10	7-7
7C	6-14	6-9	6-8	6-6½	6-3
9C	7-4	6-14	6-11	6-10	6-10
11C	9-2	9-2	8-8½	8-8½	8-9
12C	5-9	5-6	5-6	5-7	5-4½
13C	7-0	6-13	6-9	6-8	6-3
14C	6-6	6-0	5-15	5-12	5-14
15C	6-3	6-0	5-14	5-12	5-10½
18C	6-12	6-9	6-5	6-3	6-2½
19C	8-4	8-0	7-13	7-12	7-13
27C	7-3	7-0	6-12	6-11	6-7
28C	7-3	7-0	6-13	6-13	6-12
30C	9-0	8-12	8-7	8-6	8-7
31C	7-9	7-6	7-2	7-1	7-½
32C	7-5	7-5	7-0	6-13½	6-12
33C	7-4	7-4	7-0	7-½	6-14
34C	5-4	5-4	5-3	5-1	5-1

TABLE XXXIII

WEIGHTS IN POUNDS AND OUNCES FOR
NEWBORNS IN THE EXPERIMENTAL GROUP

Infant	Day 1	Day 2	Day 3	Day 4	Day 5
1E	7-0	6-12	6-7	6-5	6-6
2E	8-6	8-2	7-14	7-13	8-0
3E	6-15	6-12½	6-8	6-9	6-12
4E	7-1	6-15	6-12	6-11	6-8
6E	7-0	6-14½	6-8½	6-8½	6-11
7E	9-5	9-2	8-12	8-9½	8-9
8E	6-12	6-12	6-6	6-3	6-0
11E	7-8	7-2	7-0	7-0	7-1
13E	8-6	8-2	8-½	8-½	7-13
17E	6-7	6-4	6-1	6-1	6-1
18E	7-10	7-5	7-4½	7-4½	7-1
19E	6-2	5-15	5-14½	5-13½	5-14
21E	8-0	7-10	7-7	7-5	7-7
22E	7-8	7-5½	7-3½	7-0	6-15½
23E	6-4	6-½	5-12	5-10	5-6
24E	6-7	6-7	6-3	6-0	6-1
25E	6-14	6-11½	6-8	6-7	6-8