Loma Linda University
TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works

Loma Linda University Electronic Theses, Dissertations & Projects

6-1963

A Comparison of the Effectiveness of two Cooling Baths for Reducing Fever in Children

Mildred Bailey Howard

Follow this and additional works at: https://scholarsrepository.llu.edu/etd

 Part of the Pediatric Nursing Commons

Recommended Citation

Howard, Mildred Bailey, "A Comparison of the Effectiveness of two Cooling Baths for Reducing Fever in Children" (1963). *Loma Linda University Electronic Theses, Dissertations & Projects*. 786.
https://scholarsrepository.llu.edu/etd/786

This Thesis is brought to you for free and open access by TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. It has been accepted for inclusion in Loma Linda University Electronic Theses, Dissertations & Projects by an authorized administrator of TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. For more information, please contact scholarsrepository@llu.edu.

WERNER RADCLIFFE MEMORIAL LIBRARY
LOMA LINDA UNIVERSITY
LOMA LINDA, CALIFORNIA

LOMA LINDA UNIVERSITY

Graduate School

Thesis
1963

A COMPARISON OF THE EFFECTIVENESS OF TWO COOLING BATHS FOR REDUCING FEVER IN CHILDREN

by

Mildred Bailey Howard

59334

A Thesis in Partial Fulfillment

of the Requirements for the Degree

Master of Science in the Field of Nursing

WERNER RADCLIFFE MEMORIAL LIBRARY
LOMA LINDA UNIVERSITY
LOMA LINDA, CALIFORNIA

June, 1963

131861

I certify that I have read this thesis and that in my opinion it is acceptable, in scope and quality, as a thesis for the degree of Master of Science.

Betty J. Trubey, Chairman
Betty J. Trubey, M.S., Associate Professor of Nursing

Nord S. Nation M.D.
Nord S. Nation, M.D., Instructor in Pediatrics

Sadie B. Sinclair
Sadie B. Sinclair, M.S., Clinical Instructor in Physical Therapy

TABLE OF CONTENTS

LIST OF TABLES

PARCHMENT

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Cooling baths have been used for many years as a means of reducing fevers due to many causes. A search of the literature led to the discovery that much of the knowledge about the effectiveness of cooling baths for the reduction of fevers due to infection is of an empirical nature. Only one study was found in which the relative effectiveness of two cooling measures for reducing fevers due to infection was investigated.[1] Kueffner found the cooling bath to be more effective than a cooling sponge for reducing fever in children and recommended that further studies be done in this area. A desire to learn more about effective cooling measures for reducing fever in children with infection led to this study.

I. THE PROBLEM

Statement of the Problem

The study was to find out if there was a significant difference in the reduction of body temperature between two methods of administration of the cooling tub bath to children with fever due to infection.

Purpose of the Study

The purpose of the study was to evaluate the relative effectiveness of two methods of administration of the cooling bath in reducing

---

[1]Marilyn C. Kueffner, "A Study of the Effectiveness of Two Cooling Measures for Reducing Fever in Children" (Unpublished Master's thesis, Loma Linda University, Loma Linda, California, 1962).

the temperatures of children with fevers due to infections.

Need for the Study

Fever is associated with many of the acute illnesses commonly found in infants and children. Cooling measures are frequently ordered by the physician for children with elevated temperatures as prolonged high fever may lead to such serious complications as dehydration and convulsions.[2]

In cases of elevated temperatures, the physician may designate a specific medication or method for reducing the fever; or he may order cooling measures, leaving the choice of the method to the discretion of the nurse. If the choice is left to the nurse it is desirable that she have a more adequate basis for the selection of a particular cooling procedure.

In cases of high fever due to suspected bacterial infections, antibiotics are frequently ordered. Various studies on patients with infection, who have been treated with antibiotics show that there is no appreciable drop in temperature in less than 24 to 48 hours.[3] The administration of an antibiotic, therefore, does not cancel the need for cooling measures.

A review of the literature revealed no studies on the comparative effectiveness of cooling baths used to reduce fever due to infections

---

[2]Ella L. Rothweiler, Jean Martin White, and Doris A. Geitgey, The Art and Science of Nursing (Philadelphia: F. A. Davis Company, 1959), p. 249.

[3]Louis S. Goodman and Alfred Gilman, The Pharmacological Basis of Therapeutics (New York: The MacMillan Company, 1955), pp. 1321-1413.

in children. It is because of this that two methods of administration of the cooling bath were selected for comparative study.

The Hypothesis

A warm immersion bath for fifteen minutes is as effective a method for reducing fever due to infection in children as a cool immersion bath for twenty minutes.

II. DEFINITION OF TERMS

Immersion is the placement of the patient in a tub of water so that the water covers all of the body up to the waist. Water is applied to the arms, upper chest and upper back by hand during the time that the patient is in the tub.

Cool is bath water temperature between 75 and 95 degrees Fahrenheit.

Warm is bath water temperature between 95 and 100 degrees Fahrenheit.

III. THE ASSUMPTION

It was assumed that fevers due to any type of infection would be effected in a similar manner by the cooling measure.

IV. THE LIMITATIONS

The limitations of this study were as follows:

1. The subjects selected were six months to three years of age.

2. The subjects selected had had no antipyretic or other cooling measure administered within four hours previous to the administration of the cooling bath.

3. The temperature and humidity of the room in which the baths were given varied.

4. It was difficult to match the subjects physiologically.

5. The subjects were limited to those children who met the criteria, who were available to the investigator, during December, 1962, January and February, 1963.

V. THE METHOD USED

The experimental method with a retroactive comparison of a parallel group was used for the study. The experimental method is an active process in which observation is usually employed in securing measures of change. This observation is carried out in a situation where each entity may be selected to conform with the requirements of the problem.[4] Groups are said to be parallel when they are matched in their essential characteristics. For a previous study by Kueffner, seven subjects had been given a cool immersion bath. These subjects were used as the Kueffner Group. The subjects for the Experimental Group were selected from the pediatric ward, pediatric clinic, and emergency room of one general hospital.

Procedures Selected for Administration of the Cooling Baths

The procedures selected for administration of the cooling

---

[4]Burton Meyer and Loretta E. Heidgerken, Introduction to Research in Nursing (Philadelphia: J. B. Lippincott Company, 1962), pp. 377-378.

baths were (1) the subjects in the Kueffner Group had been immersed in water 95 degrees Fahrenheit which was gradually reduced to 75 degrees Fahrenheit, the subject remaining in the tub for a period of twenty minutes; and (2) the subjects in the Experimental Group were immersed in water 100 degrees Fahrenheit which was gradually reduced to 95 degrees Fahrenheit, the subject remaining in the tub for a period of fifteen minutes.

Basis for the Selection of Subjects

Subjects were selected on the following basis:

1. They had a rectal temperature of 101 degrees Fahrenheit or over.

2. They were six months to three years of age.

3. No antipyretic or other cooling measure had been received within four hours.

4. Infection was diagnosed as the cause of the fever.

VI. ORGANIZATION OF REMAINDER OF THE STUDY

The remainder of the study is organized in the following manner:

Chapter II. This chapter is a review of literature which pertains to the physiological processes involved in the production of fever, the use of hydrotherapy in the reduction of fever in children, and studies that have been done on the reduction of fever.

Chapter III. This chapter contains the method of approach and collection of data.

Chapter IV. This chapter includes the analysis and interpretation of the data.

Chapter V. This chapter comprises the summary of the study, the conclusions drawn, and the recommendations made.

VII. SUMMARY

Since cooling measures are frequently used to reduce fever due to infection in children, this study was done to evaluate the relative effectiveness of two methods of administration of a cooling bath: immersion in a tub of cool water, and immersion in a tub of warm water.

CHAPTER II

REVIEW OF THE LITERATURE

A review of literature was made to more fully understand (1) what studies had been done on the reduction of fever, (2) the physiological processes involved in the production of fever, and (3) the effects of hydrotherapy used to reduce fever in children.

I. HISTORICAL BACKGROUND

As recently as 1869, physicians thought of fevers as being diseases rather than symptoms of disease. Bloodletting and emetics were used in the treatment of patients with fever.[5] By the early part of this century cold baths and antipyretic drugs were used.[6] In this quotation from a textbook written in 1904, note that some concern is expressed about the patient's ability to withstand heroic, cold treatments and that the author suggests the use of lukewarm water.

> If the cold tub is not well borne by the patient lukewarm baths given in the same manner are often followed by good results. The procedure may bring about a drop in temperature of from one to four degrees (F.).[7]

There followed years during which medical knowledge grew. Physicians learned that successful treatment of the cause of a fever

---

[5]Alfred Hudson, Lectures on the Study of Fever (Philadelphia: H. C. Lea, 1869), p. 63.

[6]Hobart Amory Hare, Fever: Its Pathology and Treatment (Philadelphia: F. A. Davis, 1891), pp. 159-160.

[7]Reynold Webb Wilcox, A Manual of Fever Nursing (Philadelphia: P. Blakiston's Son and Company, 1904), p. 46.

would eliminate the fever. The advent of antibiotic drugs, refrigeration blankets and advances in techniques of fluid therapy made available new methods to aid in the control of fevers.

II. STUDIES THAT HAVE BEEN DONE

In attempts to learn more about body temperatures a number of studies have been done on the effects of heat and cold on the temperatures of healthy adults.[8,9,10,11] We also find case reports of the use of hypothermia in encephalitis and other conditions where the central regulatory mechanism of body heat is disturbed. In these cases rapid, drastic cooling is necessary. Ice, and chlorpromazine to prevent shivering, has been successfully used for cooling patients when the central regulatory mechanism of body heat is disturbed.[12]

No studies other than Kueffner's were found on the use of hydrotherapy in the reduction of fever due to infection in children. Referring to recent gains in knowledge about fever, Dr. Robert Petersdorf remarked:

---

[8]Eugene F. DuBois, Fever and the Regulation of Body Temperature (Springfield, Illinois: Charles C. Thomas, Publisher, 1948), pp. 4-62.

[9]R. K. MacPherson, "The Effect of Fever on Temperature Regulation in Man," Clinical Science, 18:281-287, May, 1959.

[10]C. H. Wyndham and Others, "Methods of Cooling Subjects with Hyperpyrexia," Journal of Applied Physiology, 14:771-776, 1959.

[11]L. W. Eichna, "Thermal Gradients During Varying Body Temperatures," Archives of Physical Therapy, 29:687-689, November, 1948.

[12]A. W. Johnston and Others, "Hyperpyrexia in Encephalitis," Lancet, 2:670-671, September, 1958.

> We know a fair amount about the physiologic mechanisms which control the balance of heat production and heat elimination in health but relatively little is known about how this equilibrium is disturbed in disease...The common denominator responsible for fever has been thought to be tissue injury... The relationship between fever in the experimental laboratory and fever at the bedside is a hazy one and we really have not been able to apply, at bedside, the facts learned in the laboratory.[13]

III. PHYSIOLOGICAL PROCESSES OF FEVER

Temperature Regulation

Sir George Pickering stresses the importance of the regulation of central body temperature in both health and disease.[14] The central body temperature is determined by the balance between heat production in the tissues and heat lost to the environment.[15] Normally body temperature is regulated by a central as well as a peripheral mechanism. The chief central mechanism controlling heat production is located in the hypothalamus. Extirpation of this region, in the experimental animal, releases the heat loss mechanism, located elsewhere, from coordinated control.[16] Heat is produced in the tissue and dissipated at the skin surface and to a lesser extent from the lungs. Of man's

---

[13]University of Washington School of Medicine Conjoint Conference, "Experimental and Clinical Aspects of Fever," Northwest Medicine, 60:507-512, May, 1961.

[14]George Pickering, "Regulation of Body Temperature in Health and Disease," Lancet, 1:1-9, January, 1958.

[15]Charles H. Best and Norman B. Taylor, The Physiological Basis of Medical Practice (Baltimore: The Williams and Wilkins Company, 1961), pp. 884-885.

[16]A. D. Keller and W. K. Hare, "The Hypothalamus and Heat Regulation," Proceedings of the Society for Experimental Biology and Medicine, 29:1069-1070, 1932.

many temperatures, it is the deep tissue temperature, represented by the rectal temperature, which is most important to body function and which is normally maintained at the homeothermic norm by compensating mechanisms. The other body tissues, particularly the skin, adjust their temperatures in such a manner as to keep the deep tissue temperature normal.[17]

Heat Production

Heat production is the result of chemical reactions[18] stimulated by food intake, exercise, and exposure to cold. These factors stimulate metabolism which is the source of body heat.[19]

Heat Loss

Heat loss is dependent upon physical and physiological factors. Heat is lost from the body through: (1) radiation, convection, and conduction, (2) evaporation of water from the lungs and skin, (3) raising the inspired air to body temperature, and (4) urine and feces. Under ordinary conditions over ninety-five per cent of heat loss occurs through numbers one and two.[20]

Radiation is the emanation of heat energy waves from the body. Heat loss in radiation is affected by the surface area and temperature of the body and also the surrounding objects and air temperature.[21]

---

[17]Eichna, op. cit., p. 687.

[18]Best and Taylor, op. cit., p. 884.

[19]Elbert T. Phelps, "Fever--Its Causes and Effects," The American Journal of Nursing, 56:319-321, March, 1956.

[20]Best and Taylor, op. cit., p. 885.

[21]Chester S. Keefer and Samuel E. Leard, Prolonged and Perplexing Fevers (Boston: Little, Brown and Company, 1955), p. 31.

Convection is the exchange of cooler, drier air away from a body for the warmer, humid layers close to the body. Heat loss due to convection is directly related to the movement of air. It increases with acceleration of air movement up to about seventy miles per hour.[22]

Heat loss due to conduction is related to the transfer of heat from one place to another.[23] The constriction and dilatation of the skin capillaries regulate the amount of blood that is allowed to come from the deeper and warmer areas to the skin surface for changes due to conduction, radiation and convection. The walls of arterioles are composed chiefly of involuntary muscle fibers arranged in a circular fashion. The musculature is supplied with two types of nerve fibers--inhibitory and excitatory. Those which inhibit cause vasodilatation. Those which excite cause vasoconstriction. Evidence has accumulated within recent years which indicates that vasoconstriction is mediated through the liberation of noradrenaline at the nerve endings.[24]

Body temperature under ordinary conditions is no doubt maintained largely by the responses of the vessels of the skin themselves to external stimuli. The central mechanism functions, (1) as a governor over the peripheral mechanisms, and hence manifests itself more strongly when the need is extreme, and (2) as a mechanism for utilizing or integrating the entire skin surface for heat conservation or

---

[22] Ibid., p. 31.

[23] Phelps, op. cit., p. 319.

[24] Best and Taylor, op. cit., pp. 345-346.

dissipation when only a part is subjected to a changing temperature.[25]

Body Temperature in Fever

In fever the balance between heat production and heat loss persists except the thermostat (hypothalamus) is set higher. Salicylates act to reset the thermostat and heat dissipation is augmented by increased peripheral blood flow and sweating.[26] Unless the heat elimination keeps pace with production the body temperature must rise. Elevated temperature usually makes a child uncomfortable and restless so some form of hydrotherapy may be ordered to check the rise of the fever and to provide relaxation.[27] Pickering states that present knowledge suggests that:

> Small deviations in central body temperature are opposed by corresponding deviations in cutaneous vasomotor tone. Larger deviations upward and downward are opposed respectively by sweating and shivering. The effector mechanisms are activated chiefly and persistently by cutaneous receptors.[28]

IV. HYDROTHERAPY FOR FEVER

Water absorbs and gives off heat rapidly. In the administration of either heat or cold there is a certain effect due to the temperature

---

[25]O. R. Hyndman and J. Wolkin, "The Automatic Mechanism of Heat Conservation and Dissipation," American Heart Journal, 22:289-304, September, 1941.

[26]L. S. Goodman and Alfred Gilman, The Pharmacological Basis of Therapeutics (New York: The MacMillan Company, 1955), p. 283.

[27]Robert A. Lyon and Elgie M. Wallinger, Mitchell's Pediatrics and Pediatric Nursing (Philadelphia: W. B. Saunders Company, 1954), p. 178.

[28]Pickering, op. cit., p. 8.

of the water used which is called the intrinsic effect. Another is due to the reaction of the body to the temperature of the water used and is called the reactionary effect. The intrinsic effect of either heat or cold is always the opposite to the reactionary effect. The intrinsic action of cold is a vital depressant. Very soon after it has been applied the body reacts and a stimulative effect is produced. In the young or old, reaction is slow, sometimes not occuring at all.[29] This implies that children may not have the desired reaction following a cold treatment.

In some cases when the peripheral tissues are cooled the returning blood flow to the skin remains below normal and the patient is left with a cool skin but the rectal temperature remains high. In such circumstances, vasoconstrictor reflexes initiated by the cool skin may outweigh the central vasodilating influences of the warm blood. The skin remains relatively bloodless; the blood is not cooled and the deep heat is not extracted. Furthermore, the cold skin reduces the opportunities for heat loss at the surface by convection and radiation. The results may be maintenance of high deep tissue temperature in spite of the effects produced by cooling. At times the reflexes from the cold skin are so strong that the patient chills and his temperature may even rise.[30] For these reasons a tepid bath is recommended for infants[31] for its antipyretic and soothing effects. The

---

[29]William W. Worster, Elements of Physical Medicine (San Gabriel, California: The College Publishing Company, 1947), pp. 130-131.

[30]Herbert Worley Kendell, Fever Therapy (Springfield, Illinois: Charles C. Thomas Publisher, 1951), p. 49.

[31]Gertrude B. Finnerty and Theodore Corbitt, Hydrotherapy (New York: Frederick Ungar Publishing Company, 1960), p. 40.

physical principle upon which this treatment is based is:

> The cutaneous vessels ordinarily store about 10% or more of the volume of blood in the body. However, the skin vessels can accommodate almost 2/3 of the blood supply of the body... In the presence of heat, the small cutaneous blood vessels dilate. The skin is then in position to dissipate body heat by four methods: by sweating (evaporation), radiation, conduction, and convection.[32]

No studies were found in which different methods of administration of the cooling bath had been compared for effectiveness in reducing fevers in children.

V. SUMMARY

Normal body temperature is regulated by a central as well as a peripheral mechanism. The central heat regulatory mechanism is probably in the hypothalamus. Heat generated by the normal metabolic processes is eliminated through the skin and the lungs primarily. A disturbance of heat regulation, heat production, or heat elimination will cause a rise or fall in body temperature. Factors which dispose to disturbance of these mechanisms include the environment, the condition of the skin, disease, and stimuli such as emotion that influence the hypothalamus as well as blood flow in the periphery.[33]

Water is efficient in conducting heat and hydrotherapy has long been an accepted method of fever control. However, relatively little is known about how the body's heat regulation is affected by disease and the best methods of administering mild cooling measures during febrile illnesses are still to be found.

---

[32] Ibid., p. 8.

[33] Keefer, op. cit., p. 39.

CHAPTER III

METHOD OF INVESTIGATION AND COLLECTION OF DATA

This experimental study is an extension of the earlier study of cooling measures as recommended by Marilyn Kueffner. After reading her study and discussing it with members of the staff of the Department of Pediatrics the decision was made to try to discover if a warm immersion bath would be an effective way to reduce fevers due to infection in children.

A review of the literature was made to discover (1) what studies had been done on the reduction of fever, (2) the physiological processes involved in the production of fever, and (3) the effects of hydrotherapy used to reduce fever in children. No studies were found other than Kueffner's in which cooling baths had been used for children with infections.

The experimental method with a retroactive comparison of a parallel group was chosen to compare two procedures for the administration of the cooling bath. Two parallel groups of children were used. The Kueffner Group included seven subjects who had been given a cool immersion bath. The data for the subjects in the Kueffner Group had been collected by Kueffner and were taken from her study.

The subjects in the Kueffner Group had been immersed in a tub of water 95 degrees Fahrenheit. Within five to seven minutes the water was reduced to 75 degrees Fahrenheit. The subjects remained immersed in the water a total of twenty minutes, after which they were immediately wrapped in a bath blanket and gently dried. A rectal

temperature was taken for the subjects in the Kueffner Group before the bath and at 15 minutes, 30 minutes, 45 minutes, and 60 minutes following the bath. The thermometer was inserted into the rectum to a depth of 2.5 cm. and held in place for three minutes.

The Experimental Group included eight subjects who were given a warm immersion bath by the investigator. The subjects in the Experimental Group were immersed in a tub of water 100 degrees Fahrenheit. Within five to seven minutes the water was reduced to 95 degrees Fahrenheit. The subjects remained immersed in the water a total of fifteen minutes, after which they were immediately wrapped in a bath blanket and gently dried. A rectal temperature was taken for the subjects in the Experimental Group before the bath and immediately following the bath, and at 15 minutes, 30 minutes, and 45 minutes following the bath. As with the Kueffner Group, the thermometer was inserted into the rectum to a depth of 2.5 cm. and held in place for three minutes.

The effectiveness of each method of administration of the cooling bath was evaluated in relationship to the drop in body temperature which was measured by the thermometer.

I. METHOD OF APPROACH

Selection of Facilities

The Pediatric Unit of one general hospital was selected for the gathering of data. Letters[34] asking permission to do the study were sent to the Hospital Administrator, the Chairman of the Department

---

[34]See Appendix A.

of Pediatrics, and the Director of Nursing Service. When permission to do the study was granted personal interviews with members of the pediatric staff resulted in working out details which facilitated the collection of data.

Selection of Method

The experimental method with a retroactive comparison of a parallel group was selected for this study. The subjects in the Kueffner Group had previously been given a cool immersion bath. The subjects in the Experimental Group were given a warm immersion bath. An arbitrary decision was made to use the warm bath between 95 and 100 degrees Fahrenheit because water at this temperature (1) would be several degrees cooler than the patient's rectal temperature, and (2) would feel comfortable to the patient during the entire treatment. The decision to use a procedure of 15 minutes duration for the Experimental Group as opposed to the 20 minute procedure used for the Kueffner Group was to see if a shorter period of time would be as effective.

Subjects were selected for the Experimental Group who would as nearly as possible match those in the Kueffner Group in relationship to diagnosis, age, and initial temperature. It was difficult to match the groups as accurately as desired for these factors because of the small number of subjects available.

Body surface area was not a factor in the selection of subjects. However, the amount of surface exposed to cooling would relate to the effectiveness of the treatment, so these data were collected to aid in evaluating the similarity of the two groups. Body surface area

was calculated by using the nomogram made by R. R. Hannon for estimating the surface areas of children according to the formula by DuBois and DuBois.[35]

Selection of Administration of Procedure

The subjects in the Kueffner Group had been given a cool immersion bath. Each subject was placed in a tub of water 95 degrees Fahrenheit. Within five to seven minutes the temperature of the water was reduced to 75 degrees Fahrenheit. The temperature was reduced gradually in order to keep the augmentation of heat production at a minimum level.[36]

Each subject remained in the water for twenty minutes to allow time for the vascular defense mechanism to become insufficient to cope successfully with the demand placed upon it to constrict the blood vessels and conserve heat.[37] During this time gentle rubbing was applied to the body parts to aid vasodilatation and consequent heat loss.[38]

Following the procedure each subject was removed from the tub and immediately wrapped in a cotton bath blanket and thoroughly and

---

[35]Eugene F. DuBois, Basal Metabolism in Health and Disease (Philadelphia: Lea and Febiger, 1936), p. 135.

[36]Josef B. Nylin, "Hydrotherapy" in Principles and Practice of Physical Therapy, Vol. III, Harrey E. Mock, Ralph Pemberton, and John S. Coulter (eds.), (Hagerstown, Maryland: W. F. Prior Company, Inc., 1933), Chapter 20,

[37]Ibid., p. 2.

[38]Finnerty and Corbitt, op. cit., p. 20.

gently dried. Close observation was made for any signs of chilling during the procedure and for one hour following treatment. The subjects' rectal temperatures were taken immediately before beginning the bath and at fifteen, thirty, forty-five and sixty minutes following the procedure.

The subjects in the Experimental Group were given a warm immersion bath. Each subject was placed in a tub of water 100 degrees Fahrenheit. Within five to seven minutes the temperature of the water was reduced to 95 degrees Fahrenheit. These water temperatures were used because the subjects would be comfortably warm during the entire treatment and the water would be several degrees lower than the rectal temperature of the subjects.

Each subject remained in the water for fifteen minutes to see if a period less than 20 minutes would be as effective in reducing the rectal temperature. During this time it was not necessary to rub the body parts as the subjects were comfortable without friction to the skin. Water from the tub was applied by hand to the arms, chest and upper back during the treatment. This process and the movement of the child kept the water in the bath moving enough so the water temperature was uniform.

Following the procedure each subject was removed from the tub and immediately wrapped in a cotton bath blanket and thoroughly and gently dried. Each subject was observed for one hour for signs of chilling. Rectal temperatures were taken and recorded immediately before the bath and at fifteen, thirty, forty-five and sixty minutes following the initial temperature.

Instruments Used to Register Temperatures

New Chieftain rectal thermometers were used throughout the study. They were marked with red lacquer to insure the accurate depth of insertion for each patient as in Kueffner's study.[39] The thermometer was inserted into the rectum to a depth of 2.5 cm. and was held in place for three minutes. One new Taylor bath thermometer was used to measure the temperature of all water used in the procedures during the study.

Selection of Patients for the Experimental Group

Patients were chosen who met the following criteria:

1. They were six months to three years of age.

2. They had a rectal temperature of 101 degrees Fahrenheit or over.

3. No antipyretic or other cooling measure had been given within four hours.

4. Infection was diagnosed as the cause of the fever.

This is the same criteria used in the selection of the patients in the Kueffner Group with the exception of the degree of the rectal temperature. All subjects in the Kueffner Group had a rectal temperature of 102 degrees Fahrenheit or over. This change was made for the Experimental Group so more children could be found to include in the study.

Due to the difficulty of finding patients to meet these criteria no attempt was made to match the two groups beyond this.

---

[39]Kueffner, op. cit., p. 23.

II. COLLECTION OF DATA

Permission to use the hospital clinical facilities was obtained. Data on the Experimental Group were collected during December, 1962, January and February, 1963. All children that were available during the time the investigator was collecting data, who met the criteria, were used in the Experimental Group.

In addition to having no antipyretic within four hours of the cooling bath, aspirin was also withheld from patients included in the study for the one hour during which the bath was given and the follow-up rectal temperatures taken. Often aspirin is given with a cooling measure to facilitate the lowering of the body temperature. All subjects in the Experimental Group had received antibiotics before the bath.

All data for the subjects in the Experimental Group were collected by the investigator to insure a maximum interest in accuracy in the technique used. A special form was used for recording the necessary information.[40]

The technique of administration of the bath was perfected on a patient with fever who was not included in the study.

III. SUMMARY

The experimental method with a retroactive comparison of a parallel group was used to evaluate the relative effectiveness of two methods of administration of the cooling bath for reducing fever due

---

[40]See Appendix B.

to infections in children. Subjects in the Kueffner Group had been immersed for twenty minutes in a tub of cool water. The subjects in the Experimental Group were immersed for fifteen minutes in a tub of warm water. Following the procedures each subject was immediately wrapped in a cotton bath blanket and thoroughly and gently dried. The relative effectiveness of the method of administration was evaluated by taking a rectal temperature before the bath and at fifteen, thirty, forty-five and sixty minute intervals following the procedure.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This experimental study was done to evaluate the relative effectiveness of two methods of administration of the cooling bath for reducing fever due to infection in children. A total of seven subjects in the Kueffner Group had been given a cool immersion bath. A total of eight subjects in the Experimental Group were given a warm immersion bath. The relative effectiveness of each treatment was evaluated in relationship to the drop in rectal temperature following the treatment.

I. PRESENTATION OF DATA

Diagnosis of the Patients

All the patients in the study had fever due to infection. The diagnosis was obtained from the patients' charts. Table I shows the diagnosis of the subjects in the Kueffner Group who were given a cool immersion bath and the diagnosis of the subjects in the Experimental Group who were given a warm immersion bath. The diagnoses were similar for the two groups. No follow up was done to find out if any fever was due to a subsequently diagnosed viral disease.

Age of the Patients

All of the patients were between the ages of six months and three years, with one exception. One subject in the Experimental Group was thirty-seven months of age. This subject was included in the category of subjects thirty-one months to thirty-six months. Table II

shows the ages of the subjects in the Kueffner and the Experimental Group. In the age groups from six months to eighteen months the subjects in the two groups were fairly well matched. All three children between nineteen and thirty-six months were in the Experimental Group.

Body Surface Area

Because of the limited number of patients available it was not possible to select subjects who matched accurately in body surface area. However, the distribution of cases by body surface area in the two groups is fairly comparable. Table III shows the body surface area of the subjects in the Kueffner Group and the Experimental Group.

Initial Temperature

A temperature referred to as the initial temperature was taken on each child immediately preceding his cooling bath. While a rectal temperature of at least 101 degrees Fahrenheit was required, the initial temperatures varied from 101.6 to 105.2 degrees Fahrenheit. Table IV shows the initial temperatures of the subjects in the two groups. The three lowest initial temperatures were all in the Experimental Group and the highest initial temperature was in the Kueffner Group. The initial temperatures in the Kueffner Group tended to be high while the initial temperatures in the Experimental Group tended to be lower.

Degree of Temperature Drop Following the Cooling Measure

The mean drop in temperature was computed for the subjects in the Kueffner and the Experimental Group. The mean initial temperature

TABLE I

DISTRIBUTION OF CASES BY DIAGNOSIS

Diagnosis	Kueffner Group Cool Bath	Experimental Group Warm Bath
Acute tonsilitis		1
Bronchiolitis		1
Bronchopneumonia	2	1
Croupe		1
Exudative tonsilitis	1	
Fever of undetermined origin	1	
Herpes Stomititis		1
Infection of V.S. shunt		1
Lobar pneumonia	1	
Otitis media, upper respiratory infection	1	1
Pharangitis	1	
Upper respiratory infection		1

TABLE II

DISTRIBUTION OF CASES BY AGE

Age	Kueffner Group Cool Bath	Experimental Group Warm Bath
6 - 12 months	5	3
13 - 18 months	2	2
19 - 24 months		1
25 - 30 months		1
31 - 36 months		1

TABLE III

DISTRIBUTION OF CASES BY BODY SURFACE AREA

Body Surface Area Square Meters	Kueffner Group Cool Bath	Experimental Group Warm Bath
.68		1
.50		1
.48	1	1
.46		2
.44	1	
.42	1	
.40	2	
.38	1	1
.36	1	1
.32		1

TABLE IV

DISTRIBUTION OF CASES BY INITIAL TEMPERATURE

Initial Temperature Degrees F.	Kueffner Group Cool Bath	Experimental Group Warm Bath
101 - 102		3
102.2 - 103	3	3
103.2 - 104	1	
104.2 - 105	2	2
105.2 - 106	1	

for the Kueffner Group was 103.8 degrees Fahrenheit. Fifteen minutes following the bath another temperature reading had been recorded. This was thirty-five minutes following the time the initial temperature was taken. At that time the mean drop in temperature for the Kueffner Group was 2.8 degrees. At fifty minutes following the initial temperature the mean drop in temperature was at a maximum of 3.2 degrees. At sixty-five minutes following the initial temperature the mean temperature drop had lessened to 2.3 degrees for the Kueffner Group. At eighty minutes following the initial temperature the mean temperature drop for the Kueffner Group was 1.94 degrees.

In the Experimental Group the mean initial temperature was 102.8 degrees Fahrenheit. Immediately following the procedure another rectal temperature reading was recorded. This was fifteen minutes following the time the initial temperature was taken. At that time the mean drop in temperature for the Experimental Group was .65 degrees. At thirty minutes following the initial temperature the mean drop in temperature for the Experimental Group was .92 degrees. At forty-five minutes following the initial temperature the mean drop in temperature was at a maximum of 1.22 degrees. This mean drop of 1.22 degrees was retained at sixty minutes following the time of the initial temperature in the Experimental Group.

It was found that the mean drop in temperature was greater for the subjects in the Kueffner Group who were given the cool bath at all time periods than for the subjects in the Experimental Group who were given the warm bath. This could be due either to the lower water temperature or longer time period of the cool immersion bath. Figure 1

indicates the mean drop in temperature of subjects in the Kueffner Group and in the Experimental Group following the cooling measures.

Figure 2 indicates the actual degree of temperature change for each subject and the mean temperature change for subjects in the Kueffner Group. All subjects in the Kueffner Group showed a drop in temperature reading between the initial temperature and the temperature taken thirty-five minutes following the initial temperature. Subjects number 2, 3, and 4 showed an additional temperature drop fifty minutes following the initial temperature while subjects number 1 and 5 had a temperature rise and subjects 6 and 7 remained the same at this time. The temperatures of all subjects in the Kueffner Group had begun to rise sixty-five minutes following the initial temperature, and all except subjects number 5 and 6 continued to rise at eighty minutes following the initial temperature. The subjects with the highest initial temperatures in the Kueffner Group showed the greatest drop in temperature.

Figure 3 indicates the actual degree of temperature change for each subject and the mean temperature change for subjects in the Experimental Group. The changes in rectal temperature for the subjects in the Experimental Group is not as uniform as in the Kueffner Group. All subjects showed a drop in temperature reading between the initial temperature and the temperature taken fifteen minutes following the initial temperature except subject number 7 whose temperature rose .2 degree. There was a range from .2 degree to 2.2 degrees in the temperature drop in the other subjects in the Experimental Group during this same fifteen minute time period. All subjects in the Experimental

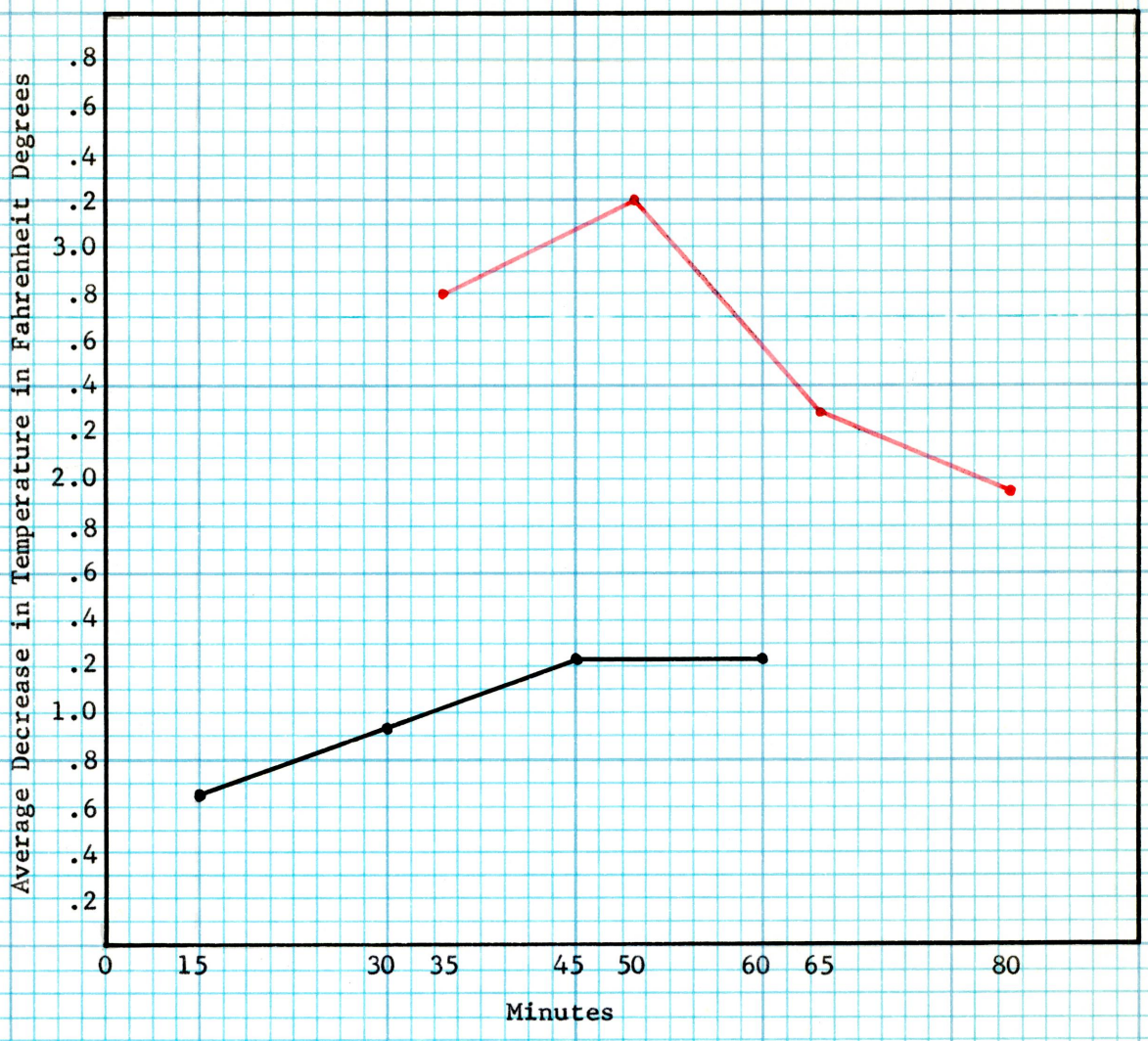

FIGURE 1

MEAN DROP IN BODY TEMPERATURE
FOLLOWING THE INITIAL TEMPERATURE

Kueffner Group (Cool Bath) ——
Experimental Group (Warm Bath) ——

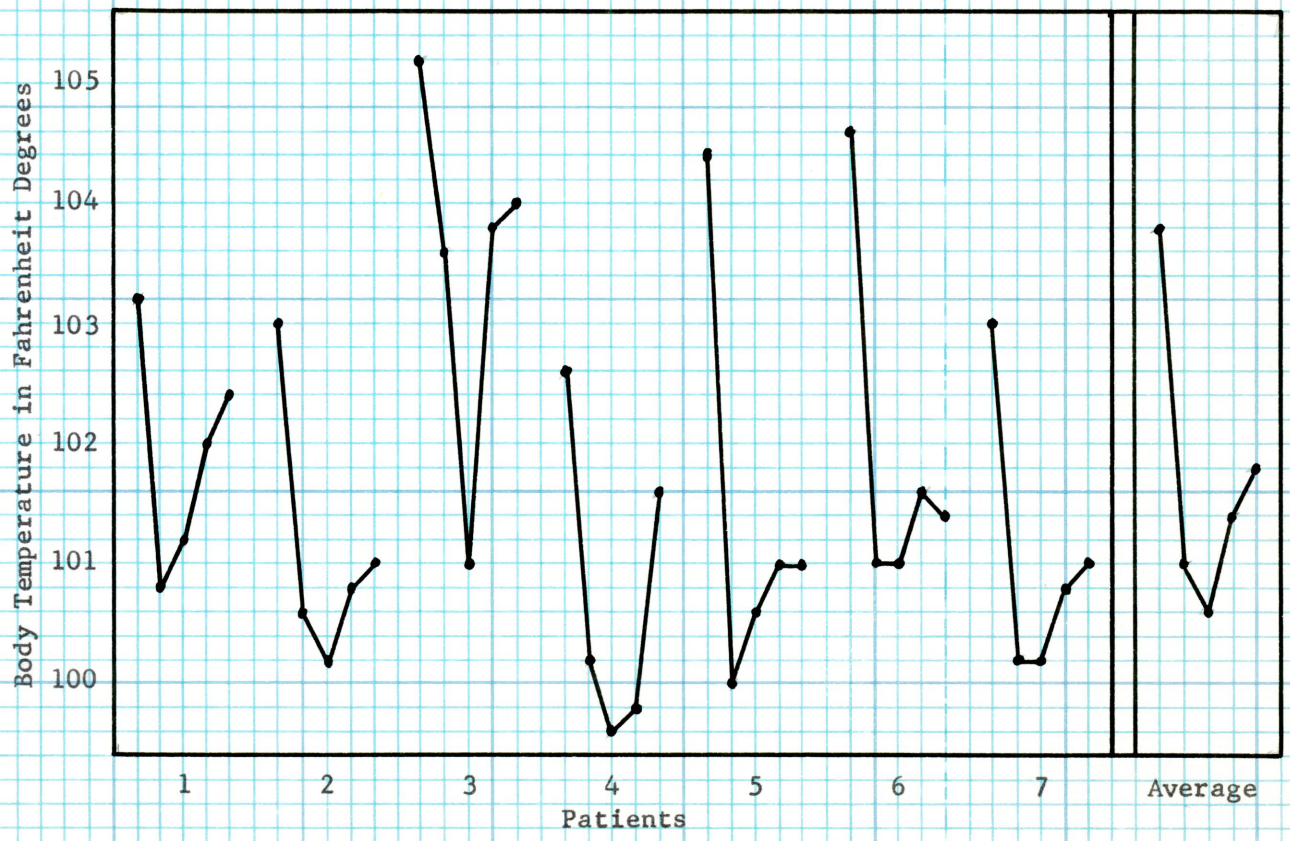

FIGURE 2

THE ACTUAL TEMPERATURES FOR PATIENTS IN THE KUEFFNER GROUP BEFORE THE COOLING BATH AND 15, 30, 45, AND 60 MINUTES FOLLOWING THE PROCEDURE

Group showed an additional drop in temperature thirty minutes following the initial temperature except subjects number 4 and number 8. Subject number 4 had a temperature rise of .8 degree and subject number 8 had a temperature rise of 1.2 degrees. Most of the subjects in the Experimental Group had a temperature drop at forty-five minutes following the initial temperature. Only subjects number 1 and 2 showed a temperature rise at this time interval. Sixty minutes following the initial temperature most subjects in the Experimental Group showed another slight temperature drop or retained the same temperature as at forty-five minutes following the initial temperature. Subjects number 5 and 7 had a temperature rise sixty minutes following the initial temperature. The mean temperature for the Experimental Group showed an overall downward tendency following the warm immersion bath. However, the temperature reaction of individual subjects in the Experimental Group was more diverse than the individual temperature reactions of subjects in the Kueffner Group. There did not seem to be any consistent pattern in temperature reactions of subjects in the Experimental Group in relation to the height of the initial temperature or the time at which a general rise or leveling off in temperature appeared. No follow up was done to see if any fever was due to an unknown viral disease which was diagnosed later.

Medication

The effect of antibiotics on this study is not too clear but administration of antibiotics would have an indirect effect on the temperature change of the patients.

FIGURE 3

THE ACTUAL TEMPERATURES FOR PATIENTS IN THE EXPERIMENTAL GROUP BEFORE THE COOLING BATH AND IMMEDIATELY, 15, 30, AND 45 MINUTES FOLLOWING THE PROCEDURE

Six subjects in the Kueffner Group had received no previous medication. One subject had received an initial dose of penicillin the day preceding the treatment.

All subjects in the Experimental Group were receiving antibiotics. The length of time that subjects in the Experimental Group had been on antibiotic therapy varied from 24 to 120 hours.

Reaction to the Treatment

While no particular criteria were set up to evaluate the reaction of subjects to the treatment, Kueffner reported that the subjects in the Kueffner Group cried vigoriously during the procedure and two of the group kept asking to be taken out of the water for approximately the last ten minutes of the treatment. On the contrary all the subjects in the Experimental Group relaxed during the warm bath and the two children who cried at first were easily distracted and then enjoyed the procedure. All subjects in the Experimental Group were comfortable during the procedure and there was no problem of chilling. Three of the four hospitalized subjects in the Experimental Group went to sleep soon after they were returned to bed following the warm immersion bath. This was in contrast to the generally irritable and restless state the subjects were in before the bath.

II. SUMMARY

Analyses were made of the diagnosis, age, body surface area, and initial temperature of the subjects in the Kueffner Group who were immersed in a tub of cool water and the subjects in the Experimental Group who were immersed in a tub of warm water. Analysis of the mean

drop in temperatures following the two methods of administration of the cooling bath indicated that for each interval during the entire time period following the bath the mean drop in temperature was greater for subjects in the Kueffner Group than for subjects in the Experimental Group. The maximum mean temperature drop for subjects in the Kueffner Group was 3.2 degrees Fahrenheit. The maximum mean temperature drop for subjects in the Experimental Group was 1.22 degrees Fahrenheit. All subjects in the Experimental Group had received antibiotics prior to the administration of the cooling bath, but only one subject in the Kueffner Group had received antibiotics.

While no criteria were set up to evaluate the reaction of subjects to each treatment, the subjects in the Kueffner Group cried vigoriously during the cool bath while the subjects in the Experimental Group were able to relax and enjoy the warm bath. Following the warm bath three of the subjects went to sleep which was in contrast to their generally restless and irritable state before the bath.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

This experimental study using a retroactive comparison of a parallel group was conducted to evaluate the relative effectiveness of two methods of administration of the cooling tub bath for reducing fever due to infection. Children age six months to three years whose rectal temperatures were 101 degrees Fahrenheit or over were selected. The two cooling baths used were (1) patients in the Kueffner Group had been immersed in a tub of water 95 degrees Fahrenheit which was reduced to 75 degrees Fahrenheit within five to seven minutes, with the subject remaining in the tub a total period of twenty minutes, and (2) patients in the Experimental Group were immersed in a tub of water 100 degrees Fahrenheit which was reduced to 95 degrees Fahrenheit within five to seven minutes, with the subject remaining in the tub for a total period of fifteen minutes.

A review of the literature revealed that normal body temperature is regulated by a central as well as a peripheral mechanism. A disturbance of heat regulation, heat production, or heat elimination will cause a rise or fall in body temperature. Water is efficient in conducting heat and hydrotherapy has long been an accepted method of fever control. However, relatively little is known about how the body's heat regulation is affected by disease and the best methods of administering mild cooling measures during febrile illnesses are still

to be proved. Only one study was found in which cooling baths were used to reduce infectious fevers in infants and children.

The experimental method with a retroactive comparison of a parallel group was used in conducting the study. In a previous study by Kueffner, seven subjects referred to as the Kueffner Group were immersed in a tub of water 95 degrees Fahrenheit which was reduced within five to seven minutes to 75 degrees Fahrenheit. After remaining in the tub for a total of twenty minutes, each subject was removed and gently dried with a cotton bath blanket. The clothing was replaced. For the present study, eight additional subjects referred to as the Experimental Group were immersed in a tub of water 100 degrees Fahrenheit which was reduced within five to seven minutes to 95 degrees Fahrenheit. After remaining in the tub a total of fifteen minutes, each subject was removed and gently dried with a cotton bath blanket. The clothing was replaced.

On all subjects in each group a rectal temperature was taken before beginning the cooling bath and at fifteen minute intervals following, for one hour. The thermometer was inserted into the rectum to a depth of 2.5 cm. and held in place for three minutes. The reactions of each child in the bath were noted and recorded.

Twelve diagnoses were recorded for the fifteen children in the two groups. The subjects were not matched according to the type of infectious fever. In the age groups from six months to eighteen months, the subjects in the Kueffner Group and the Experimental Group were well matched for age. Three subjects in the age groups nineteen months to thirty-six months were given the warm immersion bath, but no subjects

in these age groups were given the cool immersion bath. The subjects in the two groups were fairly well matched according to body surface area and initial temperature. However, the initial temperatures of the subjects in the Kueffner Group tended to include more high temperatures and the subjects in the Experimental Group included the three lowest temperatures. The mean drop in temperature for subjects given the cool bath was 2.8 degrees at thirty-five minutes, 3.2 degrees at forty-five minutes, 2.31 degrees at sixty-five minutes, and 1.94 degrees at eighty minutes following the initial temperature. The rectal temperatures for subjects in the Experimental Group were taken at different specific numbers of minutes following the initial temperature due to the difference in the length of the two procedures. The mean drop in temperature for subjects given the warm bath was 0.65 degrees at fifteen minutes, 0.92 degrees at thirty minutes, 1.22 degrees at forty-five minutes, and 1.22 degrees at sixty minutes following the initial temperature. The mean drop in temperature for subjects in the Kueffner Group, who were given the cool immersion bath, was greater at all time intervals than for the subjects in the Experimental Group, who were given the warm immersion bath. Subjects in the Kueffner Group who had the highest initial temperatures had the greatest temperature drop, but this was not true of the subjects in the Experimental Group.

II. CONCLUSIONS

The findings of this study would suggest that the hypothesis be rejected. Immersion in a tub of warm water for fifteen minutes as used in this study does not appear to be as effective in producing a

temperature drop for fever due to infection as immersion in a tub of cool water for twenty minutes. It is recognized that this extremely small series does not allow for unqualified conclusions. It is also recognized that the subjects in the two groups were not as equally matched as could be desired.

Other conclusions drawn were:

1. That the mean drop in temperature was greater at all time intervals following the procedure in which the subjects were immersed in the cool baths.

2. That the mean drop in temperature for those subjects given a cool immersion bath was greater fifteen and thirty minutes following the bath than it was forty-five and sixty minutes following the bath.

3. That the mean drop in temperature of subjects immersed in the warm tubs was not as great as that of the subjects immersed in the cool tubs but the maximum drop in temperature was maintained longer.

4. That the subjects immersed in the warm tubs appeared to relax during the treatment and even those who cried some at first could be distracted and enjoyed the bath later.

III. RECOMMENDATIONS

As a result of the findings of this study, the following recommendations were made:

1. That further and more extensive study be conducted to evaluate the relative effectiveness of the two cooling measures compared in this study.

2. That study be made of the effectiveness of other cooling measures commonly used by nursing personnel.

3. That study be made of the effectiveness of a cooling bath that has water temperatures in relation to the initial rectal temperature of the individual patient treated.

4. That study be made to see if the amount of time used in a cooling bath, to lower the temperature of the patient, is related to the length of time the temperature remains lowered before it starts to rise.

5. That comparison be made of the effectiveness of aspirin and aspirin in combination with a cooling measure.

6. That study be made of the effectiveness of cooling measures for reducing fever due to causes other than infections.

7. That study be made of the effectiveness of cooling measures for reducing fever due to specific types of infections.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Abbott, George K., Fred B. Moor, and Kathryn L. Jensen-Nelson. Physical Therapy in Nursing Care. Washington, D. C.: Review and Herald Publishing Association, 1945. 494 pp.

Best, Charles H., and Norman B. Taylor. The Physiological Basis of Medical Practice. Seventh edition. Baltimore: The Williams and Wilkins Company, 1961. 1469 pp.

DuBois, Eugene F. Basal Metabolism in Health and Disease. Philadelphia: Lea and Febiger, 1936. 494 pp.

_____. Fever and the Regulation of Body Temperature. Springfield, Illinois: Charles C. Thomas, Publisher, 1948. 68 pp.

Finnerty, Gertrude B. and Theodore Corbitt. Hydrotherapy. New York: Frederick Unger Publishing Company, 1960. 250 pp.

Goodman, L. S., and Alfred Gilman. The Pharmacological Basis of Therapeutics. New York: The MacMillan Company, 1955. 1387 pp.

Hare, Hobart Amory. Fever: Its Pathology and Treatment. Philadelphia: F. A. Davis, 1891. 166 pp.

Hudson, Alfred. Lectures on the Study of Fever. Philadelphia: H. C. Lea, 1869. 316 pp.

Keefer, Chester Scott, and Samuel E. Leard. Prolonged and Perplexing Fevers. First edition. Boston: Little, Brown, 1955. 248 pp.

Kendell, Herbert Worley. Fever Therapy. Springfield, Illinois: Charles C. Thomas, Publisher, 1951. 101 pp.

Lyon, Robert A., and Elgie M. Wallinger. Mitchell's Pediatrics and Pediatric Nursing. Fourth edition. Philadelphia: W. B. Saunders Company, 1954. 547 pp.

Meyer, Burton, and Loretta E. Heidgerken. Introduction to Research in Nursing. Philadelphia: J. B. Lippincott Company, 1962. 431 pp.

Rothweiler, Ella L., Jean Martin White, and Doris A. Geitgey. The Art and Science of Nursing. Philadelphia: F. A. Davis Company, 1959. 589 pp.

Wilcox, Reynold Webb. A Manual of Fever Nursing. Philadelphia: P. Blakiston's Son and Company, 1904. 236 pp.

Worster, William W. Elements of Physical Medicine. San Gabriel, California: The College Publishing Company, 1947. 333 pp.

B. BOOKS: PARTS OF SERIES

Nylin, Josef B. "Hydrotherapy" in Principles and Practice of Physical Therapy, Vol. III, Harry E. Mock, Ralph Pemberton, and John S. Coulter (eds.). Hagerstown, Maryland: W. F. Prior Company, Inc., 1933.

C. PERIODICALS

Eichna, L. W. "Thermal Gradients During Varying Body Temperatures," Archives of Physical Therapy, 29:687-697, November, 1948.

Hyndmen, O. R., and J. Wolkin. "The Automatic Mechanism of Heat Conservation and Dissipation," American Heart Journal, 22:289-304, September, 1941.

Johnson, A. W., and Others. "Hyperpyrexia in Encephalitis Treated by Hypothermia," Lancet, 2:670-671, September, 1958.

Keller, A. D., and W. K. Hare. "The Hypothalamus and Heat Regulation," Proceedings of the Society for Experimental Biology and Medicine, 29:1069-1070, 1932.

MacPherson, R. K. "The Effect of Fever on Temperature Regulation in Man," Clinical Science, 18:281-287, May, 1959.

Phelps, Elbert T. "Fever--Its Causes and Effects," American Journal of Nursing, 56:319-321, March, 1956.

Pickering, George. "Regulation of Body Temperature in Health and Disease," Lancet, 1:1-9, 1958.

Richards, Charles C. "The Use of Body Cooling in Pediatrics," Clinical Pediatrics, 2:55-60, February, 1963.

University of Washington School of Medicine Conjoint Conference. "Experimental and Clinical Aspects of Fever," Northwest Medicine, 60:507-512, May, 1961.

Wyndham, C. H., and Others. "Methods of Cooling Subjects with Hyperpyrexia," Journal of Applied Physiology, 14:771-776, 1959.

D. UNPUBLISHED MATERIALS

Kueffner, Marilyn Catherine. "A Study of the Effectiveness of Two Cooling Measures for Reducing Fever in Children," Unpublished Master's thesis, Loma Linda University, Loma Linda, California, 1962.

APPENDICES

APPENDIX A

137 Butterfield Road
West Covina, California
November 11, 1962

White Memorial Hospital
1720 Brooklyn Avenue
Los Angeles 33, California

Dear

May I have your permission to gather data for a research study in the Pediatric Department of the White Memorial Hospital? The research will compare the effectiveness of the use of two cooling measures in reducing fevers of children. I am a student in the Graduate Program in Nursing of Loma Linda University.

Miss Schaeffler has suggested that with certain limitations the study could be done within the existing organization of the ward. I would expect to work under the direction of the house staff of the Department of Pediatrics during the study.

Sincerely,

(Mrs.) Mildred B. Howard

APPENDIX B

FORM FOR COLLECTING DATA

Name:

Procedure:

Date:

Birthdate:

Time:

Weight:

Temperatures
Before:
After 15 min:
30 min:
45 min:
60 min:

Height:

Diagnosis:

Medications:

Comments:

LOMA LINDA UNIVERSITY

Graduate School

A COMPARISON OF THE EFFECTIVENESS OF TWO COOLING BATHS FOR REDUCING FEVER IN CHILDREN

by

Mildred Bailey Howard

An Abstract of a Thesis

in Partial Fulfillment of the Requirements

for the Degree Master of Science

in the Field of Nursing

June, 1963

ABSTRACT

The purpose of this study was to evaluate the relative effectiveness of two methods of administration of the cooling bath for reducing fever due to infection. Fifteen infants and children age six months to three years with rectal temperatures of 101 degrees Fahrenheit or over were included in the study.

The experimental method with a retroactive comparison of a parallel group was the research approach used. For a previous study by Kueffner, seven subjects had been immersed in tubs of water 95 degrees Fahrenheit which was gradually reduced to 75 degrees Fahrenheit, each subject remaining in the tub a total of twenty minutes. These subjects were the Kueffner Group for this study. The eight subjects in the Experimental Group were immersed in tubs of water 100 degrees Fahrenheit which was gradually reduced to 95 degrees Fahrenheit, each subject remaining in the tub for a total of fifteen minutes.

Immediately following each procedure, each subject was gently dried with a cotton bath blanket. A rectal temperature was taken immediately before the administration of each cooling bath and at fifteen, thirty, forty-five, and sixty minute intervals following the procedure. The relative effectiveness of the method of administration of the cooling bath was evaluated by the measured amount of drop in rectal temperature following the bath.

Analyses were made of the diagnosis, age, body surface area, and initial temperature of the subjects. An analysis of the mean drop in temperature indicated that the mean temperature of subjects given

ARTHUR A. SCHARLETT MEMORIAL LIBRARY
LOMA LINDA, CALIFORNIA

the cool immersion bath was lower for all time intervals than was the mean temperature of subjects given the warm immersion bath. The mean temperature drop for subjects in the Kueffner Group who were given the cool immersion bath was a maximum 3.2 degrees thirty minutes following the treatment and was 1.94 degrees Fahrenheit sixty minutes following the treatment. The mean temperature drop for subjects in the Experimental Group who were given the warm immersion bath showed a gradual decline following the treatment and was 1.22 degrees Fahrenheit at the end of one hour.

Because of the small number of subjects it was impossible to draw unqualified conclusions, but it would appear that immersion in a tub of water 95 degrees Fahrenheit which was gradually reduced to 75 degrees was more effective than the warm immersion bath as used in this study for causing a drop in rectal temperatures due to infection in children.

While no criteria were set up to evaluate the reaction of subjects to each treatment, the subjects in the Kueffner Group cried vigoriously during the cool bath while the subjects in the Experimental Group were able to relax and enjoy the warm bath. Following the warm bath three of the subjects went to sleep which was in contrast to their generally restless and irritable state before the bath.

ARTHUR A. SCHARLETT MEMORIAL LIBRARY
L.L.U.