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COLLEGE OF MEDICAL EVANGELISTS

School of Graduate Studies

A COMPARISON OF RECTAL AND AXILLARY TEMPERATURES
ON ONE HUNDRED SELECTED NEWBORN INFANTS

by

Marlene Van Puymbrouck

A Thesis in Partial Fulfillment
of the Requirements for the Degree
Master of Science in the Field of Nursing

May, 1961

I certify that I have read this thesis and that
in my opinion it is fully adequate, in scope and
quality, as a thesis for the degree of Master of
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Marlene Van Puymbrouck

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CHAPTER I

INTRODUCTION TO THE STUDY

I. THE NEED FOR THE STUDY

The method of taking temperatures of the newborn in nurseries varies with hospitals. The American Academy of Pediatrics recommends to hospital staffs that the newborn's temperature be taken in the axilla, stating that axillary temperatures are sufficiently dependable.¹ A reply to a letter written to the American Academy of Pediatrics requesting information for the basis of this recommendation made reference to several articles in literature. These references were reviewed and are reported in the second chapter.

In reviewing literature conflicting statements have been found about whether or not temperatures should be taken by axilla or rectum. Some who advocate rectal temperatures do not agree about the depth of insertion of the thermometer in the rectum. Authors also disagree about the length of time the thermometer should be held in place regardless of the method used. For example, Lyon and Wallinger say an

¹American Academy of Pediatrics, Standards and Recommendations for Hospital Care of Newborn Infants Full-term and Premature, Evanston: American Academy of Pediatrics, 1957, p. 35.

axillary temperature should be read after the thermometer has been held in place for five minutes.² Loudon recommended four minutes,³ whereas the American Academy of Pediatrics recommends one and one-half minutes.⁴ Then again, Nelson stated that, as far as possible axillary temperatures should be avoided.⁵ Karlberg stated that discrepancies in rectal temperature readings would be avoided if the thermometer was inserted five cm., but he found that nursery personnel usually insert the thermometer three cm.⁶

II. THE PROBLEM OF THE STUDY

Statement of the Problem

The problem of this study was to find out if body temperature of the newborn registers differently for axillary or rectal measurements in specific periods of time, and to

²Robert A. Lyon, and Elgie M. Wallinger, Nursing of Children, Philadelphia: W. B. Saunders Company, 1959, p. 164.

³I. S. L. Loudon, "On Taking the Temperature in the Mouth and the Axilla," The Lancet, 273:234, August 3, 1957.

⁴American Academy of Pediatrics, op. cit., p. 65.

⁵Waldo E. Nelson, ed., Mitchell-Nelson Textbook of Pediatrics, Philadelphia: W. B. Saunders Company, 1950, p. 178.

⁶P. Karlberg, "The Significance of Depth of Insertion of the Thermometer for Recording Rectal Temperatures," Acta Paediatrica, 38:359, 1949.

find out which depth of rectal insertion for given periods of time records the highest degree of body temperature.

Purpose of the Study

The purpose of this study was to provide information regarding the degree of variations of body temperature which may be found in taking temperatures of newborns by four measures at three time periods. It may be that small differences in temperature readings might be of little significance as compared with the economy of time in taking temperatures, economy of materials, and personnel preferences.

Assumption

It is assumed that a five minute rectal measurement of body temperature at 5 cm. insertion is considered an accurate means of measurement.

Hypothesis

There is no significant difference between body temperature readings taken by rectum and axilla on the newborn.

Sub-hypothesis

There is no significant difference of body temperature reading when taken by insertion of the bulb of the thermometer past the rectal sphincter, at 2.5 cm., or 5 cm. depth of insertion with the rectal thermometer.

There is no significant difference in body temperature when readings are taken at one and one-half, three, and five minutes when the thermometer is inserted rectally at the depths mentioned above.

III. SAMPLE AND METHOD

The experimental method was used in conducting this research. Literature was reviewed to help clarify the need and approaches used in the study. This is reported in the second chapter. A pilot study was done on five infants to aid in determining materials needed and techniques to be used in taking the temperatures. Permission was obtained from administrators and nursing service directors of the two hospitals where data were gathered, to use the facilities of the hospitals. One hundred full-term normal newborn infants over twenty-four hours of age were studied. The newborn was used only once.

Data were gathered. An axillary temperature was taken on each newborn. The reading was recorded at one and one-half, three, and five minutes. The thermometer was inserted three different depths in measuring rectal temperature and the temperature reading obtained was recorded at one and one-half, three, and five minutes for each depth of insertion. Depths used were (1) insertion of the bulb end of the thermometer just past the sphincter, (2) 2.5 cm., and (3) 5 cm. into the

rectum. Temperatures were recorded at the measured intervals of time without removing the thermometer. The same thermometer was used for the four measurements on the individual newborn.

Data were analyzed, conclusions drawn and recommendations made.

IV. DEFINITIONS OF TERMS USED

Rectal Temperature

The temperature obtained by insertion of a clinical thermometer into the rectum.

Axillary Temperature

The temperature obtained by holding the clinical thermometer firmly in the armpit with the arm pressed against it.

Full-term Normal Newborn Infant

An infant weighing more than 2500 grams at birth and free of visible or known gross congenital defects. An infant is considered a newborn during the first twenty-eight days of life. Congenital defects are considered to be those defects present at the time of birth.

V. SUMMARY

This study was done to find out if the measurement of body temperature of the newborn varies with the method used, namely rectal or axillary. Consideration was given to three time periods of axillary measurement and three time periods of three depths of insertion of rectal measurement. One hundred full-term normal newborn infants were used in the study. Literature was limited on the subject of measurement of body temperature of the newborn infant.

CHAPTER II

REVIEW OF LITERATURE

In the review of literature consideration was given to the importance of measurement of body temperature, methods of determining body temperature, and factors which may influence changes in body temperature. Information specific to the newborn was limited. Material written regarding temperature measurement in children and adults which may be pertinent to this study was summarized.

I. IMPORTANCE OF BODY TEMPERATURE MEASUREMENT

Body temperature is considered an indicator of health or disease with the normal temperature considered to be 98.6° F. DuBois states that this is a rough approximation but is adequate for ordinary purposes. There is actually no one normal temperature but instead a fairly wide variation that shifts up and down with the time of day and other factors.⁷

Selle, in referring to the normal temperature of 98.6° F. states that this reading does not refer to the temperature of

⁷Eugene F. DuBois, Fever and the Regulation of Body Temperature, Springfield, Ill.: Charles C. Thomas, Publisher, 1948, p. 3.

the body as a whole but it most nearly approximates the temperature of the deep central areas of the body.⁸

In a study by Gibson it was stated that probably no procedure is as universally employed in the examination of patients as the taking of body temperature and that it is important it be accurate.⁹

It is recommended that the temperature of the newborn be taken every four hours until it becomes stable and then once daily unless the infant's condition indicates more frequent checking.¹⁰ This is done to find out how well the infant is maintaining his own body temperature and it is also a check for fever.¹¹ The normal newborn has a drop in temperature after birth and during the first day of life low temperatures predominate. Occasionally the temperature may drop as low as 94° F.¹²

⁸W. A. Selle, Body Temperature: Its Changes With Environment, Disease and Therapy, Springfield, Ill.: Charles C. Thomas, Publisher, 1952, p. 12.

⁹J. P. Gibson, "A Study of Rectal and Axillary Temperatures in Infants," Texas State Journal of Medicine, 40:478, January, 1945.

¹⁰American Academy of Pediatrics, op. cit., p. 35.

¹¹Carolyn Conant Van Blarcom, Obstetrical Nursing, New York: The Macmillan Company, 1957, p. 624.

¹²Clement A. Smith, The Physiology of the Newborn Infant, Springfield, Ill.: Charles C. Thomas, Publisher, 1945, p. 153.

Fever in the newborn may be due to transitory fever which manifests itself by a sudden rise of temperature on the third or fourth day of life of an apparently well infant. The cause is unknown. The fever probably would not be detected unless routine temperatures were taken. Its importance lies in the differential diagnosis, for it is important that a search for an infection be made when a rise in temperature occurs.¹³ Infection is the most common cause of extensive rise in temperature,¹⁴ and is a frequent cause of neonatal death. Reduction of neonatal deaths from infections requires good technique in nurseries but also includes early diagnosis and treatment.¹⁵ Taking routine temperatures on the newborn in nurseries provides detection of fever should it occur, which can be further diagnosed.

¹³Ronald S. Illingworth, The Normal Child, Boston: Little, Brown and Company, 1957, pp. 121, 122.

¹⁴Robert A. Lyon, and Elgie M. Wallinger, Mitchell's Pediatrics and Pediatric Nursing. fourth edition; Philadelphia: W. B. Saunders Company, 1954, p. 31.

¹⁵Herman N. Bundesen, et. al., Progress in the Prevention of Needless Neonatal Deaths, Chicago: Chicago Department of Public Health, 1951, p. 152.

II. METHODS OF DETERMINING BODY TEMPERATURE

It has been stated by Selle¹⁶ and Talbot et al.¹⁷ that different areas of the body show varying degrees of temperature, and in measuring body temperature, DuBois says, one is actually measuring the degree of temperature at just one level or area.¹⁸ Authors recommend various ways of measurement of the temperature of the body and present differing opinions regarding time and method of use.

Rectal Temperature

Gibson states that physicians and nurses employ the rectal method of taking temperatures of infants because it is the most "accurate" method.¹⁹ Craig states that rectal readings of temperatures are "most suitable",²⁰ and Holt and McIntosh make the statement that temperatures of infants should

¹⁶Selle, op. cit., p. 5.

¹⁷Fritz B. Talbot, et al., "Skin Temperatures of Children," American Journal of Diseases of Children, 42:1050 October, 1931.

¹⁸Eugene F. DuBois, Fever and the Regulation of Body Temperature, Springfield, Ill.: Charles C. Thomas, Publisher, 1948, p. 10.

¹⁹Gibson, loc. cit.

²⁰W. S. Craig, et al., Nursing Care of the Newly Born Infant, London: E. and S. Livingstone Ltd., 1955, p. 99.

be taken in the rectum.²¹ Karlberg also recommends rectal temperatures on infants and states that the insertion of a rectal thermometer 5 cm. will give a more accurate average temperature of the body.²²

Gibson,²³ Lyon and Wallinger,²⁴ and Karlberg²⁵ state that the thermometer should be inserted rectally 5 cm. for accuracy, while Craig does not mention a specific depth but uses the words "kept in position".²⁶ Porter and Carter do not specify any depth of insertion of the rectal thermometer.²⁷

In writing a book on child care for the use of parents, Litchfield and Dembo give instructions to insert the thermometer rectally one-half inch past the bulb,²⁸ while Holt

²¹L. Emmett Holt, and Rustin McIntosh, Holt Pediatrics, twelfth edition; New York: Appleton-Century-Crofts, Inc., 1953, p. 54.

²²Karlberg, op. cit., p. 360. ²³Gibson, loc. cit.

²⁴Robert A. Lyon, and Elgie M. Wallinger, Mitchell's Pediatrics and Pediatric Nursing, fourth edition; Philadelphia: W. B. Saunders Company, 1954, p. 166.

²⁵Karlberg, loc. cit. ²⁶Craig, et al., loc. cit.

²⁷Langley Porter, and William E. Carter, Management of the Sick Infant and Child, fifth revised edition; St. Louis: C. V. Mosby Company, 1938, p. 676.

²⁸Harry R. Litchfield, and Leon H. Dembo, Your Child Care, Garden City, New York: Doubleday and Company, Inc., 1960, p. 18.

instructs the use of a one inch insertion.²⁹ Karlberg states that the 3 cm. depth of insertion as "usually taken" is not as representative of body temperature.³⁰ Mead and Bonmarito conducted a study which showed that if a measuring device was inserted deeper into the rectum it would not necessarily produce a higher degree of temperature.³¹

The writer questioned nurses that were contacted during the study regarding the depth of insertion of the thermometer in the rectum and found that they had been taught or were using a one inch depth of insertion. It was necessary to contact several doctors in obtaining permission to do the study on newborns in nurseries. These doctors expressed disbelief that the use of the 5 cm. insertion was necessary. They felt the depth of 2.5 cm. was used and was adequate.

Written statements regarding the length of time for measurement of the temperature rectally do not vary greatly. Craig,³² Lyon and Wallinger³³ state that a minimum period of

²⁹L. Emmett Holt, The Good Housekeeping Book of Baby and Child Care, New York: Appleton-Century-Crofts, Inc., 1957, p. 188.

³⁰Karlberg, loc. cit.

³¹Jere Mead, and C. Lawrence Bonmarito, "Reliability of Rectal Temperature as an Index of Internal Body Temperature," Journal of Applied Physiology, 2:97, August, 1949.

³²Craig, et al., loc. cit.

³³Robert A. Lyon, and Elgie M. Wallinger, Mitchell's Pediatrics and Pediatric Nursing, fourth edition; Philadelphia: W. B. Saunders Company, 1954, p. 166.

one minute should be used. Gibson feels one minute may be adequate for newborns while two minutes is needed as age increases.³⁴ Porter and Carter recommend two minutes,³⁵ while DuBois mentions a three minute time period being used.³⁶

There is mention made of disadvantages to the taking of the temperature rectally. Perforation of the rectum has been known to result from carelessly inserting the thermometer too far into the rectum.³⁷ Grayson says that the rectum has long held a position almost sacrosanct, as the area for taking an accurate temperature. In his study he shows that the rectal temperature "does not always behave as may be expected" and variations in findings can occur in the use of this method of measurement.³⁸ Karlberg, in advocating insertion of the thermometer 5 cm. into the rectum, mentioned the risk of breakage of the thermometer at this depth.³⁹

Economy of time and materials should be considered. In taking the temperatures rectally on the infants, the writer

³⁴Gibson, loc. cit. ³⁵Porter and Carter, loc. cit.

³⁶Eugene F. DuBois, Fever and the Regulation of Body Temperature, Springfield, Ill.: Charles C. Thomas, Publisher, 1948, p. 8.

³⁷Craig, loc. cit.

³⁸John Grayson, "Observations on the Temperature of the Human Rectum," British Medical Journal, 2:1379, December 8, 1951.

³⁹Karlberg, loc. cit.

noted that most infants would cry and need some measure to quiet them after the procedure. This involved holding them, changing position, or offering them a bottle of water. It was also noted that in most instances insertion of the thermometer induced defecation and necessitated a diaper change. This took additional time and involved the use of more materials.

Axillary Temperature

Gibson stated that as "undesirable" as the measurement of body temperature by axilla may be it should be studied because many mothers wish to use this method of taking temperatures on their children in preference to rectal measurements.⁴⁰

The American Academy of Pediatrics was organized to elevate standards of infant care. A recent recommendation made by them to hospitals, was that axillary temperatures be taken on normal newborn infants. They state that with this method properly used, the findings are "sufficiently dependable".⁴¹

In a textbook written on the nursing of children, Lyon and Wallinger state that an "approximate" temperature of the body can be obtained when the thermometer is placed in the

⁴⁰Gibson, loc. cit.

⁴¹American Academy of Pediatrics, op. cit., p. 35.

axilla.⁴² Then again, Nelson states that "as far as possible axillary temperatures should be avoided,"⁴³ while Porter and Carter say that the measurement by axilla is very "inaccurate".⁴⁴ Kerley states this means of measurement is "thoroughly misleading and should never be depended upon."⁴⁵

A factor in dealing with the axillary measurement which has varying opinions seems to be in regard to length of time. The American Academy of Pediatrics recommends one and one-half minutes of time to hold the thermometer in position.⁴⁶ Gibson felt that three minutes gives a fairly accurate reading,⁴⁷ while Loudon felt four minutes necessary.⁴⁸ Lyon and Wallinger state that the thermometer should be held in place for at least five minutes or "until the mercury stops rising."⁴⁹

⁴²Robert A. Lyon, and Elgie M. Wallinger, Nursing of Children, Philadelphia: W. B. Saunders Company, 1959, p. 164.

⁴³Nelson, op. cit., p. 178.

⁴⁴Porter and Carter, loc. cit.

⁴⁵Charles Gilmore Kerley, Treatment of the Diseases of Children, second edition; Philadelphia: W. B. Saunders Company, 1911, p. 497.

⁴⁶American Academy of Pediatrics, op. cit., p. 65.

⁴⁷Gibson, op. cit., p. 478.

⁴⁸Loudon, op. cit., p. 234.

⁴⁹Robert A. Lyon, and Elgie M. Wallinger, Nursing of Children, Philadelphia: W. B. Saunders Company, 1959, p. 164.

In referring to the measurement of temperatures on infants, Holt and McIntosh state that "axillary temperatures avoid the irritation and frequent defecation of rectal temperatures."⁵⁰

DuBois, in his study on adults, found that the skin temperature is cooler than the rectal area and it can vary up or down while the rectal temperature is constant.⁵¹ Gibson compared infants with children in his study, and found that rectal and axillary temperature readings were close in the newborn group.⁵² Grayson reported that rectal temperature changes closely followed skin temperature changes.⁵³

An advantage of axillary measurement, as mentioned by Mead and Bonmarito, stresses the ability to place the thermometer in position under direct vision so that the position is known.⁵⁴

⁵⁰Holt and McIntosh, op. cit., p. 159.

⁵¹Eugene F. DuBois, Fever and the Regulation of Body Temperature, Springfield, Ill.: Charles C. Thomas, Publisher, 1948, p. 10.

⁵²Gibson, op. cit., p. 479.

⁵³Grayson, op. cit., p. 1381.

⁵⁴Mead and Bonmarito, op. cit., p. 107.

Oral Temperature

Taking of the temperature by mouth produces a measurement close to the internal average of body temperature but is influenced by many factors.⁵⁵ These factors, as listed by Selle, are hot or cold foods and drinks, air temperature, breathing and talking.⁵⁶ With infants the factor of positioning would be incurred and as Porter and Carter state, it is useless to try to take a child's temperature by mouth.⁵⁷ For the purpose of this study further material on this subject was not revealed.

Other Methods of Measuring Body Temperature

For purposes of scientific investigation on body temperature in children, Talbot, et al. did studies measuring the temperature of many areas of the body including those mentioned above. These areas included the face, feet, thighs, hands, and various areas on the trunk. It was found that in adults and children the temperature of the trunk is highest, with that of the face next and the extremities recording the

⁵⁵Eugene F. DuBois, Fever and the Regulation of Body Temperature, Springfield, Ill.: Charles C. Thomas, Publisher, 1948, p. 10.

⁵⁶Selle, op. cit., p. 6.

⁵⁷Porter and Carter, op. cit., p. 676.

lowest temperature.⁵⁸ In infants, McClure and Sauer state they found the temperature of the face, hands and feet to be about equal.⁵⁹

III. FACTORS THAT INFLUENCE TEMPERATURE READINGS

In reviewing material regarding body temperatures, there is evidence that factors are present which cause variation in the temperature of the body. These will be considered with emphasis on those factors related to the infant.

Environment

In Section I, mention was made of the normal fall in body temperature of the infant after birth. It is known the temperature rises and is considered to be somewhat stable after the first day of life. The normal drop of temperature after birth occurs regardless of environment,⁶⁰ however environment is considered an important factor in maintaining a stable temperature after the first day of life. Selle states that temperature regulation during the first months of life

⁵⁸Talbot, et al., op. cit., p. 965.

⁵⁹W. B. McClure, and L. W. Sauer, "The Influence of Clothing on the Surface Temperature of Infants," American Journal of Diseases of Children, 10:425, December, 1915.

⁶⁰Clement A. Smith, The Physiology of the Newborn Infant, Springfield, Ill.: Charles C. Thomas, Publisher, 1945, p. 154.

is "notably poor." He mentions that small infants are "virtually poikilothermic; the internal body temperature varies with that of the surroundings," therefore it is stressed that a carefully controlled environment is necessary to maintain stable temperature readings in the infant.⁶¹

Parmelee reports that in an experiment where the environmental temperature was elevated infants produced an immediate rise in skin temperature.⁶² Nelson also states that the temperature of the newborn is labile and responds readily to changes in environmental temperature.⁶³

In the study done by Talbot, et al. it was found that humidity within the range of thirty-one to ninety per cent produced no changes of the temperature of the skin.⁶⁴

Clothing

It is known that the protection of the body with clothing helps to lessen the expenditure of heat from the body and to maintain body temperature at a close uniform level by keeping a layer of warm air next to the skin. Talbot, et al. found

⁶¹Selle, op. cit., p. 4.

⁶²Arthur Hawley Parmelee, Management of the Newborn, Chicago: The Year Book Publishers, Inc., 1952, pp. 117, 118.

⁶³Nelson, op. cit., p. 314.

⁶⁴Talbot, et al., op. cit., p. 1052.

in a study on the skin temperatures of children that temperatures showed definite changes after exposure of the body.⁶⁵

Sex

In Gibson's study there were no significant variations in temperature when consideration was given to the sex of children. This study was conducted on well children.⁶⁶ Smith states that "differences between the sexes are without effect upon the metabolism not only in the neonatal period but until some time after infancy."⁶⁷

Surface Area

Smith states that the demands of the surface area on an infant is a handicap to the control of temperature. "Small human beings have greater surface areas as compared with their weights." A newborn infant has fifteen per cent as much surface area as an adult with weight about only five per cent that of the adult.⁶⁸

⁶⁵Ibid., pp. 983, 984.

⁶⁶Gibson, op. cit., p. 479.

⁶⁷Clement A. Smith, The Physiology of the Newborn Infant, Springfield, Ill.: Charles C. Thomas, Publisher, 1945, p. 148.

⁶⁸Ibid., p. 142.

Exercise

Many authors have mentioned the effect of exercise on body temperature and there are many conflicting statements. In reference to children, Holt and McIntosh state that rectal temperature may rise as much as 3° F. following exercise while oral temperature reading does not change.⁶⁹ Merry and Merry state that there may be a rise of as much as one degree after a child has been running around.⁷⁰ While Van Der Bogert and Moravec state that "intensive physical exercise has been known to cause a marked rise in body heat."⁷¹

McClure and Caton did a study on the temperatures of newborns just after birth. The thermister element was inserted just beyond the sphincter and continuous rectal readings were taken. It was found that there were marked fluctuations "which could not be related to crying and/or physical activity."⁷² In Mestayan and Vargas study on newborn and premature infants they state that there is "no doubt that muscular activity plays

⁶⁹Holt and McIntosh, op. cit., p. 54.

⁷⁰Frieda Kiefer Merry, and Ralph Vickers Merry, The First Two Decades of Life, New York: Harper and Brothers, 1950, p. 105.

⁷¹Frank Van Der Bogert, and Clayton L. Moravec, "Body Temperature Variations in Apparently Healthy Children," Journal of Pediatrics, 10:469, April, 1937.

⁷²James H. McClure, and William L. Caton, "Newborn Temperature," Journal of Pediatrics, 47:583,587, November, 1955.

an important role in the defense against cooling in the neonatal period."⁷³

Murlin and Conklin in a study on the newborn state that crying one per cent of the time raises the metabolism one per cent."⁷⁴

Shivering and physical activity are forms of regulation of temperatures. Shivering is not commonly seen in the newborn but as age increases the physical mechanism becomes more responsive and as a result the temperature of the body becomes more constant.⁷⁵

Food

The body's metabolism is expressed in production of heat and the simplest way to measure this heat is with the use of a clinical thermometer. Increase in the production of heat is accomplished by the ingestion of food. Selle reports that about one hour after taking food the metabolism raises, reaching a maximum about the third hour. Metabolism is maintained

⁷³Gy Mestyan, and F. Varga, "Chemical Thermoregulation of Full-term and Premature Newborn Infants," The Journal of Pediatrics, 56:623, May, 1960.

⁷⁴John R. Murlin, Ruth E. Conklin, and M. Elizabeth Marsh, "Energy Metabolism of Normal Newborn Babies," American Journal of Diseases of Children, 29:21, January, 1925.

⁷⁵Clement B. Smith, The Physiology of the Newborn Infant, Springfield, Ill.: Charles C. Thomas, Publisher, 1945, p. 153.

at this level for several more hours. There is controversy about whether or not this is affected by age or environment.⁷⁶

In studying the reactions of the temperature of the skin Talbot, et al. observed the effect of food on surface temperatures. The findings indicated no characteristic reaction of the skin temperature to the ingestion of a meal.⁷⁷

Smith found that the tissues of an infant of two weeks of age may be about the same in basal metabolism as those of an infant one day after birth. A small change may be detected at the age of three weeks.⁷⁸

IV. SUMMARY

A survey of related literature revealed that there is little written regarding the method of temperature measurement specific to the newborn. There is controversy regarding the method to be used and the length of time the thermometer should be held in place.

It was found that environment, clothing, sex, surface area, exercise, and food intake were factors considered in doing study on body temperature measurements.

⁷⁶Selle, op. cit., pp. 16, 18.

⁷⁷Talbot, et al., op. cit., p. 996.

⁷⁸Clement A. Smith, The Physiology of the Newborn Infant, Springfield, Ill.: Charles C. Thomas, Publisher, 1945, p. 148.

CHAPTER III

METHOD OF APPROACH

The experimental method was used to find out if the degree of body temperature of the newborn, as recorded by axillary and rectal measurements would show variations between the methods and time periods used.

Experimental research is defined as "the description and analysis of what will be, or what will occur, under carefully controlled conditions."⁷⁹

In the previous chapter it was shown that various factors influence body temperature. Authors present different views on the method of taking infant temperatures and the length of time needed for the recording instrument to be held in position. A review of materials written helped to clarify the needs and approaches used in the study.

I. PREPARING THE SETTING

Selection of Tools

Chieftain Star thermometers number 46810 were obtained for use. They were of the stubby type, considered safest for

⁷⁹John W. Best, Research in Education, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959, p. 125.

rectal use. These thermometers were certified by the manufacturer that they met the regulations for accuracy as set up by the United States Bureau of Standards.⁸⁰

The thermometers were marked with red lacquer at a distance of 2.5 cm. and 5 cm. from the bulb end.

A Cleco stop watch was used during the experiment to keep an accurate observation of time.

Selection of Hospitals

Permission was obtained from the administrators and directors of nursing service at Hinsdale Sanitarium and Hospital in Hinsdale, Illinois and MacNeil Memorial Hospital in Berwyn, Illinois to gather data in the newborn nurseries of these hospitals. For the sake of accuracy all temperatures were taken by the investigator.

As mentioned in the second chapter, environment is an important factor in the regulation of body temperature of the newborn. For this reason, nurseries were selected which were temperature controlled. Even though the infants were used as their own controls, as many environmental factors were reduced as was possible. The clothing worn by each infant consisted of a cotton shirt and diaper and the covering was of a cotton blanket and sheet. The infants were kept covered as much as

⁸⁰Hugh H. Smith, "Notes on the History of Clinical Thermometry," Arizona Medicine, 14:574, October, 1957.

possible while the temperatures were taken.

Two hospitals were chosen for the collection of data to provide an adequate census of newborns during the period of time selected for gathering data.

Selection of Infants

One hundred normal full-term newborn infants in two hospitals were selected for the study. All infants were residents of newborn nurseries and were within the ages of twenty-four hours to seven days. Since the body temperature is not stabilized during the first day of life infants were not included in the study until they reached twenty-four hours of age.

It has been reported, as mentioned in the second chapter, that the temperature of a newborn may drop as low as 94° F. during the first hours of life. Since the lowest point of measurement on the thermometers used was 94° F., newborn infants in the first hours of life who might register a temperature below 94° F. were not included for the study.

Infants were used as their own controls and were used only one time for each of the four measures.

Selection of Procedure

An axillary measurement and three depths of rectal insertions of measurement were selected to be studied. In

literature, mention was made of various depths of rectal insertion of a measuring device for the study of body temperature by rectum. Three of the commonly used depths were selected for use in this study. They are (1) insertion of the bulb end of the thermometer just past the sphincter,* (2) 2.5 cm. and (3) 5 cm. depth into the rectum.

Time periods for measurement of body temperature recommended by authors varied from one to five minutes. The time periods of (1) one and one-half, (2) three, and (3) five minutes were used in this study to record the temperature of the body for each method of measurement used. More frequent measures of time would have made it difficult to record accurately while observing time and holding the thermometer in position.

Pilot Study

A pilot study was conducted to aid in determining materials needed and procedures to be used in taking the temperatures. Five infants were used. It was found that the degree of temperature could be read while the thermometer remained in position in the axilla and rectum. A method of recording was devised so that the recording materials which were considered a source of contamination to the nursery were not brought into that area. Clean paper towels were used for recording data.

*In the future this measure will be referred to as the rectal bulb measure.

To avoid further contamination the pencil and stop watch were handled with a disposable tissue which could be replaced for use with each infant.

II. GATHERING OF DATA

Temperatures were taken in a two week period in December, during the hours of 7 a.m. and 5 p.m. while infants were in the nursery.

The temperatures of the nurseries were checked and recorded each day. Temperatures of the rooms ranged from 76-78° F. during the period of the study. Humidity was not recorded because, as indicated in the previous chapter, this was not found to have an influence on infant temperatures.

Thermometers were prepared for use by cleansing with soap and water and soaking overnight in a solution of Zephiran 1:1000. This procedure met with the policy of the institutions involved.

In selecting infants, all newborns meeting the criteria as set forth in the study, in one nursery were studied the first day. Infants in a second nursery were included the second day in addition to those in the first nursery that had attained twenty four hours of age. This was continued until infants in five nurseries were used. Sixty-three infants of two nurseries were used in the Hinsdale Hospital and thirty-seven

infants from three nurseries were studied at MacNeil Memorial Hospital, making a total of one hundred infants studied.

An axillary temperature for the three time periods was taken on each newborn. A stop watch was used and temperature readings were recorded at one and one-half, three, and five minute intervals without removing the thermometer. No clothing was removed from the infant for this procedure.

Following the measurement of the axillary temperature, the mercury of the thermometer was shaken to its lowest reading, the thermometer lubricated with Lubafax and the bulb end inserted into the rectum beyond the sphincter muscle. Readings were recorded for the three time periods. The thermometer was removed, shaken down, inserted 2.5 cm. rectally and the reading at the three time periods was again recorded. This was repeated at a 5 cm. depth of rectal insertion of the thermometer, thus the same thermometer was used for all readings on the individual infant. The procedure took approximately twenty-five minutes for each infant.

III. SUMMARY

The experimental method was used as the research method in this study. Temperatures were taken on one hundred full-term normal newborn infants between the ages of twenty-four hours and seven days, who were residents of newborn nurseries of two hospitals.

Temperatures were measured four ways on each infant, by (1) axilla, (2) insertion of the bulb of the thermometer just beyond the sphincter, (3) 2.5 cm. into the rectum, and (4) 5 cm. insertion into the rectum. Body temperature at each measure was read and recorded at one and one-half, three, and five minute intervals on each infant.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

Temperatures of one hundred normal newborn infants between the ages of twenty-four hours and seven days were studied. All infants were residents of newborn nurseries in two hospitals. Temperatures were measured on each infant; one measurement by axilla and three by rectum in varying depths of insertion. The depths of insertion were (1) insertion of the bulb of the thermometer just past the sphincter, (2) 2.5 cm., and (3) 5 cm. into the rectum. Body temperature was read and recorded at one and one-half, three, and five minute intervals for each measurement used.

I. ANALYSIS AND INTERPRETATION

In observing the degree of temperature change in the infants comparisons were made between the various measures used to record temperatures. The amount of change as influenced by time was also noted.

Comparison of the Means of Measures of Body Temperatures

It was found when considering the means of temperatures taken on one hundred infants that the 5 cm. depth of insertion of the rectal thermometer provided readings which were stable

over the three periods of time. This measure also recorded the highest degree of body temperature in comparison to the other measures of taking temperatures as used in this study. Therefore it may be said that a temperature taken by a 5 cm. depth of rectal insertion for 1.5 minutes most nearly approaches body temperature when compared with the other measures used in the study.

The 2.5 cm. depth of insertion by rectum provided a mean temperature that showed little variation during the 5 minute period. It was found to be $.2^{\circ}$ lower than the 5 cm. depth at a period of 5 minutes, while the insertion of the rectal bulb alone recorded the lowest mean temperature reading of the measures used except at the 1.5 minute period when the axillary measure was the lowest reading obtained.

Axillary measures showed the greatest variation during the 5 minute time period, the highest degree of change occurred in the 1.5 to 3 minute time period. The mean of the 5 minute axillary temperatures was approximately the same as that of the 2.5 cm. rectal measures for 5 minutes. With axillary measure, it appeared that the length of time of measurement was important in order to obtain a degree of temperature more closely approximating body temperature. (See Table I and Figure 1).

Comparison of the Mean Differences of Body Temperature Readings

Mean differences of the temperature readings by the various measures over a 5 minute time period were compared. The readings obtained at the 5 cm. depth of rectal insertion showed no change during the 5 minute time period, while the 2.5 cm. insertion showed $.1^{\circ}$ increase between 1.5 and 3 minutes, and an additional $.1^{\circ}$ from 3 to 5 minutes.

TABLE I

MEAN TEMPERATURE READINGS FOR FOUR MEASURES OF
BODY TEMPERATURE AT THREE TIME PERIODS
ON ONE HUNDRED SELECTED NEWBORNS

Method of Measurement	Time in Minutes			Average for all Time Periods
	1.5	3.0	5.0	
Rectal 5 cm.	98.6	98.6	98.6	98.6
Rectal 2.5 cm.	98.2	98.3	98.4	98.3
Rectal bulb	97.6	97.9	98.0	97.8
Axillary	97.5	98.0	98.3	97.9

The mean temperature readings recorded with the rectal bulb measure showed $.3^{\circ}$ elevation when time was increased from 1.5 to 3 minutes, and an added $.1^{\circ}$ was recorded when time was increased from 3 to 5 minutes.

The mean of the axillary measures showed an elevation of $.5^{\circ}$ with the increase of time from 1.5 to 3 minutes. There

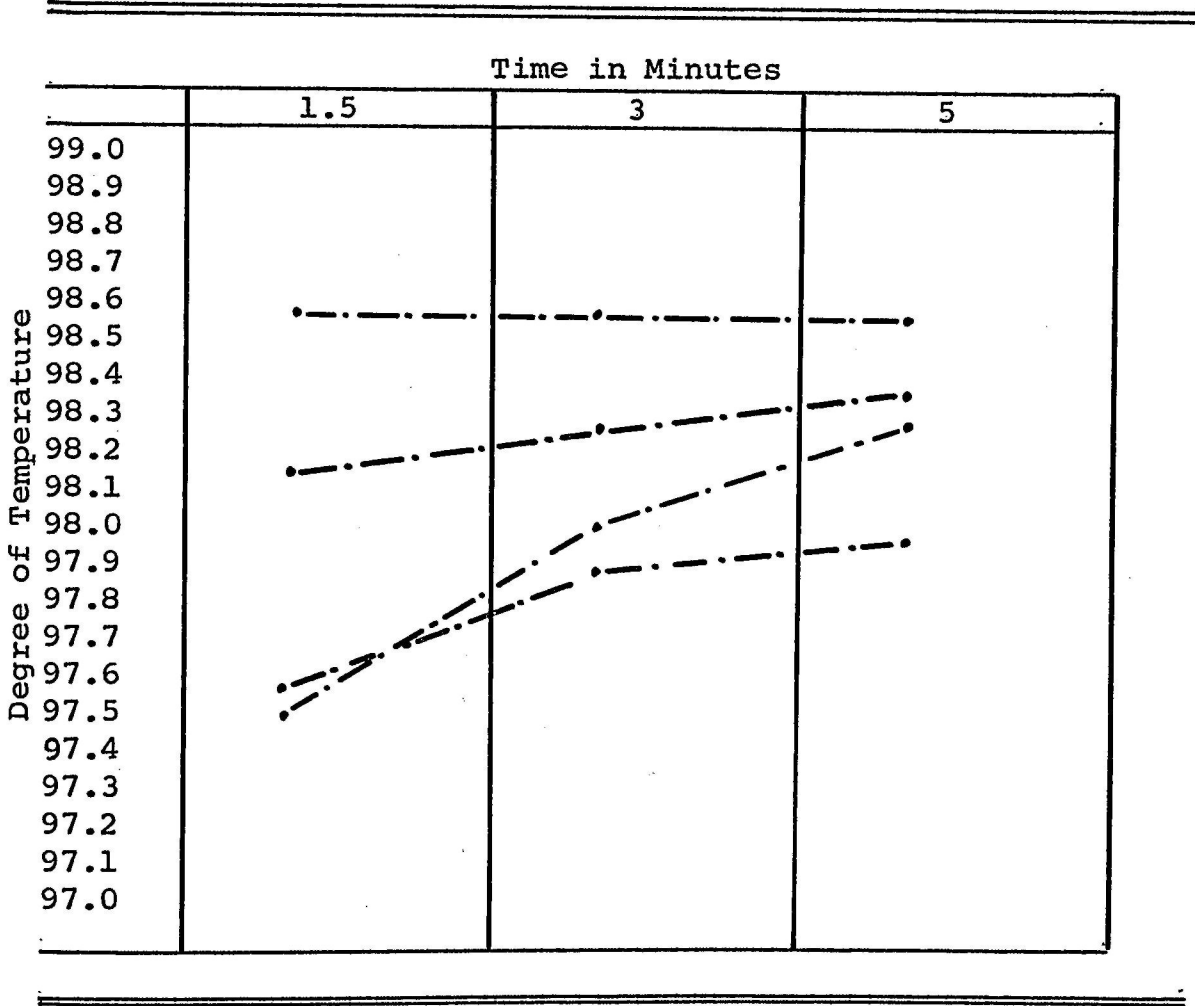


FIGURE 1

MEAN TEMPERATURE READINGS FOR FOUR MEASURES OF
 BODY TEMPERATURE AT THREE TIME PERIODS
 ON ONE HUNDRED SELECTED NEWBORNS

Legend: Rectal 5 cm. ---
 Rectal 2.5 cm. ---
 Axillary ---
 Rectal Bulb ---

was an increase of $.3^{\circ}$ when time was extended from 3 to 5 minutes. Therefore it was shown that the 5 cm. rectal measure remained stable during the time periods from 1.5 to 5 minutes and the 2.5 cm. measure was almost as stable. The rectal bulb measure showed some degree of elevation from 1.5 to 3 minutes of time while there was little change when time was extended from 3 to 5 minutes. The greatest mean difference was shown with the axillary measure during the time period of 1.5 to 3 minutes, thus demonstrating that time was an important factor in obtaining a higher degree of temperature as registered by the thermometer with the axillary measure. (See Table II).

TABLE II

MEAN DIFFERENCES OF BODY TEMPERATURE READINGS BY FOUR MEASURES FOR THREE TIME PERIODS ON ONE HUNDRED SELECTED NEWBORN INFANTS

Method of Measurement	Time Periods		Total Mean Difference
	1.5-3.0 minutes	3.0-5.0 minutes	
Rectal 5 cm.	.0	.0	.0
Rectal 2.5 cm.	.1	.1	.2
Rectal bulb	.3	.1	.4
Axillary	.5	.3	.8

Comparison of the Means of Axillary Temperature Readings with Readings Obtained by Rectal Measurement

Axillary to Rectal 5 cm. In a comparison of the means of axillary temperatures and rectal temperature readings it was found that the greatest difference occurred in the reading at 1.5 minutes between the axillary and the 5 cm. depth of insertion of rectal measure. The mean difference at 1.5 minutes was 1.1° . At 3 minutes the difference was $.6^{\circ}$ and at 5 minutes the difference was $.3^{\circ}$. For an axillary measurement of temperature to produce a degree of temperature more nearly that of the rectal measure it would be necessary to take the axillary measure for 5 minutes as compared with a 1.5 minute rectal 5 cm. measure. (See Table III).

TABLE III

COMPARISON OF MEAN TEMPERATURES OF AXILLARY AND RECTAL 5 CM. MEASURES FOR THREE TIME PERIODS ON ONE HUNDRED NORMAL NEWBORN INFANTS

Method of Measurement	Time in Minutes		
	1.5	3.0	5.0
Axillary	97.5	98.0	98.3
Rectal 5 cm.	98.6	98.6	98.6
Mean Degree of Difference	1.1	.6	.3

Axillary to Rectal 2.5 cm. The axillary measure was compared with the 2.5 cm. rectal measure and a mean difference of $.7^{\circ}$ at 1.5 minutes was observed. At 3 minutes there was a $.3^{\circ}$ difference while at 5 minutes $.1^{\circ}$ was noted. It is to be noted that the mean degree of the axillary temperature at 5 minutes is the same as that obtained in 3 minutes by the 2.5 cm. rectal measure, however readings by both measures at 3 minutes were very similar. (See Table IV).

TABLE IV

COMPARISON OF MEAN TEMPERATURES OF AXILLARY AND RECTAL
2.5 CM. MEASURES FOR THREE TIME PERIODS ON ONE
HUNDRED NORMAL NEWBORN INFANTS

Method of Measurement	Time in Minutes		
	1.5	3.0	5.0
Axillary	97.5	98.0	98.3
Rectal 2.5 cm.	98.2	98.3	98.4
Mean Degree of Difference	.7	.3	.1

Axillary to Rectal Bulb. In comparing the means of the axillary measure with those of the rectal bulb measure, it was found that at 1.5 minutes there was $.1^{\circ}$ difference. At 3 and 5 minutes the axillary temperature reading was higher than the rectal bulb measure with $.1^{\circ}$ mean difference at 3 minutes and $.3^{\circ}$ mean difference at 5 minutes. Thus it would seem that

these measures produced a degree of temperature which was more alike than that obtained by other measures, therefore it appears the axillary measure could be relied upon as well as the rectal bulb measure. (See Table V).

TABLE V

COMPARISON OF MEAN TEMPERATURES OF AXILLARY AND RECTAL BULB MEASURES FOR THREE TIME PERIODS ON ONE HUNDRED NORMAL NEWBORN INFANTS

Method of Measurement	Time in Minutes		
	1.5	3.0	5.0
Axillary	97.5	98.0	98.3
Rectal bulb	97.6	97.9	98.0
Mean Degree of Difference	.1	-.1	-.3

Percentage of Infants Demonstrating Varying Degrees of Temperature Differences

It was of interest to note the degree of temperature change of the individual infants as shown with the various measures used.

Rectal 5 cm. As the length of time was increased for the measurement of body temperature it was found that the rectal measure at 5 cm. depth of insertion provided the least change. Eighty-four per cent of the infants registered no

change in temperature when time was increased from 1.5 to 3 minutes and 97 per cent showed no elevation of the temperature reading when the time was extended from 3 to 5 minutes. Sixteen per cent of the infants showed a $.2^{\circ}$ increase with extension of time from 1.5 to 3 minutes, while 3 per cent showed a $.2^{\circ}$ with increase of time from 3 to 5 minutes. This seems to indicate that a 5 cm. depth of insertion is dependable when taken for 1.5 minutes. (See Table VI).

TABLE VI

PERCENTAGE OF INFANTS SHOWING DEGREE OF TEMPERATURE CHANGE WITH USE OF THE RECTAL 5 CM. MEASURE IN SPECIFIC TIME PERIODS

Degree of Change	Percentage of Infants	
	1.5 - 3.0 Minutes	3.0 - 5.0 Minutes
.4	.0	.0
.2	.16	.03
.0	.84	.97

Rectal 2.5 cm. At a depth of 2.5 cm. by rectum, 90 per cent of the infants showed $.0$ to $.2^{\circ}$ change of temperature when time was increased to 3 minutes from 1.5 minutes. Approximately 95 per cent showed an increase of $.0$ to $.2^{\circ}$ when time was extended from 3 to 5 minutes. There were no changes noted over $.4^{\circ}$ with the exception of one infant that displayed a $.6^{\circ}$ change at the 5 minute period. This appears

to indicate that with the use of the Rectal 2.5 cm. measure there is a very small chance of a change in the degree of temperature obtained with the increase in the time of measurement. (See Table VII).

TABLE VII

PERCENTAGE OF INFANTS SHOWING DEGREE OF TEMPERATURE CHANGE WITH USE OF THE RECTAL 2.5 CM. MEASURE IN SPECIFIC TIME PERIODS

Degree of Change	Percentage of Infants	
	1.5 - 3.0 Minutes	3.0 - 5.0 Minutes
.4	.10	.02
.2	.32	.30
.0	.58	.64

Rectal Bulb. In computing the degree of change within the time intervals with the rectal bulb measure, it was observed that 32 per cent of the infants showed no change in temperature when time was increased from 1.5 to 3 minutes, while 62 per cent showed no change when time was extended 3 to 5 minutes. There were approximately 60 per cent that gave evidence of $.2^{\circ}$ to $.6^{\circ}$ change with increase of time from 1.5 to 3 minutes while 35 per cent showed $.2^{\circ}$ to $.4^{\circ}$ increase of temperature in the time extension of 3 to 5 minutes. With this measure was seen a wide variation of temperature changes as demonstrated by some infants showing 1.2° to 1.4° change

with the extension of time periods in the measurement of the temperature. (See Table VIII).

TABLE VIII

PERCENTAGE OF INFANTS SHOWING DEGREE OF TEMPERATURE
CHANGE WITH USE OF THE RECTAL BULB MEASURE
IN SPECIFIC TIME PERIODS

Degree of Change	Percentage of Infants	
	1.5 - 3.0 Minutes	3.0 - 5.0 Minutes
1.4	.02	.01
1.2	.00	.01
1.0	.03	.01
.8	.02	.00
.6	.15	.01
.4	.21	.11
.2	.25	.23
.0	.32	.62

Axillary. Temperatures taken by the axillary measure showed the greatest change in degree when time was increased from 1.5 to 3 minutes. Approximately 75 per cent of the infant temperatures increased $.4^{\circ}$ to $.6^{\circ}$ during this time while 15 per cent showed an increase of $.8^{\circ}$ to 1.0° . When time was extended from 3 to 5 minutes an increase of $.2^{\circ}$ to $.4^{\circ}$ was shown by 80 per cent of the infants while 16 per cent showed

no change during this time. It is evident that after the first 3 minutes when time was increased to 5 minutes that there was not as much increase in the degree of temperature as was seen in the first 3 minutes when temperatures were recorded by axillary measure. (See Table IX).

TABLE IX

PERCENTAGE OF INFANTS SHOWING DEGREE OF TEMPERATURE
CHANGE WITH USE OF THE AXILLARY MEASURE
IN SPECIFIC TIME PERIODS

Degree of Change	Percentage of Infants	
	1.5 - 3.0 Minutes	3.0 - 5.0 Minutes
1.0	.05	.00
.8	.10	.02
.6	.32	.02
.4	.42	.27
.2	.11	.53
.0	.00	.16

Percentage of Infants Showing Varying Degrees of Temperature
Changes with Comparisons of Measures and Consideration of Time
Periods

A comparison was made between the axillary measure and the various rectal measures to show the percentage of infants demonstrating differences of temperature.

Axillary to Rectal 5 cm. It was shown that the longer the thermometer was held in place in the measurement of body temperature the less difference there was in the degree of temperature obtained between the measures used. For example, in comparing axillary measure to the rectal 5 cm. measure at 1.5 minutes, approximately 50 per cent of the infants showed $.6^{\circ}$ to 1.0° difference of temperature, at 3 minutes 46 per cent of the infants showed a $.4^{\circ}$ to $.6^{\circ}$ difference, while at 5 minutes 50 per cent showed only $.2^{\circ}$ to $.4^{\circ}$ difference. At 5 minutes 8 per cent of the infants demonstrated a $.2^{\circ}$ higher temperature by axillary measure than by the 5 cm. rectal measure. (See Figure 2, page 45)

Axillary to Rectal 2.5 cm. In comparing axillary to rectal 2.5 cm. measure 52 per cent of the infants showed $.4^{\circ}$ to $.8^{\circ}$ difference in 1.5 minutes. At 3 minutes 51 per cent showed $.2^{\circ}$ to $.4^{\circ}$ difference, while at 5 minutes 64 per cent showed $.0$ to $.4^{\circ}$ difference. With this comparison axillary measure recorded a higher temperature than the rectal measure in 4 per cent of the infants at 1.5 minutes, in 11 per cent at 3 minutes, and in 21 per cent at 5 minutes. Here again, is shown that given time axillary measure may produce temperatures closely approximating body temperature. (See Figure 3, page 46)

Axillary to Rectal Bulb. Use of the rectal bulb measure as compared to the axillary measure showed less difference in

degree of temperature during the time periods than the other measures. At 1.5 minutes there were 38 per cent of the infants with .0 to .2° difference, at 3 minutes 34 per cent, and at 5 minutes 28 per cent. With these measures it was noted that there were more infants showing a higher temperature reading by axillary measure than by the rectal measure. For example, a higher axillary temperature was manifested by 37 per cent of the infants at 1.5 minutes, 50 per cent at 3 minutes, and 56 per cent at 5 minutes. This may mean that an axillary temperature at 3 minutes more closely approximates body temperature than does the rectal bulb measure. (See Figure 4, page 47).

Statistical Analysis of Findings

Analysis of Variance. An analysis of variance was computed to test the sub-hypotheses that there is no significant difference between body temperature readings when they are measured by insertion of the thermometer rectally by a depth of 5 cm., 2.5 cm., and by bulb and when readings are taken at 1.5, 3, and 5 minutes at the 3 depths. An F value of 26.4 was determined between the groups representing the various measures. This showed a high probability of significance. An F value does not indicate where within the measures the significant difference lies. This was computed by use of the t test. An F value of 4.61 was found when the time of measurement was the

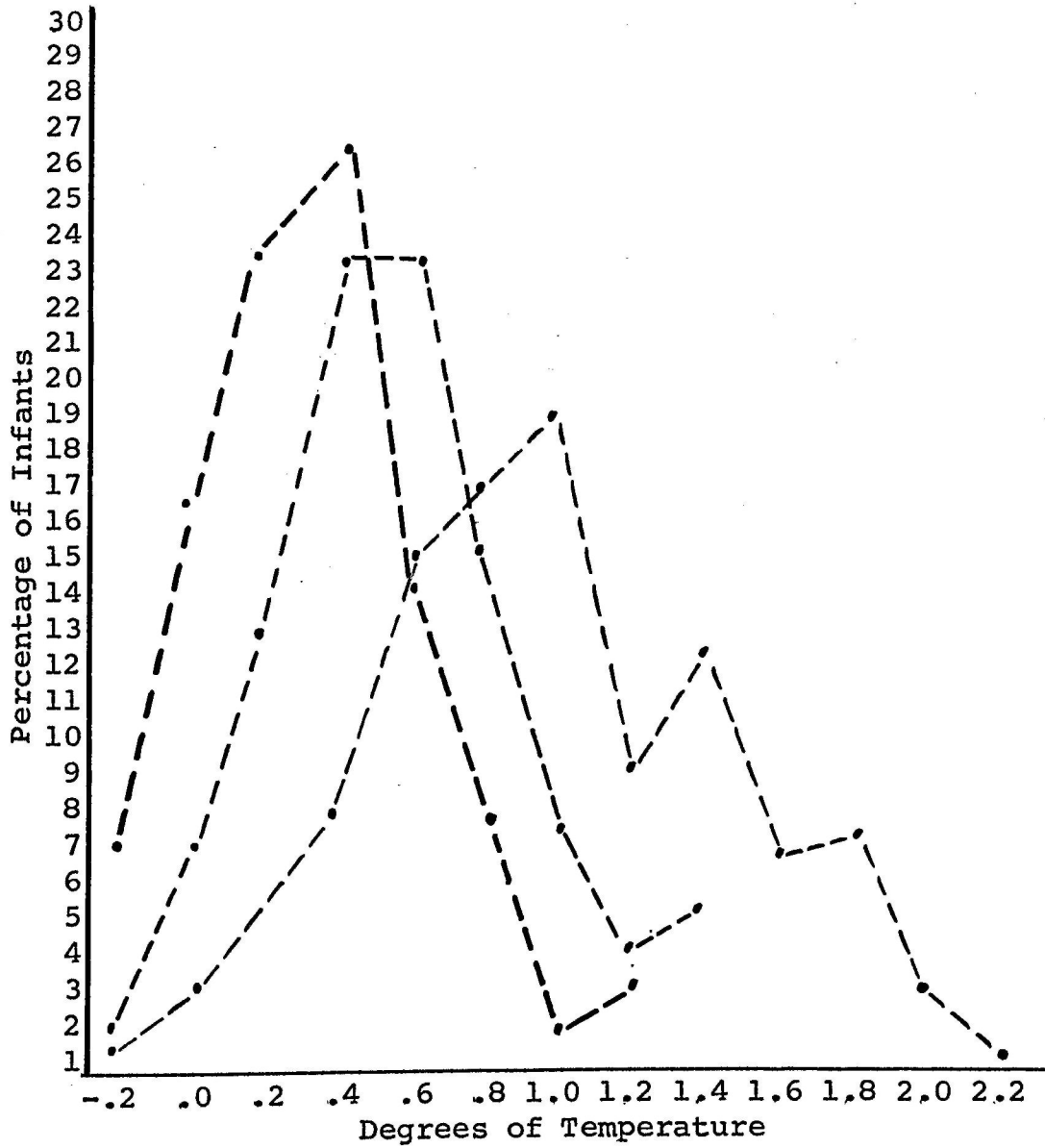


FIGURE 2

PERCENTAGE OF INFANTS WITH VARIOUS TEMPERATURE DIFFERENCES
AS SHOWN BETWEEN AXILLARY AND RECTAL 5 CM. MEASUREMENTS
FOR DESIGNATED TIME PERIODS ON NEWBORN INFANTS

Legend: 1.5 minutes ---
3 minutes ---
5 minutes ---

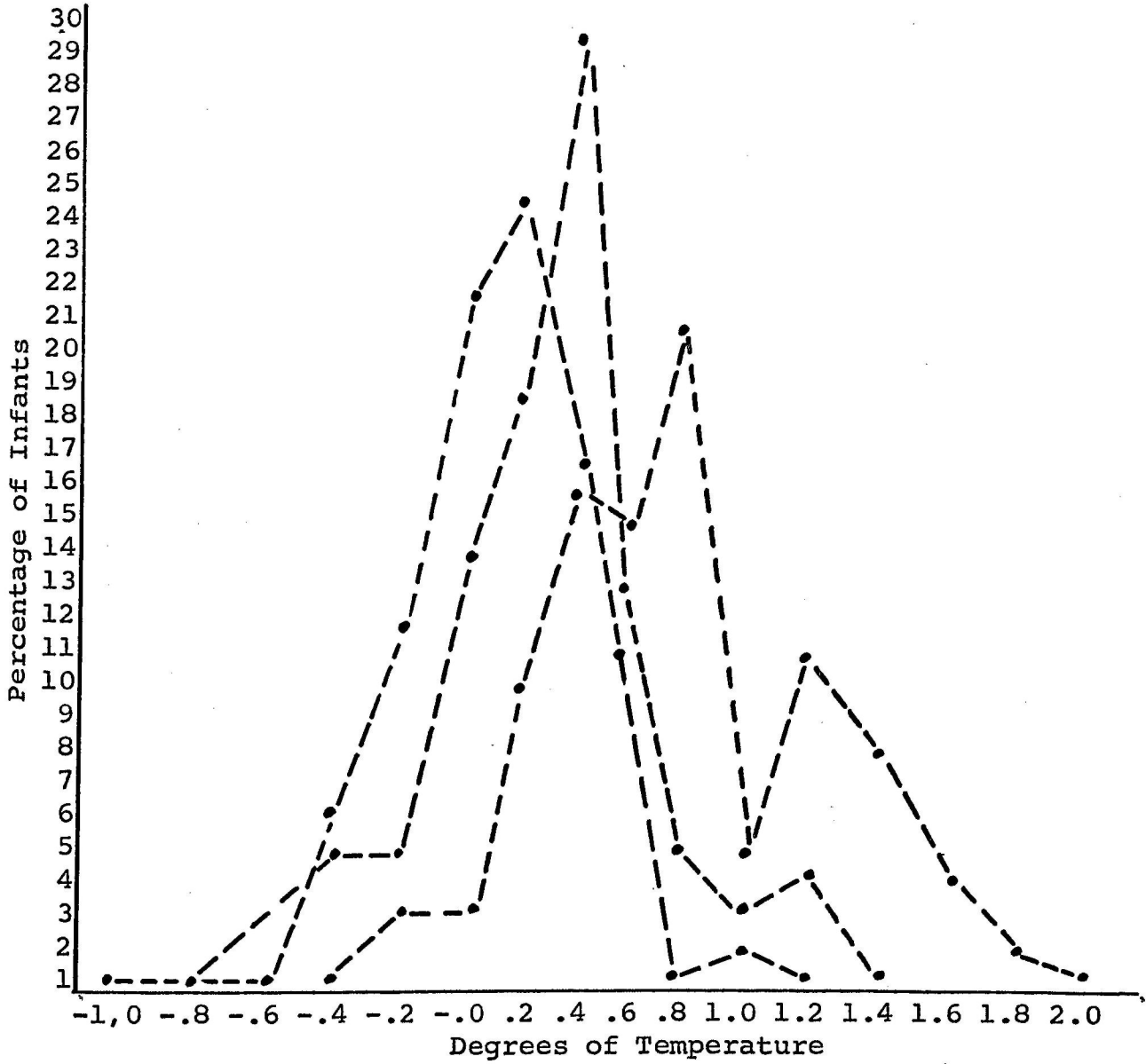


FIGURE 3

PERCENTAGE OF INFANTS WITH VARIOUS TEMPERATURE DIFFERENCES AS SHOWN BETWEEN AXILLARY AND RECTAL 2.5 CM. MEASURE FOR DESIGNATED TIME PERIODS ON NEWBORN INFANTS

LEGEND: 1.5 minutes ---
 3 minutes ---
 5 minutes ---

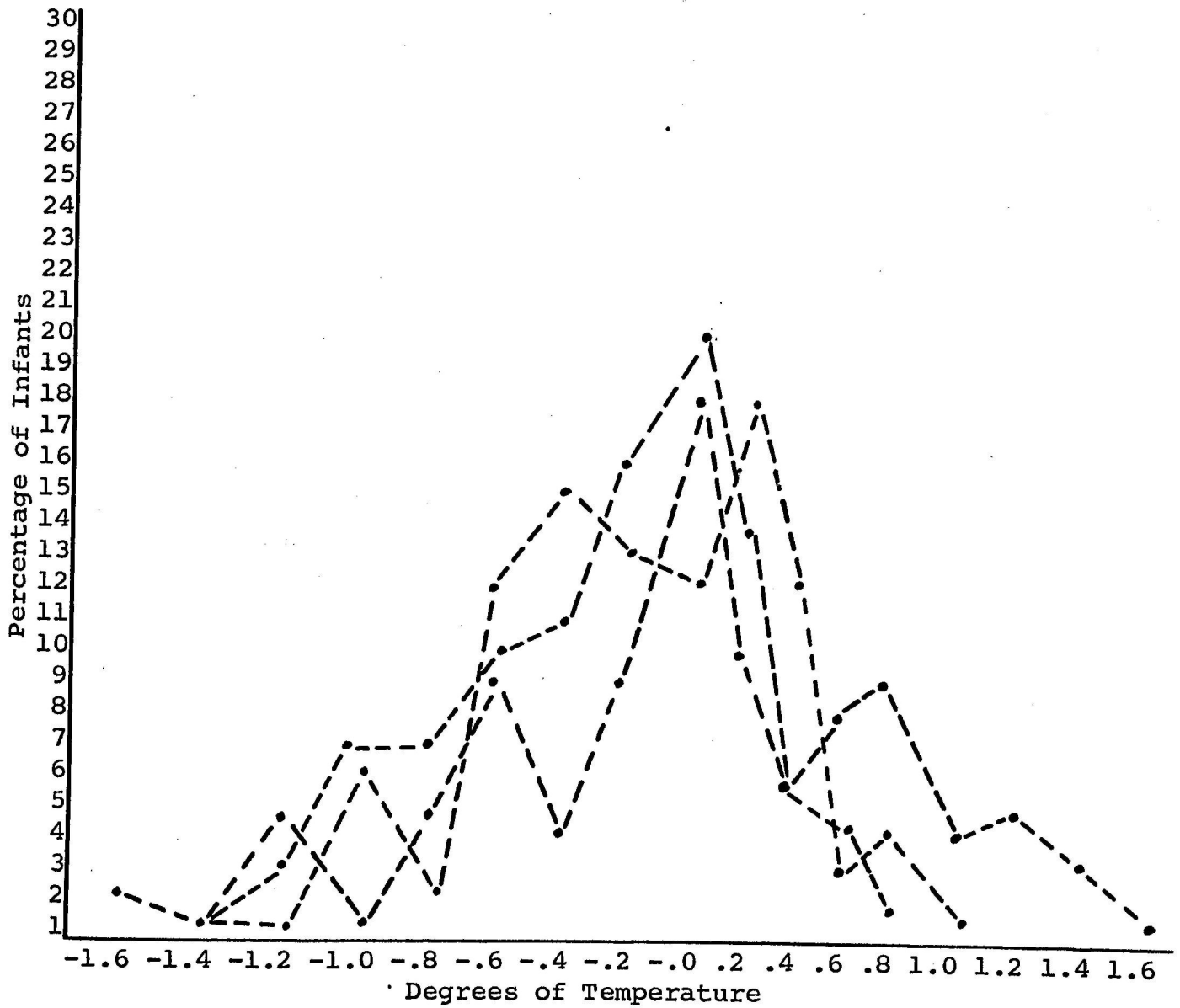


FIGURE 4

PERCENTAGE OF INFANTS WITH VARIOUS TEMPERATURE DIFFERENCES
AS SHOWN BETWEEN AXILLARY AND RECTAL BULB MEASURE
FOR DESIGNATED TIME PERIODS ON NEWBORN INFANTS

LEGEND: 1.5 minutes ----
3 minutes ----
5 minutes ----

variable. An interpretation showed a low probability of significance. Thus the hypotheses would be partially rejected. (See Table X).

TABLE X

VALUES OF F--RATIOS COMPUTED IN TESTING (1) METHODS OF MEASUREMENTS OF TAKING BODY TEMPERATURE AND (2) LENGTH OF TIME OF INSERTION OF THERMOMETER

Groups Tested	F Value	Probability of Chance
Between Methods of Measurement	26.4*	Between 1% and 2.5%
Between Time Periods	4.61**	Much less than 5%

* Denotes high probability of significance

** Denotes low probability of significance

T Test. A statistical analysis using the t test to determine significance between the methods of measurement of temperatures and between the times of insertion was done. It was found that with the rectal 5 cm. and 2.5 cm. measures there was low probability of significant difference between temperatures due to time of insertion. It was also found that there was a low probability of significant difference in the rectal bulb measure with extension of time from 3 to 5 minutes.

In comparison of temperatures taken by axilla and the rectal bulb measurement there was low probability of significant

difference found at the 1.5 and 3 minute times of insertion. All other measures and time periods showed a high probability of significant difference. A significant difference was reported when $.3^{\circ}$ difference of temperature was recorded. In a clinical situation whether this would be considered significant by medical personnel is a factor which would need to be determined by these individuals. (See Tables XI and XII).

TABLE XI

"t" VALUES IN TIME COMPARISON

Time Comparison	"t"	Probability of Chance	Probability of Significance
Axillary 1.5 to 3 minutes	8.65	.001	.999
Axillary 3 to 5 minutes	4.35	.001	.999
Axillary 1.5 to 5 minutes	12.65	.001	.999
Rectal bulb 1.5 to 3 minutes	4.5	.001	.999
Rectal bulb 3 to 5 minutes	1.6	.1	.9
Rectal bulb 1.5 to 5 minutes	6.1	.001	.999
Rectal 2.5 cm. 1.5 to 3 minutes	1.7	.1	.9
Rectal 2.5 cm. 3 to 5 minutes	1.2	.2	.8
Rectal 2.5 cm. 1.5 to 5 minutes	2.9	.01	.99
Rectal 5 cm. 1.5 to 3 minutes	.51	.6	.4
Rectal 5 cm. 3 to 5 minutes	.13	.9	.1
Rectal 5 cm. 1.5 to 5 minutes	.62	.5	.5

TABLE XII

"t" VALUES IN COMPARISON OF METHODS OF MEASUREMENT

Time of Insertion	Comparison of Methods of Measurement	"t"	Probability of Chance	Probability Significance
1.5	Axillary to Rectal 5 cm.	15.6	.001	.999
	Axillary to Rectal Bulb	1.3	.2	.8
	Axillary to Rectal 2.5 cm.	12.2	.001	.999
	Rectal bulb to Rectal 2.5	9.7	.001	.999
	Rectal bulb to Rectal 5 cm.	13.3	.001	.999
	Rectal 2.5 to Rectal 5 cm.	5.0	.001	.999
3.0	Axillary to Rectal 5 cm.	8.8	.001	.999
	Axillary to Rectal bulb	.17	.8	.2
	Axillary to Rectal 2.5 cm.	5.6	.001	.999
	Rectal bulb to Rectal 2.5 cm.	7.1	.001	.999
	Rectal bulb to Rectal 5 cm.	11.5	.001	.999
	Rectal 2.5 to Rectal 5 cm.	3.9	.001	.999
5.0	Axillary to Rectal 5 cm.	5.1	.001	.999
	Axillary to Rectal bulb	4.0	.001	.999
	Axillary to Rectal 2.5 cm.	2.5	.01	.99
	Rectal bulb to Rectal 2.5 cm.	5.6	.001	.999
	Rectal bulb to Rectal 5 cm.	8.4	.001	.999
	Rectal 2.5 cm. to Rectal 5 cm.	3.0	.001	.999

II. SUMMARY

In this chapter comparisons were made of the means of temperatures taken on one hundred selected infants by four measures for three time periods. The percentages of infants showing degrees of temperature differences between the measures used was also observed. It was found that at a 5 cm. depth of rectal measurement the mean temperature was highest. Time did not cause the degree of temperature registered on the thermometer to be changed when taken at this depth. The 2.5 cm. measure by rectum was stable to within $.2^{\circ}$ to $.4^{\circ}$ and almost as high as that of the 5 cm. depth. The rectal bulb measure produced a mean temperature similar to the axillary measure at 1.5 minutes while at 3 and 5 minutes a higher reading was recorded with the axillary measure.

Axillary measures were compared with the three rectal measures used to find out what percentage of infants showed changes in temperature and what the change was. The highest percentage of change between axillary and rectal measures were found with the use of the 5 cm. rectal depths of measure. A wide variation in degree was observed with the use of the rectal bulb measure.

Statistical computation of the findings showed that there was a probable significant difference between the measures used and a low probable significant difference between some of the time periods.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. SUMMARY OF THE STUDY

This study was conducted on newborn infants to compare axillary and rectal body temperature and to find out which measure in a given period of time records the highest temperature. Consideration was given to three time periods of axillary measurement and to three time periods of three depths of insertion of rectal measurement. The time periods were (1) one and one-half, (2) three, and (3) five minutes. The depths of rectal insertion included (1) insertion of the bulb end of the thermometer just beyond the sphincter, (2) 2.5 cm., and (3) 5 cm. into the rectum.

In the second chapter it was shown that authors have varying opinions regarding the method of choice of temperature measurement, and the length of time the thermometer should be held in position. Variables which may influence the degree of temperature of infants were found to be environment, clothing, exercise, and surface area of the body.

The research was carried out by the experimental method. One hundred full-term normal newborn infants, twenty-four hours to seven days of age were studied. All infants were in newborn

nurseries of two hospitals. Nurseries in these hospitals were temperature controlled and infants were dressed alike. To avoid possible error all temperatures were taken by one individual and one thermometer was used for the four measures on each infant. Thermometers were shaken to their lowest reading between each measure and a stop watch was used for consistent timing.

The data collected for this study were analyzed and interpreted as follows: (1) Comparisons of the means of the temperatures for the four measures and the three time periods, (2) Comparison of the mean differences of temperatures with consideration to four measures and three time periods, (3) Comparison of the means of the axillary measures to the rectal measurements for the three time periods, (4) Percentage of the infants demonstrating temperature change with each measure used, (5) Comparison of the percentage of infants showing temperature changes between axillary and the rectal measures for the three time periods, and (6) Statistical analysis by use of the F value and t test.

Comparison of the Means

In this comparison it was shown that the 5 cm. measure rectally provided readings that were identical for the three time periods. The highest degree of body temperature was obtained by this measure. At 2.5 cm. rectally a fairly stable

temperature over the time periods existed, the degree of temperature being slightly lower than that of the 5 cm. depth. At 3 minutes and 5 minutes the rectal bulb measure recorded temperature readings lower than those recorded by the other measures and there was little difference between the 3 and 5 minute readings. Of the four measures the mean temperature of the axillary measure showed the lowest reading at 1.5 minutes whereas at 3 minutes there was an increase of $.5^{\circ}$, while at 5 minutes the reading increased $.3^{\circ}$ making the mean temperature only $.1^{\circ}$ lower than the 2.5 cm. rectal reading for the same time period.

Comparison of the Mean Differences

The findings with comparison of mean differences showed that the highest degree of change occurred with the axillary measure when time was increased from 1.5 to 3 minutes, this being $.5^{\circ}$, while the rectal bulb measure showed a $.3^{\circ}$ change in this time period. There was only $.1^{\circ}$ difference within the increase of time periods from 1.5 to 3 minutes and from 3 to 5 minutes when the 2.5 cm. rectal measure was used while the 5 cm. rectal measure showed no difference.

Comparison of the Means of Axillary Measures with Rectal

Measures for Identical Time Periods

The highest mean difference observed between axillary and rectal measures was found to be between the axillary

and 5 cm. rectal measure at 1.5 minutes. The rectal measure recorded the higher temperature and the mean difference was 1.1° . This difference was reduced to a $.6^{\circ}$ difference when time was increased to 3 minutes for measurement, while the difference was lowered to $.3^{\circ}$ with an increase of time to 5 minutes. The 2.5 cm. rectal measure was compared to the axillary measure and the rectal measure showed a $.7^{\circ}$ higher temperature in 1.5 minutes. There was a $.3^{\circ}$ difference when time was extended to 3 minutes and only $.1^{\circ}$ difference in 5 minutes of time. The rectal bulb measure demonstrated little difference with the axillary measure in 1.5 minutes but at 3 and 5 minutes the axillary measure showed temperatures $.1^{\circ}$ and $.3^{\circ}$ higher than those measured by rectal bulb.

Percentage of Infants Demonstrating Temperature Change with Each Measure

It was found that with the rectal 5 cm. measure 80 to 95 per cent of infants did not have a change in the degree of temperature when the period of time was extended for measurement. This was also true with 60 to 65 per cent of the infants when temperature was measured with the 2.5 cm. rectal measure. With the rectal bulb measure there were 30 per cent of the infants that showed no change in degree of temperature when time was increased from 1.5 to 3 minutes and 60 per cent when time was increased from 3 to 5 minutes. Therefore it would seem that

time was an important factor in taking temperatures with the rectal bulb measure. There were more variations of temperature with this measure, a few infants showed as much as 1.4° change of temperature. With the axillary measure all infants showed a temperature change when time of measurement was increased from 1.5 to 3 minutes. It was found that 40 per cent of the infants showed $.4^{\circ}$ change and 32 per cent $.6^{\circ}$ change in the 1.5 minute to 3 minute time period. In the extension of time from the 3 minute period to the 5 minute period over 70 per cent of infants demonstrated $.2^{\circ}$ or less in change of temperature. Thus it appears that at 3 minutes an axillary temperature would more closely approximate body temperature than at 1.5 minutes.

Percentage of Infants Showing Temperature Change with
Comparison of Axillary to the Rectal Measures

A comparison of axillary to rectal measures showed up a difference in the relation of the measures to each other. It was shown that with the comparisons made of the temperatures recorded in 3 minutes and 5 minutes that there was considerably less difference in the degree of temperature obtained. Thus increase of time caused temperatures taken by different measures to be more closely related. For example, in comparing the axillary measure to the rectal 5 cm. measure, it was shown that 50 per cent of the infants showed $.6^{\circ}$ to 1.0° of difference at 1.5 minutes. At 3 minutes 50 per cent of the infants showed $.4^{\circ}$

to $.6^{\circ}$ difference, while at 5 minutes 50 per cent showed $.2^{\circ}$ to $.4^{\circ}$ difference in temperature.

With the 2.5 cm. rectal measure and axillary measure the difference was not as marked. Fifty per cent showed a $.6^{\circ}$ to $.8^{\circ}$ difference in 1.5 minutes. At 3 minutes 50 per cent showed $.2^{\circ}$ to $.4^{\circ}$ difference while in 5 minutes 50 per cent showed $.0$ to $.2^{\circ}$ difference.

In comparing the rectal bulb measure and axillary measure a wider variation in temperatures existed with the highest per cent of infants showing little temperature changes at each time period. Thus not only is there a difference in temperature readings obtained by the different measures studied but they also differ in their relation to each other.

Statistical Analysis

With the use of the F value a high statistical significant difference was found between the temperatures recorded by the various measures used, while a low probability of significant difference was shown on temperature readings recorded between the time intervals. A t test was done between measures and time periods and demonstrated a low probability of significant difference with the 5 cm. rectal measure for the time periods studied. A probable significant difference with the other measures and time periods studied was shown.

II. CONCLUSIONS

Conclusions were based on the findings of the study through the comparisons made between the means of the temperatures for the various measures and time periods and from an analysis of the percentage of infants showing temperature changes and the degree of change.

Conclusions are these:

1. Since it was shown in the fourth chapter that the highest degree of temperature was recorded by the 5 cm. rectal measure then, for the purpose of getting the highest body temperature reading this measure should be used in preference to the other measures studied.

2. It was also shown that the 5 cm. rectal measure was the most stable for the periods of time employed in the study. For the sake of getting the highest reading for any time interval it seems that the 5 cm. measure is superior.

3. It can be pointed out that the 2.5 cm. rectal measure proved almost as high as the greater depth of 5 cm. in the temperature obtained. Then this measure could be used to provide a temperature reading which closely approximates that of the 5 cm. rectal measure.

4. With consideration to time it was shown that the 2.5 cm. rectal measure was found nearly as stable as the 5 cm. measure.

5. At the full 5 minute time period the axillary measure approaches the degree of temperature of the rectal measures.

6. It appears that the rectal bulb measure is more like the axillary measure than are the other rectal measures.

7. It was found that there is a probable significant difference between the several ways of taking infant temperatures for each of the time intervals, but when considered from a clinical point of view these differences may not be significant.

8. The hypotheses of the study were that (1) There is no significant difference between body temperature readings taken by rectum and axilla on the newborn, (2) There is no significant difference of body temperature reading when taken by insertion of the bulb of the thermometer past the rectal sphincter, at 2.5 cm., or 5 cm. depth of insertion, (3) There is no significant difference in body temperature when readings are taken at one and one-half, three, and five minutes when the thermometer is inserted rectally at the depths mentioned above. These hypotheses have not been proved. Contrary to what was there predicted, except for the 5 cm. rectal depth there was a probable significant difference between the various measures studied. Clinically however, the hypotheses guiding the study may still have some validity.

9. From the clinical point of view the axillary measure appears to be as desirable as the rectal measures.

10. It appears that the commonly accepted standard that rectal temperatures are 1° higher than those measured orally and axillary measures 1° lower would not be considered applicable to newborn infants.

11. This study supports the review of literature that there is no one measure or time period which may be considered best in measurement of infant temperatures.

III. RECOMMENDATIONS

Because of the findings of the study it is recommended that:

1. Consideration be given to the practicability of the taking of infant temperatures by axilla at 3 or 5 minutes of time.
2. Nursery personnel within a hospital select a measure and time period for the taking of infant temperatures and adhere to this procedure thus lessening temperature differences caused by variations with time and measure regardless of the measure selected.
3. A study be made on infants with elevated temperatures to ascertain if skin temperature is higher than rectal temperature in the presence of fever.

4. A time study be made to determine if more nursing time is required when taking an axillary temperature for 5 minutes as compared with a rectal temperature for a shorter period of time. All nursing measures connected with the procedure should be considered.

5. Since mention was made of the danger of rectal temperature as a method of taking temperatures on infants further study may be made as to the presence and extent of this factor.

6. That a further study be done under similar circumstances using a larger number of infants.

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A COMPARISON OF RECTAL AND AXILLARY TEMPERATURES

ON ONE HUNDRED SELECTED NEWBORN INFANTS

by

Marlene Van Puymbrouck

An Abstract of a Thesis

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for the Degree Master of Science

in the Field of Nursing

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ABSTRACT

This study was conducted on one hundred full-term normal newborn infants to compare body temperatures as obtained by axilla and rectal measures and to find out which measure recorded the highest temperature. Three time periods of axillary measurement and three time periods of the three depths of rectal measure were considered. The three time periods were (1) one and one-half, (2) three, and (3) five minutes. The three depths of rectal insertion were (1) insertion of the bulb end of the thermometer just beyond the sphincter, (2) 2.5 cm., and (3) 5 cm. into the rectum.

The research was carried out by the experimental method. Infants were twenty-four hours to seven days of age and residents in two hospitals where the nurseries were temperature controlled and clothing worn was similar. One thermometer was used for the four measures on each infant and temperatures were taken by one individual to avoid possible error.

It was found that the 5 cm. depth of insertion rectally recorded the highest body temperature of the measures used. This measure was stable over the periods of increase of time of the measurement. The 2.5 cm. rectal insertion provided a degree of temperature which was very close in degree of temperature and stability when compared with the 5 cm. depth.

Variations and a lower degree of temperature was found with the rectal bulb measure. The axillary measure approximated the degree of temperature obtained by the 2.5 cm. measure at 5 minutes. It was observed that time caused a greater change in the degree of temperature recorded by axillary measurement, especially in the increase of time from 1.5 to 3 minutes.

Statistical analyses by use of the F value and t test were done. These findings did not fully support the hypotheses that there is no significant difference between axillary and rectal measures of taking infant temperatures.