THE EFFECTS OF BATHING ON SKIN EXPOSED TO COBALT-60 TELETHERAPY

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NURSING

BY

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MAY 1982

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March 5, 1982

We hereby recommend that the dissertation prepared under our supervision by Patricia Bohannan entitled The Effects of Bathing on Skin Exposed to Cobalt-60 Teletherapy

be accepted as fulfilling this part of the requirements for the Degree of Doctor of Philosophy.

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To protect individuals we have covered their signatures.

This study is dedicated to all people who will have radiation therapy with the hope that it will, in some small way, make life better for them.

ACKNOWLEDGEMENTS

In sincere appreciation, I acknowledge the support and assistance of all who have contributed professionally and personally to the development and completion of this study.

With respect and admiration, I acknowledge Dr. Barbara Carper, who served as chairperson of my committee during the developmental stages of this dissertation. I also acknowledge Dr. Margie Johnson, Dr. Anne Gudmundsen, Dr. Betty Rudnick, Dr. Barney Rubel, Dr. Eugene Hupp, and Dr. Kenneth Fry for their guidance and encouragement.

With respect and admiration, I acknowledge Dr. Roberto Restrepo for the guidance, interest, and support he gave me. The support of the staff at the Moncrief Radiation Center and Dr. Restrepo's willingness to allow me to ask his patients to be in this study made the collection of data possible.

With respect and admiration, I acknowledge Dr. Pat Scearse and the faculty of Texas Christian University School of Nursing. Their encouragement and support was invaluable to me.

With love and respect, I acknowledge my four sons, Michael, Bryan, Gary, and Steve, for their love, trust, support, and sacrifice.

I also acknowledge my typist, Doris Laing, for her skill and patience.

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CHAPTER 1

INTRODUCTION

Maintaining the integrity of the skin is an important part of nursing practice. Nurses in hospitals and nursing homes are frequently confronted with making decisions concerning the care of the skin where the patient is receiving external beam radiation therapy. Patients who are being treated in outpatient settings often make uninformed decisions concerning the skin that is exposed to radiation. These decisions may result in severe skin reactions that necessitate the temporary or permanent cessation of treatment before maximum effect can be achieved from the radiation treatments.

Early radiotherapists were limited in how much radiation they could deliver to the tumor because early equipment delivered rays that were heavily absorbed by the skin. Because of rapid advances in technology, radiation can now be delivered by equipment that emits rays that have an increased penetrating power, with less damage to the skin (Mantel, 1976).

The skin response to radiation is known as radiation dermatitis. This response is a progressive response that

occurs as the radiation dose to the skin increases. The initial response includes intermittent erythema and increased pigmentation. Near the end of the treatment period, dry desquamation may develop. This may progress to wet desquamation and epilation of large areas of skin. Except for radiosensitive areas such as the groin, axilla, and perineum, most radiation dermatitis does not progress beyond dry desquamation (Leaky, German, & Varricehio, 1979).

Much discrepancy exist in the literature and in practice as to the best method to care for the skin during and just after the treatment period. Some radiotherapists instruct their patients not to bathe or put anything on the skin while others allow the patients to bathe the skin. Some patients are not given any special instructions. Thus, the focus of this study will be to determine if a particular method of skin care is more effective than another.

Problem of Study

The problem of this study was to determine the effects of bathing or not bathing on the degree of skin reaction occurring in patients receiving Cobalt-60 radiation therapy to the chest, back, or head and neck.

Justification of Problem

Almost 56 million Americans now living will eventually have cancer. Currently there is an estimated 10 million

people under medical care for cancer. Approximately 750,000 new cases were diagnosed in 1980 (American Cancer Society, 1980). Fifty percent of these patients will require radiation therapy (Brady, 1976).

The objective of radiation therapy is to selectively kill a population of abnormal cells. The reactions that occur from radiation therapy are complex and varied. When these reactions are added to the complexity of the disease, the patient presents a challenge to all the health care team. The total care of the patient will be improved when a cooperative, multidisciplinary approach to cancer is routinely adopted. Early and effective integration of treatment modalities affords the patient the best chance for cure.

Nurses are important members of the health care team. They assess and evaluate the status of the patient receiving radiation therapy in hospitals, nursing homes, and outpatient settings. They provide care and teach patients how to care for themselves during therapy.

Nursing care of the cancer patient receiving radiation therapy should be guided by the pathophysiological processes occurring in the individual patient. All nursing actions do, in some way, influence the response the patient may have to radiation therapy. In order for the nurse to contribute

to the therapeutic effect of radiation, decisions must be made which take into consideration the biological, social, and psychological imperatives of the disease and the therapy. Nursing actions must be determined on the basis of their ability to augment therapy rather than interfere with it. In order for nurses to make informed decisions concerning the care of the patient receiving radiation therapy, they must know, and teach the patient, how activities of daily living influence and affect the response to radiation therapy.

Bathing is an activity of daily living that normally contributes to the biological, social, and psychological well being of the patient. It not only cleanses the skin, but it also aids in relaxation and contributes to the social acceptance of the individual patient. Normally bathing is a behavior that is strongly supported as a healthy behavior by nurses. When considering the biological effects of radiation on the skin, the appropriateness of daily bathing is questioned. Discrepancy exists in nursing literature as to the best method to care for the skin during radiation therapy.

This study expects to determine the extent to which bathing is a factor involved in the skin reaction that occurs from Cobalt-60 radiation therapy. This study will

provide nurses with information to utilize in planning care for patients in hospitals and nursing homes. It will also provide guidelines for developing proper instructions to give the patient receiving radiation therapy in the outpatient setting.

Theoretical Framework

The epidermis consists of four different layers of cells. Each layer is made up of cells that originate in the basal layer and progress outward through the spinous, granular, and horny layers. Normally, the rate of cellular turnover in the basal layer is slow. The total epidermis is usually replaced every 8 to 10 weeks.

Application of stress to the epidermis normally excites mitotic activity and replacement time is greatly increased. Cobalt-60 radiation therapy exerts a stress on the epidermis. Because of damage to the basal cells, and to the underlying dermis, the mitotic activity of the basal cells is reduced. Thus, there is a delay in the ability of the basal layer to replace the cells of the outer layers.

Because of the delayed mitotic activity, the horny layer becomes cornified and a peeling effect may occur. If damage to the vasculature of the dermis is sufficient, the epidermis may become necrotic and detach itself from the dermis. If an additional stress is applied to the

cornified horny layer during the time that the mitotic activity of the basal layer is suppressed, this same detachment may occur. This results in the loss of the protective barriers of the horny layer, the loss of nutritional components of the serum in the extra cellular spaces, and additional reduction of the replacement abilities of the basal layer.

Bathing the skin results in the loss of the loose flakes of the horny layer. Normally, shedding of these cells would stimulate mitotic activity of the basal layer and result in a shorter regeneration time for the epidermis. When the skin is being exposed to Cobalt-60 radiation the mitotic activity of the basal layer is delayed. Thus, bathing may be a stress to the protective horny layer that results in the loss of surface cells. Bathing may contribute to the degree of skin reaction that a patient receiving Cobalt-60 radiation may experience.

Knowledge of the physiological responses to Cobalt-60 radiation is essential for assessing, planning, implementing, and evaluating nursing care. When planning nursing actions, considerations must always be made concerning the effects these actions may have on the physiological responses to therapy. Maintaining the integrity of the skin is an important goal of the nursing care of the patient receiving

Cobalt-60 radiation therapy. The results of this study will identify the effect of bathing or not bathing on the degree of skin reaction occurring in patients receiving Cobalt-60 radiation therapy.

Assumptions

The assumptions of this study are:

1. Exposure to radiation causes changes in the skin.

2. The skin will respond to exposure to radiation by developing changes in blood supply and changes in pigmentation.

3. The skin response to exposure to radiation can be measured physiologically with a photoelectric reflection meter.

4. The skin response to exposure to radiation can be rated using the Baker-Leith Rating Scale.

5. Method of skin care, bathing or not bathing, will influence the degree of skin response to Cobalt-60 radiation therapy.

Hypothesis

1. There is no significant difference in the increase in erythema of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe.

2. There is no significant difference in the increase in pigmentation of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe.

3. There is no significant difference in the degree of skin reaction to Cobalt-60 radiation as measured by the Baker-Leith Rating Scale in patients who bathe and those who do not bathe.

Definitions of Terms

Bathing: To wash the portal of entry daily with tepid water only, omitting any soap.

Not Bathing: To avoid putting anything, including water, on the portal of entry during the entire treatment period.

Cobalt-60 Radiation Therapy: Exposing a section of the body to gamma rays emitted from a machine which houses the radioactive isotope Cobalt-60.

Dose: 200 rads of absorbed radiation daily, 5 days a week, over 5 weeks, for a total dose of 5,000 rads.

Erythema: Redness of the skin due to capillary congestion as measured by the Photovolt 670 with a 578 interference filter (Chu, et al., 1960).

Pigmentation: Coloration or discoloration of the skin as measured by the Photovolt 670 with a 660 interference filter (Chu, et al., 1960).

Radiation Dermatitis: An increase in pigmentation and erythema on the skin in the portal of entry as measured by the Photovolt 670 and the Baker-Leith Rating Scale.

Limitations

The generalizability of this study is limited by the following factors:

1. Sex, age, and race may influence the subject's skin reaction to Cobalt-60 radiation therapy.

2. Observer bias in measuring responses may influence the results of this study.

3. Only subjects who are receiving Cobalt-60 radiation therapy to the chest, back, or head and neck are included in this study.

Summary

External beam radiation therapy results in changes in the skin that are characterized by increased erythema and pigmentation. Nursing is concerned with knowing the best method for caring for the skin exposed to radiation. The purpose of this study is to determine if a daily bath affects the degree of skin reaction that occurs in patients receiving Cobalt-60 radiation to the chest, back, or head and neck.

CHAPTER 2

REVIEW OF LITERATURE

This chapter contains a review of literature and research related to the problem of this study. The chapter contains six main sections: (1) a historical review of the development of radiation therapy, (2) the biological effects of radiation, (3) the physiology of the skin, (4) skin response to radiation, (5) method to measure skin response, and (6) nursing management of the skin during radiation therapy.

History of Radiation Therapy

Ionizing radiation was first made available to medicine with the discovery of X-rays by Roentgen in 1895 and radium by Pierre and Marie Curie in 1898. The development of the Coolidge tube in 1913 resulted in improved performance and the enclosure of X-ray tubes in casings became mandatory. It was not until 1920 that the first machine was developed that could deliver 200 kilovolts. This machine marked the beginning era of deep X-ray therapy. At this energy level, the penetrating power of this radiation was limited. The rays were heavily absorbed by the skin and superficial

tissues. The severe skin reactions that occurred limited the dosage that could be delivered to the tumor (Mantell, 1976).

In 1931, the Van de Graaff generator was developed. This machine could produce gamma rays electrically at about 2.0 megavolts. Currently this machine can be updated to produce 2.5 megavolts. During the 1940's the linear accelerator produced high energy X-rays by generating electron beams which are accelerated through a tunnel and then abruptly stopped by a heavy metal target. This creates high energy photons which are directed to the patient. The betatron machine is similar to the linear accelerator except the electron beam is not converted to photons but is directly deployed into the patient.

The year 1950 marked the arrival of a machine which housed radioactive cobalt. This machine can deliver 1.25 megavolts of very uniform energy which is equivalent to photons delivered at about 2.5 megavolts of non-uniform energy of the Van de Graaf machine (Mantell, 1976).

Today the list of supervoltage equipment includes machines that will deliver up to 20 megavolts of energy. Because of this increase in penetrating power, larger doses can be delivered to deeper tumors with less back scatter and thus less damage to the skin. Work is now being

directed toward the development of machines that directly deploy protons and neutrons into the patient. Proton beams are not universally available for therapy but have been tried clinically by various groups in the United States (Leaky, et al., 1979).

Biological Effects of Radiation

The objective of cancer radiotherapy is to selectively kill a population of abnormal cell growth. However, all human cells, normal and cancerous alike, have similar susceptibility to being killed by radiation. The response of a given population of cells may vary due to its replacement abilities, the length of time after radiation when cell death occurs, and the mechanisms controlling the interactions between cell populations (Andrews, 1968).

Cells are killed by direct transfer of radiation energy to sensitive sites within the cell. This results from excitation or ionization of chemical molecules within the cell. Cell death, or loss of reproductive capacity may occur because of direct injury to the deoxyribonucleic acid which is essential for cell reproduction and growth. It may also occur because of biochemical changes that occur as a result of the dissociation of other chemical molecules into reactive free radicals, or a combination of these two processes (Andrews, 1968).

Gamma rays have no mass or charge. Their transfer of energy to matter depends upon direct collision with an orbital electron or the nucleus of the atom. Atoms are composed chiefly of unoccupied space; therefore, gamma rays may pass unaffected through a relative deep space. If the gamma ray interacts with an orbiting electron, the electron is ejected and part of the energy may be deflected in another direction. This is referred to as the Comptom Scatter Effect. The energy may be absorbed by the electron causing it to be ejected from the atom. This is referred to as the Photoelectric Absorption Effect. Pair production occurs when the energy ray interacts with the atomic nucleus. The energy is converted into a positive and a negative electron. Both will move through matter undergoing interactions with other atoms. When the energy ray interacts with large nuclei, that have more protrons, there is an increased probability for pair production to occur. Thus the interaction of radiation energy with matter is a random event. Since all matter is in constant motion, gamma rays will encounter orbital electrons or nuclei on a chance basis. It is possible for radiation to pass through cells or their substructures without having interacted at all (Pizzarello & Witcofski, 1967).

As radiation passes through tissue, it is degraded in energy or slowed down. As a result, it has a greater

opportunity to interact with atoms present and thus a greater biochemical reaction occurs (Mass & Brand, 1969). The higher the energy of the radiation, the greater its penetrating power will be. As a result, its peak energy release will occur at a deeper level than radiation from a low energy source. Radiation delivered from a 10 to 100 kilovolt machine has its peak energy release at the surface of the skin, while radiation delivered from a 1.25 megavolt machine has its peak energy release at 0.5 cm. below the surface of the skin (Berdjis, 1971).

The Gergonie and Tribondeau law stated that the sensitivity of cells to radiation is in direct proportion to their reproductive activity and inversely proportional to their degree of differentiation. Immature cells and cells in an active state of division are more sensitive to radiation than adult and resting cells (Berdjis, 1971). Radiation interferes with cell division by causing various types of damage to the chromatin material which interferes with normal mitosis in tissue that has a high rate of cell renewal. Bone marrow, gastrointestinal epithelia, and the hair follicle are examples of tissue that are very sensitive to radiation because of their rapid cell turnover (Pizzarello & Witcofski, 1967).

When radiation is given in small dose rates with a time interval between treatments, there is a certain amount of restoration that occurs. If restoration keeps up with injury, the degree of injury that occurs is controlled. However, a radiosensitive tumor may become radioresistant because a greater percentage of the most radiosensitive tumor cells die and those that survive enter into active mitosis and repopulate the tumor with radioresistant cells (Bacq & Alexander, 1961). Repeated exposure to small doses of radiation produces damage that can be expected to accumulate. Shorter interval time between exposures will result in greater effectiveness than the same total amount of exposure separated by longer intervals; consequently a greater effect will occur if the same total dose of radiation is given in a single exposure (Pizzarello & Witcofski, 1967).

The amount of oxygen in the cell at the time of radiation is related to the degree of severity of damage that occurs. Oxygen always enhances radiation effect. The oxygen must be present at the instant of exposure or within milliseconds after exposure. Radiosensitivity decreases little until oxygen tension is less than 20 mm. Hg. At about 4 mm. Hg. partial pressure, radiosensitivity is reduced to one-half of its value in 100% oxygen. Tumors

only a few millimeters in size contain hypoxic cells because of microvascular inadequacy. By delivering the total radiation dose in multiple fractions, cells may become reoxygenated and therefore more radiosensitive at the time of subsequent doses. Also, the failure for some tumors to adequately reoxygenate probably accounts for the inability to control their growth (Fletcher, 1980).

The amount of cell damage that occurs from radiation is related to the metabolic rate. If metabolism is increased by additional activity just after therapy is given, the lethal effects on the cell are greater. Also, if the metabolic rate is slowed down by lowering body temperature, the period of time before injury is apparent is lengthened. Surprisingly, the manipulation of thyroid function by either giving thyroid stimulating substances or removal of the gland does not effect radiosensitivity (Pizzarello & Witcofski, 1967). Metabolic diseases, such as diabetes, mellitus, or gout, increase radiosensitivity of the skin. Similar effects are seen following administration of iodine (Braum, et al., 1976). However, metabolic problems such as hyperglycemia and hyperuricemia do not seem to affect repair rate (Bacq & Alexander, 1961).

Generally radiosensitivity decreases as age increases. During periods of rapid growth, organisms will be more

radiosensitive. Puberty is an especially sensitive period. Throughout adult life, radiosensitivity changes little with the exception of the period of old age. This may be a reflection of the loss of resistance to any form of insult. In mammals, females appear generally to be somewhat more resistant to radiation than males but the differences are not great. Heavier organisms are more resistant to radiation than are lighter ones, although the influence of weight is unclear. Finally, radiation is more damaging to animals experiencing some kind of stress. This is probably because radiation is a stress itself (Pizzarello & Witcofski, 1967).

Physiology of the Skin

Covering the entire body is an organ called the skin. The skin protects the inner tissue from injury, drying, and foreign invasion. It transmits a range of sensations, helps regulate the body temperature, and aids in excretion and in vitamin D production (Sodman & Sodman, 1967).

The epidermis is the outer layer of the skin. It varies from one-half millimeter thick over the ear lobes to one and one-half millimeters over the palms of the hands and soles of the feet. Usually from five to ten cells deep, it overlies the loosely knit layers of the dermis. It is intimately attached to the outer surface of the dermis, the corium, by a very thin porus membrane. The

lower border of the epidermis has a wavy margin, correspondind to papillae which extend from the corium and form indentations into the lower surface of the epidermis (Cairns, 1975).

The epidermis may be divided into four layers, the basal layer, the spinous layer, the granular layer, and the loose horny layer. The surface of the skin may also contain desquamated cells. This cellular stratification is simply a reflection of the various stages through which basal cells develop. Each layer of the epidermis represents different stages in the life cycle of the basal cell (Lever, 1975).

The basal layer forms a single layer of columnar cells. They have compact nuclei and little cytoplasm. As proliferating cells are pushed outward toward the skin surface, they increase in size and become the spinous layer. The synthetic activity of the epidermis occurs mainly in the spinous and granular layers. These layers vary in depth from two to three cells in fur animals, to ten or more in the human (Spearman, 1973).

As the cells of the spinous layer progress outward, they become flattened and lose their muclei and other cellular organelles. Finally, they fuse into flakes which are eventually shed from the surface (Cairns, 1975).

The amount of melanin present in the epidermis parallels the skin color. In fair skinned caucasians, the melanin can be found almost exclusively in the basal layer. In blacks, however, melanin is found in the basal layer as well as throughout the epidermis (Lever, 1975).

The epidermis has no blood or lymphatic capillaries present in it. The dermis, however, is supplied with deep and superficial blood capillary plexus. The total skin vasculature is much greater than required for metabolism of the cells of the skin. Thus, the skin functions as a blood storage reservoir. Diffusion of gases, nutrients, and metabolites is via the dermal tissue spaces and between the epidermal basal cells, through the epidermal intercellular pathways as far as the granular layer (Spearman, 1973). As a result of this organization the epidermis will exhibit responses to vascular dilation or constriction before the dermis is affected (Lever, 1975).

About 50% of the mitotic divisions in the epidermis occur in the basal layer. Most of the remainder cell divisions occur just above the basal layer. Normally, the rate of cellular turnover in the basilar epidermis is slow since only approximately one in five hundred basal cells are in mitosis at any one time (Cairns, 1975).

Walter Lever (1975) estimates that the average normal epidermal germinative cell takes approximately 19 days to

reproduce in the adult. Once the cell has formed, the time required for it to travel from the basal layer to the surface of the granular layer is probably somewhere between 26 and 42 days. The passage of the cell through the horny layer has been calculated to be about 14 days. Thus, the total epidermis is replaced every 59 to 75 days (Lever, 1975).

Removal of the granular layer or the application of stress to the skin's surface excites a burst of mitotic activity within 24 to 48 hours. A short time after the stress is applied there is hypertrophy of the individual cells and hyperplasia of the whole epidermis (Cairns, 1975). In the skin disorder, psoriasis, the epidermis is replaced in as little as eight to ten days (Lever, 1975).

Surface characteristics of the epidermis are determined by the dermis. If epidermal tissue is removed from the thigh and grafted to the palm, it will thicken and take on the pattern of lines characteristic of the palm. If an area is subject to increased wear, an increase in the depth of the cells occurs forming a callus. If an area is denuded of epidermis, the area is recolonized through an increase in the rate of cell divisions in the surrounding epidermis (Cairns, 1975).

Normal healing of the skin involves two mechanisms. The defect fills with fibrous tissue while the epithelium

grows in from the periphery. A crust forms from the dried serum released by the vessels of the dermis. This crust produces a barrier from invasion. However, if bacteria enter via the hair follicle or sweat glands, they will grow very rapidly. Therefore, normal healing of the skin is partially dependent on the presence or absence of bacteria, crust formation, increased circulation, and the nutritional components of the blood (Lever, 1975).

From the behavior of the epidermis, certain deductions have been postulated. First, the fact that the only cells that divide are those in contact with the underlying dermis suggests that some short range signals pass through the dermis to the basal cells. Second, to prevent basal cells from invading the dermis, some mechanism which enforces this boundary must exist. Third, some system of lateral signals must regulate the spacing of epidermal structures such as hair follicles and sweat glands (Cairns, 1975).

Skin Response to Radiation

Skin reaction to radiation can be divided into acute and chronic changes. The severity depends mainly on the total dose of radiation to the skin, fractionation of the dose, and the size of the surface (Mass & Brand, 1969). The inguinal, axillary, and anal regions are more radio-sensitive than the thorax, abdomen, or face (Braun, et al.,

1976). Erythema is generally more marked above the second intercostal space than below it, due to the difference in sympathetic tone in this region (Turesson & Notter, 1976).

The cells of the skin that are the most sensitive to radiation are the basal cells, the root layer of the hair follicle, and the components of the sebaceous and sweat glands. Specific single dose values have been determined for the loss of certain structures, such as 1,200 rads for sebaceous glands, 1,600 rads for hair follicle, 2,000 rads for epidermis, and 2,500 rads for sweat glands (Berdjis, 1971).

Radiation given in fractional doses over a period of time will produce a number of cellular changes in the skin which creates a series of responses that are interdependent. Early visible changes resemble any erythema. This may appear with a single dose as small as 300 rads and it will be apparent within 24 hours after treatment. This erythema is a result of capillary congestion in the dermis. It usually fades in 2 or 3 days after therapy (Mass & Brand, 1969). Braun, et al., (1976) state that a single dose of 800 rads will likely produce erythema. This dose is sometimes referred to as S.E.D. or skin erythema dose. This inflammatory type of response is probably a result of histamine or seratonin released by the injured cells or it

may occur as a result of the release of proteolytic enzymes as in an inflammatory response (Mass & Brand, 1969).

Intermediate changes in the skin are usually seen from the 3rd week to the 12th week. They include erythema, edema, increased pigmentation, dry and wet desquamation, and ulceration, depending upon the dosage (Berdjis, 1971).

The skin-sparing effect of high energy megavoltage photons results because there is less back scatter and the maximum effect occurs below the surface of the skin. The Van de Graaf unit (2.5 megavolt) reaches its maximum effect at a depth of 0.4 cm. and the Cobalt 60 unit (1.25 megavolts) reaches its maximum effect at a depth of 0.5 cm. (Cohn, et al., 1972). The 4 Mev Linear Accelerator's maximum effect is at 1.0 cm. while the 22 Mev Linear Accelerator reaches its maximum effect at 3.6 cm. below the surface (Rafla & Rotman, 1974).

Megavoltage radiation may produce very little epidermal change but extensive dermal changes. These changes result in capillary engorgement which is demonstrated clinically by edema and an increase in temperature of the radiation field. It is not known whether the capillary congestion is a result of direct capillary damage or is secondary to damage of the surrounding connective tissue. This response is cyclic, becomes intense and then fades and recurs

somewhat less intensely. Following a dose of 500 rads, capillary permeability is increased. The peak of this response may be seen 2 weeks after exposure. Following a dose of 1,000 rads, leukocytic and erythrocytic infiltration can be seen in the dermal connective tissue (Mass & Brand, 1969).

Jolles and his co-workers examined the leakage of plasma proteins from the microvascular system into the extravascular space on rabbit's flank skin using vita blue dye. Using a 100 kv x-ray machine, they exposed a flank to 800 rads and within 2 hours defined a blue flush that persisted for 24 hours. This recurred in 9 to 16 days. It has been observed that no vascular permeability changes take place when animals are exposed to similar doses of gamma rays from a Cobalt-60 source (Jolles, et al., 1961).

Pigmentation during radiation therapy redistributes itself from the basal layer upward into the superficial layers. This occurs because of an increased production of melanin by both the basal cells and the squamous cells of the epidermis (Lever, 1975). Mass and Brand state that erythema is not a prerequisite for changes in pigmentation. They identify cellular damage resulting in increased production of melanin and vascular changes responsible for erythema as unrelated physiological processes. Multiple

suberythema doses may produce pigmentation and doses that produce erythema may not produce increased pigmentation (Mass & Brand, 1969). Turesson and Notter, in their studies with betatron radiation, demonstrated that erythema and pigmentation developed concomitantly and parallel (Turesson & Notter, 1975).

Doses at intermediate levels will kill some, but not all of the basal cells. The surviving cells will multiply and replace the dead cells in a 3 to 4 week period. At this time a dry desquamation or peeling effect occurs. If the dosage of radiation has been sufficient to cause damage to the subepidermal tissue, subcutaneous fibrosis may result. Also a decreased blood supply to the epidermis will result in slowing down in the mitotic activity of the basal cells. The horny layer of the epidermis becomes more cornified and may open and drain. This is referred to as moist or wet desquamation. Only approximately 5% of patients receiving theraputic doses of Cobalt-60 radiation develop some amount of subcutaneous fibrosis (Mass & Brand, 1969).

In severe cases of radiation dermatitis, the epidermis undergoes necrosis, either because of radiation death of the basal cells or because of loss of blood supply due to vascular damage in the dermis. The epidermis will detach

itself from the dermis. This denudation may reveal a necrotic upper dermis as well (Lever, 1975). Severe changes such as these usually are associated with complications such as infection, trauma, or thermal burns. Even when these problems occur, conservative management usually results in healing (Buschke & Parker, 1972).

The hair follicle becomes inactive the 2nd week after radiation exposure. Separation of the hair shaft from the basilar portion and degenerative changes of the papilla cells and the sebaceous glands occur during the 3rd to 12th week (Berdjis, 1971).

Ten to fourteen days after a moderate dose of radiation, the hair may be easily drawn out or it may fall out (Akerman, 1970). By 3 to 4 weeks after exposure, the hair follicles and adnexal glands are reduced in number or eliminated (Commission of Radiotherapy, 1976). A single dose of 350 to 400 rads will cause temporary hair loss in about 3 weeks. However, regrowth occurs in 8 to 9 weeks. If the dose is raised to 1,000 rads the matrix cells are destroyed which results in permanent alopecia (Braun, et al., 1976).

Many studies are reported in the literature measuring the effects of different fractionated dose schedules employed to decrease the skin response to radiation. The

results of these studies show that smaller dose fractions given over longer periods of time result in similar cancerocidal effects with a decreased skin reaction (Gagon & Peterson, 1978; Turesson & Notter, 1976; Hutton, et al., 1977; Masuda, et al., 1977).

Several studies have been reported on the effects of radiation to the skin when the radiation is given in combination with cancerocidal drugs. When Actinomycin D, Adriamycin, or Bleomycin are given in combination with radiation therapy, the effects of radiation on the skin are enhanced (D'Angio, et al., 1959; Greco, 1976; Mayer, et al., 1976; Redpath, et al., 1978, Leith, et al., 1975; Hahn, et al., 1978).

Echols and Yuhas (1976) did studies with WR-2721 [S-2-(3-aminopropylamino) ethylophosphosphorothiaic acid]. They injected this substance intraperitoneal (200 mg./kg) into rats 15 minutes before each radiation exposure. They found this increased protection about 50% on one dose only, but this decreased as the number of exposures increased. Verspohl and Messerschmidt (1975) did a similar study with female mice and they also made an open dorsal wound on each mouse. Both those mice that received WR-2721 and those that did not had an increase in lethality over those that received radiation alone.

Duncan, et al. (1978) did a study using guinea pigs. They applied Kerolyt to the experimental group. They found the control group developed erythema at doses of 3,000 rads, 4,000 rads, 5,000 rads, and 7,000 rads. This study was done using ultra violet light rather than gamma ray. The pigs treated with Kerolyt did not develop erythema. Kerolyt contains salicylic acid 6%, ethyl alcohol 9.4%, and propylene 60% by weight. Salicylic is a known inhibitor of prostaglandin which has been implicated as a mediator of ultra-violet-light-induced erythema or sunburn.

Dimethyl sulfoxide (DMSO) is a radioprotector and Metronidazale is a radiosensitizer for hypoxic cells. Moulder, et al. (1978) used these substances in combination on rats with tumors of the skin. DMSO applied topically did protect the hair of radiated rats without tumors. However, when DMSO and Methronidazale were applied to rats with tumors, they did not produce an increased therapeutic effect of radiation.

Forsberg, et al. (1978) found that they could decrease the skin reaction in the rat's leg by injecting degraded starch microspheres intraarterially to make the leg hypoxic. This relates to the basic premise that radiation sensitivity is directly related to the presence of exygen. Studies by Overgaard, et al. (1974), Law, et al. (1978), and Leith (1976) show that heat applied to the skin before, during, and

after radiation therapy will result in an increased skin response.

Measuring Skin Response

Skin Color

Scientific explanations for skin color are incomplete and controversial. Skin color is formed by light passing through the epidermis, being reflected and diffused back by the dermis, passing once more through the epidermis, to the exterior. The color that is reflected is dependent on the amount of melanin in the epidermis and the amount of blood in the dermis. White skin may have little melanin in the epidermis and so the main effect on its color will be the blood. In black or dark brown skin this is altered by the amount of epidermal melanin which acts as a filter that absorbs more light at the blue end of the spectrum than at the red. Therefore, assuming that all the illumination and viewing factors are kept standard, the main factors that determine skin color are the amounts of melanin and blood (Magnus, 1976).

Methods to Appraise Skin Response to Radiation

Visual Assessment: Leigner and Michaud (1961) used a visual assessment in which they ranked the degree of skin reactions within a scale expressed a 0, +, ++, +++.

Magnus (1976) describes the use of color charts or colorimeters in which definite shades of reds are matched. Kligerman, et al. (1976) used eight artists to score skin reaction according to a predetermined color scale. However, their observations were so inconsistent that they precluded analysis.

Baker and Leith (1975) used a grading system for evaluating skin response in the acute injury phase. This system ranges from 1.0 which is no difference to 5.0 which is loss of the epidermis with necrosis present. Although this system does not include any evaluation for increased pigmentation, it does account for the progressive process of dry to wet desquamation and on to epiliation of areas of the skin.

Instrumental Assessment. Optical plethysmography represents the most accurate method available to measure blood volume in the dermis. Red light is absorbed by oxygenated blood and is translucent to the tissue of the body. Therefore, a greater amount of light will be absorbed in skin that has a greater blood volume. Plethysmography measures only blood volume and it cannot distinguish between reduced inflow and decreased blood volume in superficial vessels. It is also a very large, stationary piece of equipment which limits its versatility (Ryan, 1973).

Edwards and Duntley (1939) did extensive studies using a reflectance spectrophotometer. They found that estimates of oxyhemoglobin may be made by reflection measurements of 556-574 millimicrons of light. They also found that the melanin content could be determined by reflection measurements of 660-680 millimicrons of light.

The Photovolt Reflection Meter Model 610 records the intensity of reflected illumination through each of three filters, red, green, and blue (Dekleine, 1955). The peak transmission of the red filter is 420 millimicrons. The peak transmission of the green filter is 525 millimicrons. The peak transmission of the blue filter is 650 millimicrons. The instrument is delicate enough to record difference in the degree of tanning caused by different exposures to the sun (Lasker, 1954). Chu, et al. (1960) and Truesson and Notter (1975) used an updated model 670 to measure color changes due to x-irradiated skin. They used the red filter (578 Millimicron) to measure oxyhemoglobin and the green filter (660 Millimicron) to measure melanin. Chu, et al. stated this was necessary because pigmentation and blood flow increase at the same time and this will provide a method of distinguishing these two effects.

Turesson and Notter (1975) collected their measurements twice a week, commencing before the first treatment.

Chu, et al. (1960) stated that selecting arbitrary days to measure the color changes may result in inadequate data. Since the variability of the individual sensitivity enters into the skin phenomenon, it is possible that a strong reaction could be overlooked.

Harris, et al. (1932) measured only the irradiated area. Chu, et al. (1960) and Jansen (1953) used a simple method of expressing the data in terms of the percent of normal skin color. They took readings of the adjacent normal skin on both sides of the portal of entry and obtained a ratio of radiated skin to non-radiated skin times 100. This method compensates for normal variation in skin color due to peripheral blood flow or variations in skin pigment.

Dekleine (1955) used this instrument to measure skin color after plastic surgery. Daniels (1958) used this instrument to measure erythema produced by sunlight. Lasker (1954) used it to measure skin color in a Mexican Mestizo population.

Nursing Care of the Skin

Suggested care of the skin during radiation treatment varies widely. Some patients are given very specific instructions on how to care for the skin and others are given no special instructions at all (Thomas, 1967).

Leaky, et al. (1979) suggests that patients receiving external beam radiation may take a shower but must avoid the use of soap on the portal of entry. Elliott (1977) and Thomas (1967) also suggest that soap would have a drying effect. Isler (1971) and Behnke (1973) suggest that patients should bathe with caution with mild soap and water. Craytor (1970) recommends that no washing should occur over the portal of entry during the time the patient is receiving radiation therapy. All of these authors stress the importance of not rubbing the skin and not removing the markings which denote the portal of entry.

Several authors caution against the use of cosmetics, powders, perfumes, or ointments on the portal of entry. Many perfumes and cosmetics contain alcohol which dries the skin. Talcums contain talc which is small metal particles that increase heat to the portal of entry during therapy (Thomas, 1967; Isler, 1971; Elliott, 1977; Baldando & Stahl, 1978). Some home remedies and beauty aids contain metal particles such as zinc and bismuth. These substances also increase heat to the skin, thus increase skin reaction (Leaky, et al., 1979; Craytor, 1970).

Patients should not apply heat in the form of hot compresses, heating pads, or hot water bottles to the portal of entry (Thomas, 1967; Craytor, 1970; Behnke, 1973;

Elliott, 1977; Leaky, et al., 1979). No reference to the application of cold was made although Baldonado (1978) suggested patients should avoid extremes of temperature.

The treatment area should not be exposed to direct sunlight. The skin is much more sensitive to sunlight and will easily develop a severe sunburn (Thomas, 1967; Craytor, 1970; Behnke, 1973; Elliott, 1977; Baldonado, 1978; Leaky, et al., 1979). Thomas (1967) suggests that the patient receiving radiation to an area of the head or neck should wear a scarf or hat in the sun. Behnke (1973) suggests the use of a protective cream, Uval, when going out into the sun.

Restricting garments such as bras, girdles, tight collars, and prosthesis should not be worn over an irradiated field unless absolutely necessary (Thomas, 1967; Behnke, 1973). Patients receiving radiation to the head should wear a loose fitting wig only when absolutely necessary. Also, patients who normally wear dentures are encouraged not to wear them if receiving therapy that will include the oral mucosa (Leaky, et al., 1979). Thomas (1967) suggested lying on the radiation field for extended periods should be avoided. Behnke (1973) suggests starched clothing can be irritating to the skin. Nylon undergarments tend to retain moisture and keep the skin moist. Cotton

undergarments tend to absorb moisture and keep the skin dryer. Women who are getting radiation to the chest wall after mastectomy surgery are advised to wear a cotton t-shirt next to the skin (Isler, 1971; Behnke, 1973).

If the portal of entry is located in an area that tends to be very moist, cornstarch applications are recommended (Leake, et al., 1979; Behnke, 1973; Isler, 1971). If the portal of entry is very dry, bland ointments such as baby oil, vitamin A & D ointment, or lanolin are recommended (Leake, et al., 1979). Applications of calamine lotion without phenol at least three to four times a day, or daily applications of gentian violet to provide relief from soreness and itching is recommended by Thomas (1967). Craytor (1970) suggests applications of Crisco for itching.

Most skin reactions end at the dry desquamated stage. However, they may advance to the wet desquamated stage. There may be blisters and loss of the superficial layers. This area should be cleansed with a gentle spray of half strength peroxide and normal saline and allowed to air dry. The patient should be encouraged to leave the area exposed as often as possible. At this point, the area is very susceptible to infection. If dressings are necessary, non-adhesive pads, Telpha pads, Microderm, nonallergic tape and surgifix were recommended (Leake, et al., 1979; Thomas, 1967).

Summary

The advancement from the first external beam radiation therapy machine developed in 1920 to the current sophisticated 20 megavolt linear accelerator used today demonstrates the rapid development of radiation as a therapeutic modality. The objective of radiation therapy is to kill a population of abnormal cell growth. Mitotically active cells as well as poorly differentiated cells are more radiosensitive. Oxygen enhances the effect of radiation. The greatest lethal effect to cancer cells and to normal cells can be obtained by giving a large dose of radiation in a single exposure. This method also results in the greatest number of side-effects. Repeated small doses given over a period of time produce damage that can be expected to accumulate. This method allows for some restoration to occur but there are less side effects. During periods of rapid growth, especially puberty, mammals are more radiosensitive. Other factors related to radiosensitivity include metabolic rate and possible stress.

The severity of skin reaction to radiation is related to the amount of radiation given, the amount of time between doses and the size and shape of the surface. The most radiosensitive cells in the skin are the basal cells, the root of the hair follicle, the sebaceous and sweat glands.

Skin reactions include erythema, increased pigmentation, dry and wet desquamation, and denudation. Other factors effecting skin reaction include heat, sun exposure, trauma, and infection. Skin reactions have been measured using rating scales, color charts, and lights that reflect off the skin. The photoelectric reflection meter represents the most objective way to measure erythema and increased pigmentation. A rating scale must be used to describe dry and wet desquamation and denudation if they occur.

Much discrepancy exists in the nursing literature as to the best method to prevent severe skin reaction and what to do if this occurs. Most reactions do not progress beyond dry desquamation. The use of various ointments and powders are recommended by some authors. The extent to which bathing prevents or enhances skin reaction is uncertain. Since nursing's contribution to the patient is to foster effective behaviors, knowledge of what behaviors best serve to protect the skin of the patient receiving Cobalt-60 radiation therapy is important. Results from this study will give the nurse valid data concerning decisions to bathe the skin being exposed to radiation with water or to not bathe the skin at all during the treatment period.

CHAPTER 3

PROCEDURE FOR COLLECTION AND TREATMENT OF DATA

This study was a field quasi experimental type study. A field experiment is a research study in a real existing social situation in which the phenomenon of interest normally occurs (Polit & Hungler, 1978). This study was conducted at the Wm. and Elizabeth Moncrief Radiation Center in Fort Worth, Texas. Each subject received Cobalt-60 radiation therapy to the head and neck, chest, or back.

The field experiment is easily contaminated because of the difficulty in controlling all the variables. Despite these difficulties, field studies are very worthwhile in nursing research because the realism of the setting makes the study more meaningful and generalizable (Polit & Hungler, 1978).

The criteria for a true experimental design are: the experimenter does something to some of the subjects, the experimenter introduces one or more controls over the experimental situation, and the experimenter assigns subjects to the experimental and control groups on a random

basis (Polit & Hungler, 1978). A description of this study using this criteria will be given.

Manipulation

The independent variable manipulated in this study was daily bathing the portal of entry with water. Subjects were assigned to one of two groups. The control group was allowed to bathe the portal of entry once daily using water only. The experimental group was not allowed to put anything, including water, on the portal of entry. Therefore, the experimental group could bathe but had to take special precautions not to get soap or water on the portal of entry.

Controls

Because this study was a field study, particular attention was placed on controlling the variables. All the participants were receiving the same dose exposure everyday, 5 days a week, for 5 weeks. Each subject received the entire course of treatment in the same room, from the same Cobalt-60 machine. The subjects were adults, 20 years of age or older. All instructions and measurements were done by the same investigator. Each subject was measured just after the fifth, tenth, fifteenth, twentieth, twenty-fifth treatment, and 2 weeks after the final treatment.

To control the variability within the individual subject, readings were taken from the portal of entry and from the adjacent normal skin. A difference score was obtained by subtracting the score of the radiated skin from the score of the normal skin. This difference score represented the actual change that occurred.

Randomization

Numbers were drawn from a table of random numbers. As the number was drawn, it was assigned to alternating groups. Each subject was given a number upon entering the research and placed in the group in which their number had been assigned.

Setting

This study was conducted at the Wm. and Elizabeth Moncrief Radiation Center, 1425 Elder Place East, Fort Worth, Texas. This center houses six pieces of therapy equipment which include a Van de Graaf unit, a Cobalt-60 unit, a 4 mev. and 8 mev. Linear Accelerator. It has the capability of treating 150 patients per day. The center has a school of Radiotherapy Technology and Nuclear Medical Technology. Physicians from radiology programs in North Texas rotate through this center. In addition to this, the center has 25 full-time employees. Each radiotherapist is

assigned certain times of the day to provide therapy for his/her patients. The radiotherapist was present each time the patient received treatments. Agency permission is included in this text (Appendix H).

Population and Sample

Eighty subjects were drawn from a population of patients receiving Cobalt-60 radiation therapy. The criteria for participating subjects were that they:

1. agreed to participate in the study
2. were 20 years of age or older
3. were to receive Cobalt-60 radiation therapy to the chest, back, or head and neck
4. were to receive 200 rads a day, 5 days a week for 5 weeks.

All subjects that developed an infection or severe injury to the portal of entry were eliminated. The radiotherapist retained the right to withdraw any subject for any reason during the study.

Protection of Human Rights

Each subject who met the criteria was randomly assigned and then given an oral explanation of the study by the investigator (Appendix C). Each subject was asked to sign a

consent form that was also signed by the investigator and the medical radiotherapist (Appendix A).

The subjects assigned to the experimental group had to take precautions not to get the portal of entry wet at any time during the 7 week period. Therefore, they could not take a complete bath for 7 weeks. The experimental subjects receiving therapy to the head could not wash their hair for 7 weeks. The practice of allowing patients to bathe the portal of entry with water only was being practiced in the setting. Therefore, for purposes of this study, the more conservative practice of not bathing was introduced to determine if the degree of skin reaction could be reduced.

The collection of data was done when the subjects came to the Radiation Center for Therapy. The length of time necessary to perform the tests was approximately 10 minutes.

The benefits of the study as explained to the subject, included a better knowledge of the care of the skin during therapy. Also, the subjects in this study had access to the close supervision of the investigator who is an oncology clinical specialist.

All subjects were informed of their right to withdraw from the study at any time without any effect to the manner in which they were being treated. Each subject was given a number and their names were not used in any way in the research reports.

Approval was obtained from Texas Woman's University Human Subjects Review Committee. Forms submitted to this committee are included in this text (Appendix B). A written description of the oral explanation given to the subjects is included in this text (Appendix C).

Research Instruments

Skin erythema and pigmentation were measured by the use of a photoelectric reflection meter (Photovolt 670). The main unit of this instrument includes an indicating galvanometer, controls, and a constant voltage transformer. The search unit houses a lamp and the photo cell. The light from the lamp passes through an exchangeable glass filter of known optical property and through an aperture in the photocell and onto the surface of the skin. The light that is reflected from the skin acts on the photocell which produces a reading on the galvonometer (Lasker, 1954).

An area of approximately 2.5 cm. square was illuminated with light of a wavelength of 578 millimicrons. Light of this wave length is absorbed by oxyhemaglobin (Chu, et al., 1960). The reflection light is measured and read from an attached meter. The increase in pigmentation is registered in the same manner but with a light of a wavelength of 660 millimicrons (Appendix F).

Each week the search unit was placed flat against the portal of entry and readings were obtained using both the 578 interference filter and the 660 interference filter. This same procedure was repeated on the normal skin of the ajacent side of the subject.

The Baker-Leith Grading System was used to assess the degree of dry and moist desquamation that occurred. This system rates the degree of skin reaction from one, which is no reaction, to five, which is moist desquamation with necrosis present (Appendix G).

Data Collection

As patients were admitted to the Radiation Center for Cobalt-60 radiation therapy to the head, neck, or chest, they were asked to participate in the study. Demographic data including age, sex, race, and color of the skin using the photoelectric reflection meter were obtained. Subjects were randomly assigned to the experimental and control groups by the use of a table of random numbers. The control group was given oral and written instructions for skin care that included bathing the portal of entry daily with water only (Appendix D). The experimental group was given oral and written instructions for skin care that excluded bathing the portal of entry during the treatment period (Appendix E).

When the subjects came to the radiation center for the fifth, tenth, fifteenth, twentieth, and twenty-fifth treatments, the portal of entry was measured with the photoelectric reflection meter. The normal skin on the opposite side of the portal of entry was also measured. A difference score was obtained by subtracting the score obtained from the radiated skin from the score obtained from the normal skin. Subjects were also given a grade using the Baker-Leith Grading System. These same procedures were performed when the subject came back to the radiotherapist 2 weeks after the last treatment was given (Appendix I).

Pilot Study

A pilot study was conducted to familiarize the researcher with the use of the Photovolt 670, to organize the method of data collection, to determine the accessibility of subjects. Each subject was randomly assigned to the experimental and control group by use of a table of random numbers. The first two subjects in each group were used for the pilot study. Each subject was measured with photoelectric reflection meter as planned in the study except the 2 week followup reading was deleted for the pilot.

An analysis of variance on this 2 x 6 repeated measure design revealed no significant difference in the increase in erythema in the bathe and the no-bathe groups

(F=5.77,d.f.=1, p. > .05). The obtained F was only .22 less than the estimated F ratio. The same statistical test revealed no significant difference in the increase in pigmentation in the bathe and the no-bathe groups (F=.113, d.f.=1, p. > .05).

Two other problems identified in the pilot study were:

1. the accessibility of patients receiving Cobalt-60 radiation was limited because only one radiotherapist agreed to allow the researcher to ask his patients to participate in the study

2. the subjects developed a dry, crusty skin that was not demonstrated in the readings from the reflection meter.

Based on the findings during the pilot, the original study was altered in the following way:

1. include patients receiving Cobalt-60 to the head and neck

2. extend the data collection period from 6 months to 16 months

3. rate the skin using the Baker-Leith Rating Scale (Appendix G).

Treatment of Data

A repeated measures Quasi Experimental design was used.

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Seven observations were made on each subject. Each observation consisted of three different measurements: an erythema difference score, a pigmentation difference score, and a rating from the Baker-Leith rating scale. For analysis the data was grouped according to the anatomical site being radiated. Mean erythema difference scores, mean pigmentation difference scores, and mean rates were calculated.

For Hypothesis I: There is no significant difference in the increase in erythema of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe. An analysis of variance was done on this 2 x 7 Repeated Measures design with repetitions over factor B (radiation dose).

For Hypothesis II: There is no significant difference in the increase in pigmentation of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe. An analysis of variance was done on this

2 x 7 Repeated Measures design with repetitions over factor B (radiation dose). A repeated measures design was chosen because both the experimental and control groups were exposed successively to all levels of radiation therapy. This design achieves the highest degree of comparability among subjects receiving the same different treatment levels and provides comparisons involving highly homogeneous material (Dayton, 1970).

For Hypothesis III: There is no significant difference in the degree of skin reaction to Cobalt-60 radiation as measured by the Baker-Leigh Rating Scale in patients who bathe and those who do not bathe. A Man-Whitney U test was done on the highest rate given to each subject during the treatment period. The Man-Whitney U test was chosen because the Baker-Leith Rating Scale assigns a number value (one to five) to the skin reaction. This represents weak interval scaling and does not meet the requirements for a parametric test. The Man-Whitney U is one of the most powerful non-parametric tests and is a useful alternative to the parametric t test (Siegel, 1956).

CHAPTER 4

ANALYSIS OF DATA

The problem of this study was to determine the effects of bathing or not bathing on the degree of skin reaction occurring in patients receiving Cobalt-60 radiation therapy to the chest, back, or head and neck.

Description of the Subjects

Eighty-two subjects were admitted to this study. Forty-one subjects were assigned to the experimental (no-bathe) group and forty-one subjects were assigned to the control (bathe) group. A total of fifteen subjects were dropped from the study for a variety of reasons. Six subjects were dropped because therapy was discontinued at the patient's request. Three subjects missed several treatments because of personal problems. One subject was dropped for each of the following reasons: infection, head injury, emergency surgery, metastatic lesion in the femur, and death. One subject was dropped because she clearly did not comply with the instructions given to her for skin care. She washed the markings off the portal of entry the first week of therapy. A total of seven subjects

were dropped from the experimental group leaving thirty-four subjects in this group. A total of eight subjects were dropped from the control group, leaving thirty-three in this group.

Primary Diagnosis

There were seven different primary diagnoses among the subjects. Twenty-nine subjects had lung cancer, twenty-one were post mastectomy, and ten had primary brain tumors. Five subjects had breast cancer which had not been treated surgically. There was one subject who had cancer of the larynx and one who had cancer of the tongue. One subject had an undifferentiated tumor of the neck. (Fig. 1)

Sex, Race, and Age

Forty-one, or 61.2%, of the subjects were female. Twenty females were in the experimental group while twenty-one were in the control group. Twenty-six, or 38.8%, of the subjects were male. Fourteen males were in the experimental group while twelve were in the control group. (Fig. 2)

The majority of the subjects were white. Fifty-six, or 83.6%, were white while only eleven, or 16.4%, were black. Twenty-nine whites were in the experimental group

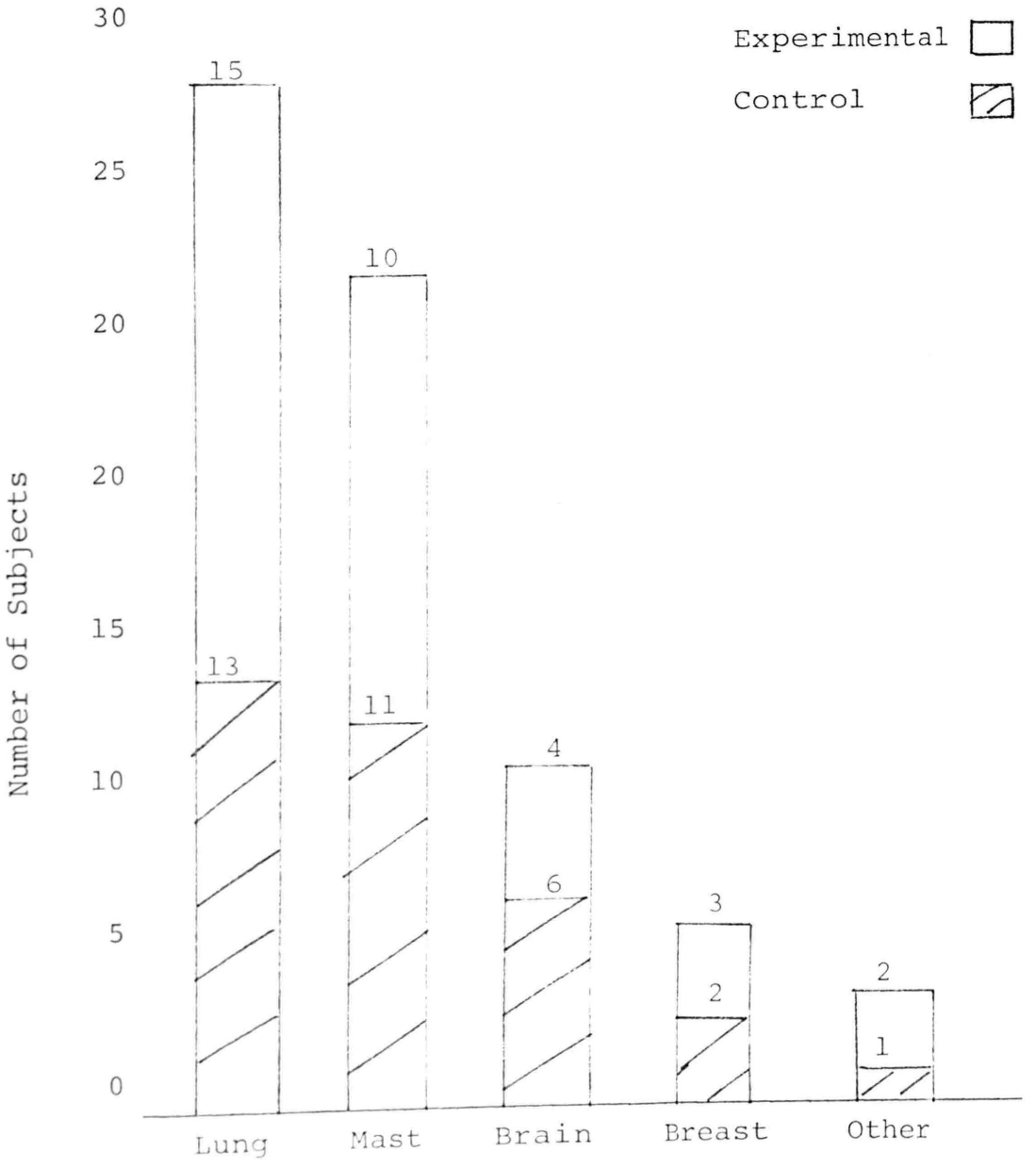


Figure 1. Primary diagnosis as distributed in experimental and control groups.

and twenty-seven whites were in the control group. Five blacks were in the experimental group and six blacks were in the control group. (Fig. 2)

Ages ranged from twenty to eighty but 85% of the subjects were forty years of age or older. The mean age for the total group of subjects was 56.73 while the mean age of the experimental group was 58.43 and the mean age of the control group was 54.86. (Fig. 3)

Radiation Sites

The sixty-seven subjects received radiation to one hundred and eleven different sites. Forty-eight subjects received radiation through the anterior chest. Fifteen subjects received radiation through the back. Twenty-four subjects received radiation bilaterally, through both the left and right sides of the head. Thirty subjects received radiation to one site. Thirty-one subjects received radiation to two sites. Three subjects received radiation to three sites, and two subjects received radiation to all four sites. (Fig. 4)

Erythema Difference Means

Photovolt erythema readings from the portal of entry of each site were subtracted from the Photovolt erythema reading of the adjacent normal skin to obtain the erythema

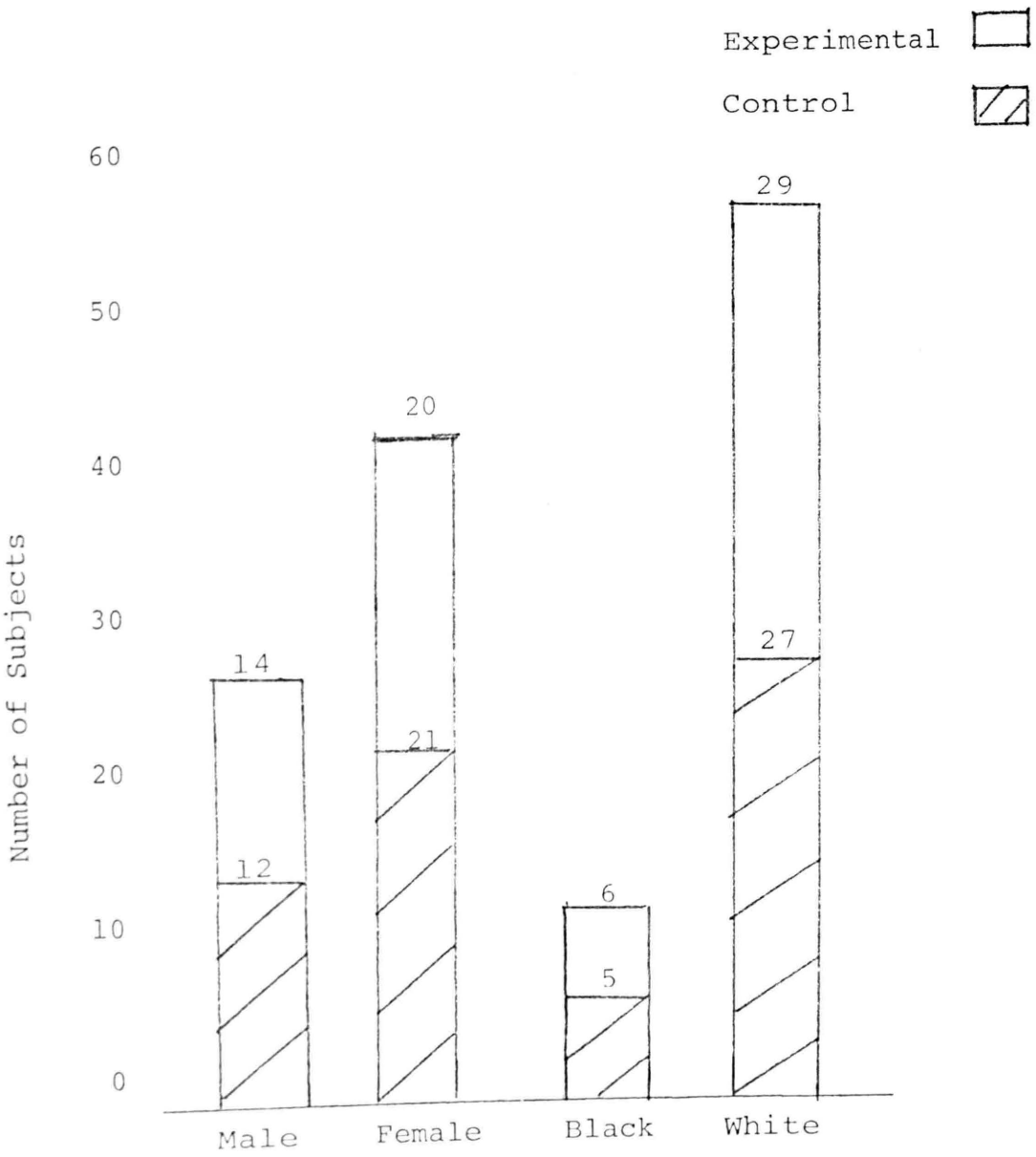


Figure 2. Sex and race distribution in experimental and control groups.

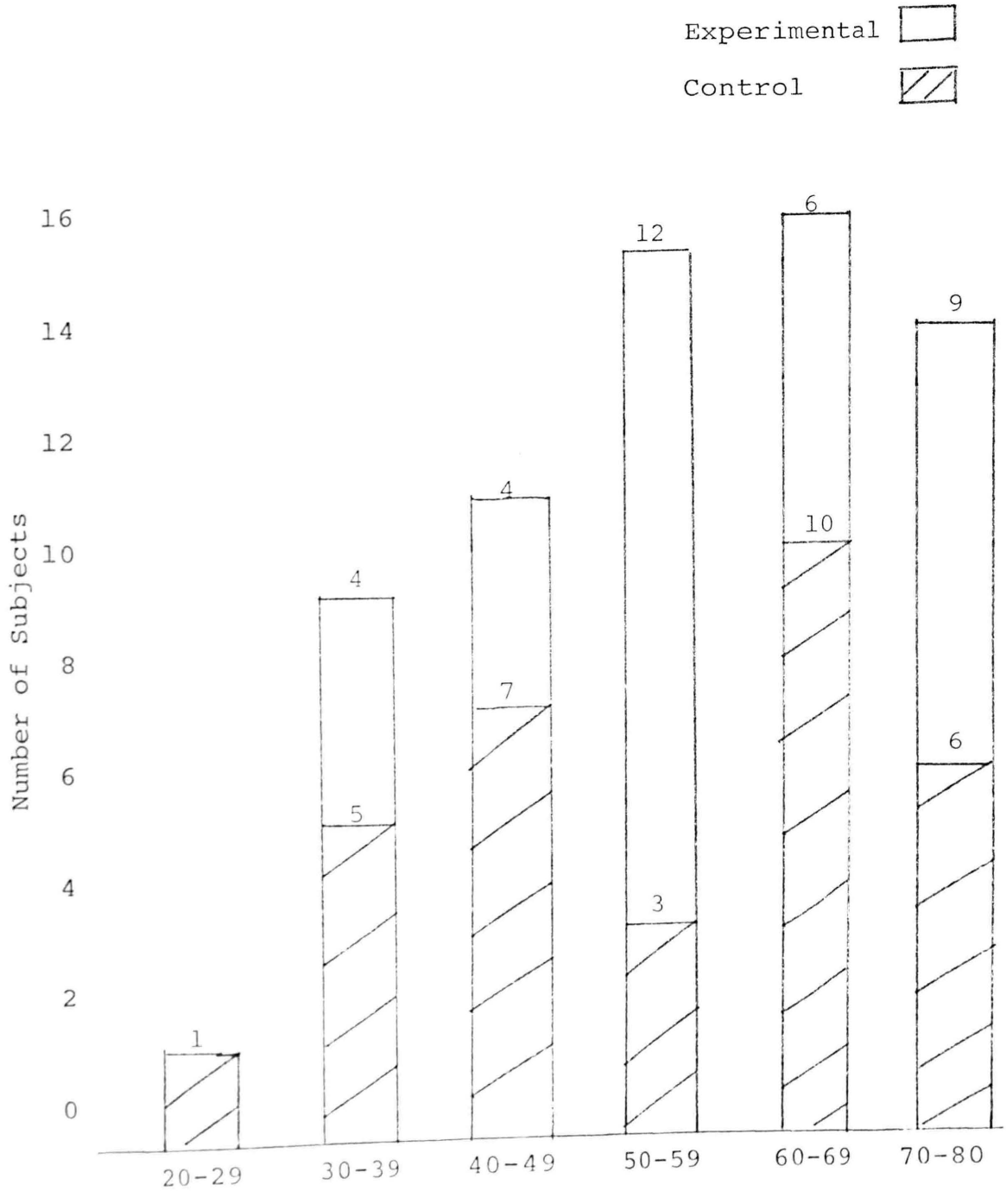


Figure 3. Age range distribution in experimental and control groups.

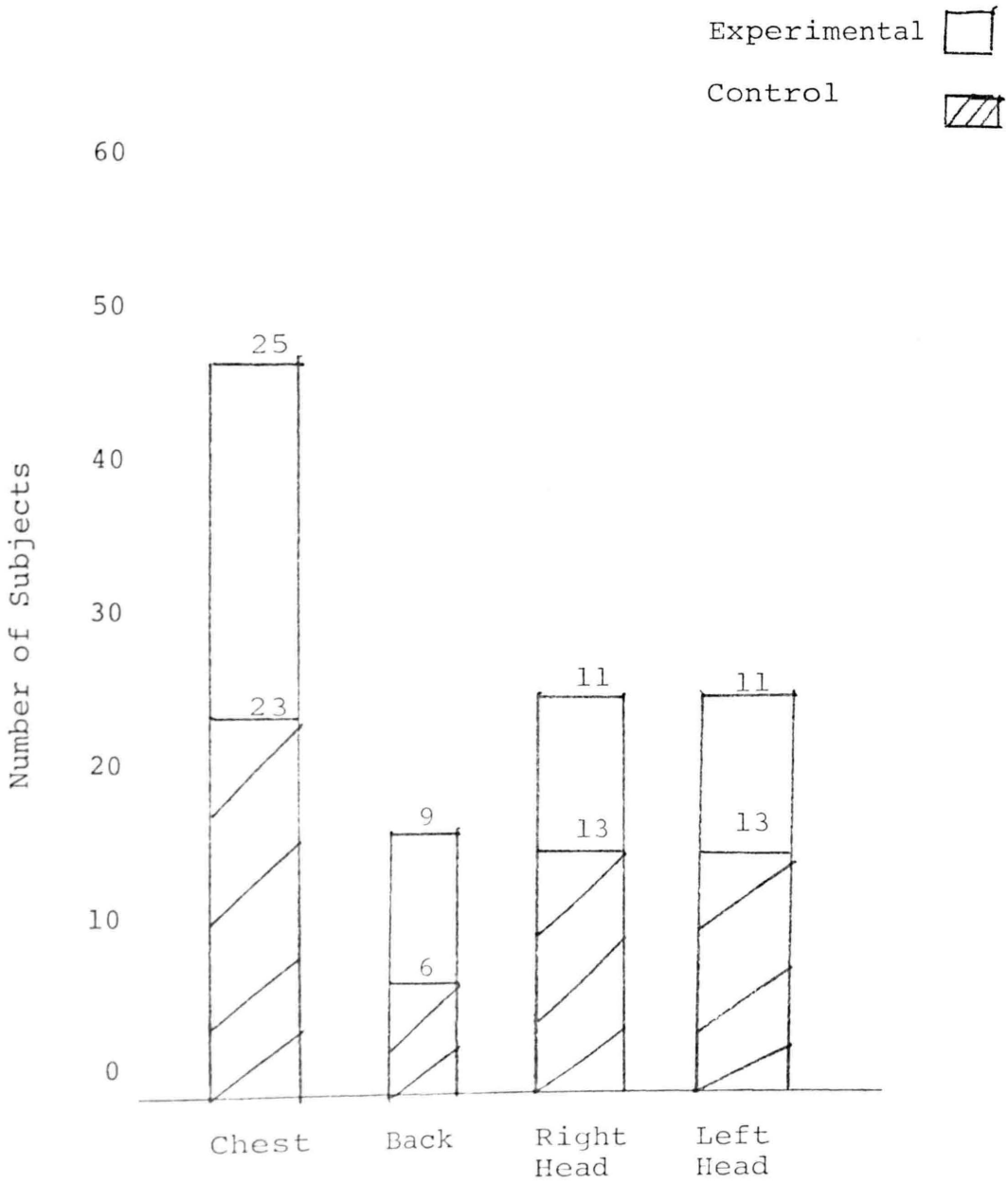


Figure 4. Anatomical site of radiation therapy as distributed in experimental and control groups.

difference score for that particular anatomical site. Site erythema difference means were calculated for each of the seven repeated measures obtained from the experimental (no-bathe) groups and from the control (bathe) groups. This is shown in Figures 5, 6, 7, and 8.

Pigmentation Difference Means

Photovolt pigmentation readings from the portal of entry of each site were subtracted from the Photovolt pigmentation reading of the adjacent normal skin to obtain the pigmentation difference score for that particular anatomical site. Site pigmentation difference means were calculated for each of the seven repeated measures obtained from the experimental (no-bathe) groups and from the control (bathe) groups. This is shown in Figures 9, 10, 11, and 12.

Skin Change Rate Means

Each time erythema and pigmentation readings were taken, each site was given a skin change rate (1.0 to 5.0) using the Baker-Leith Rating Scale. (Appendix G) Site skin change rate means were calculated for each of the seven repeated measures obtained from the experimental (no-bathe) groups and from the control (bathe) groups. This is shown in Figures 13, 14, 15, and 16.

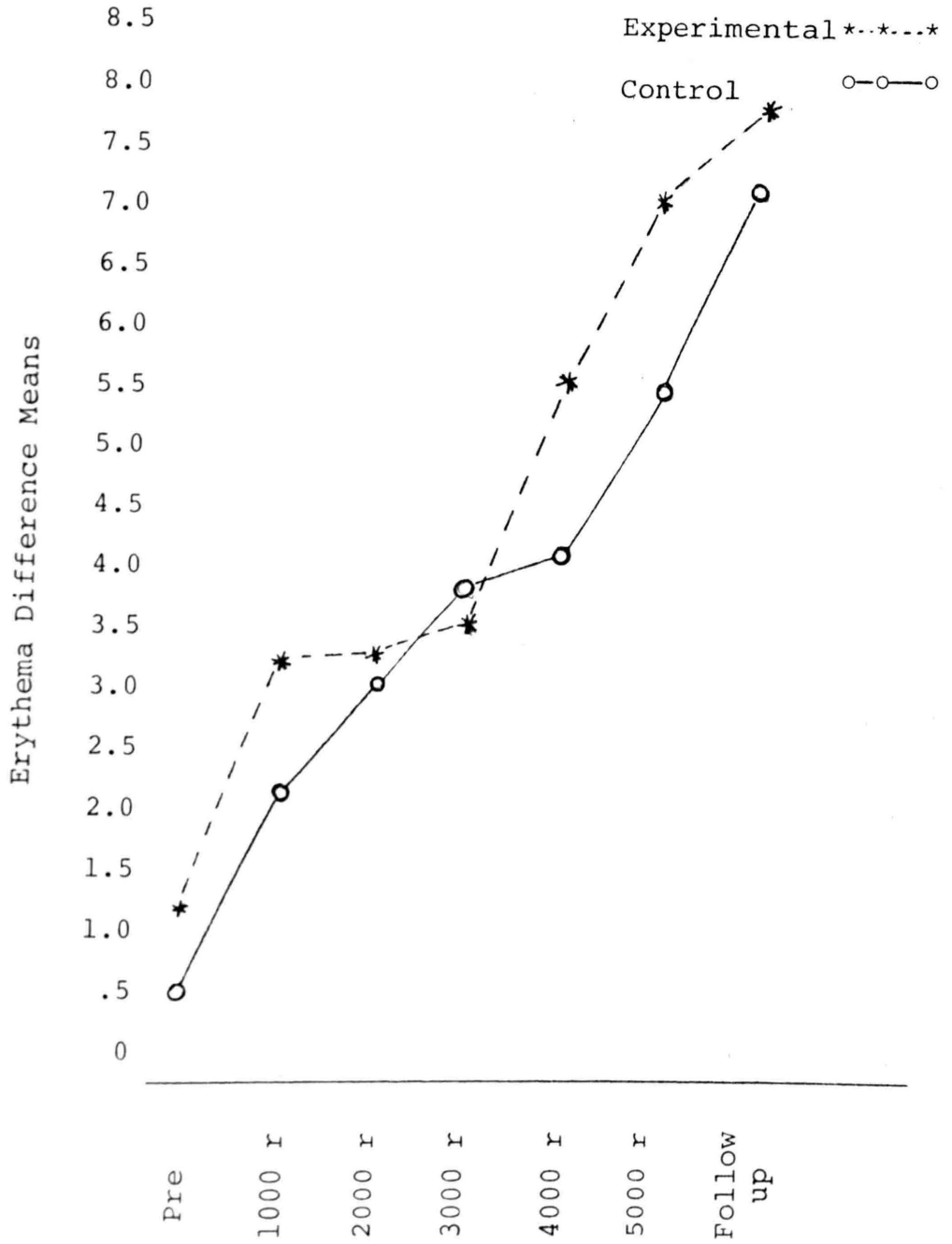


Figure 5. Chest erythema difference means of experimental and control groups.

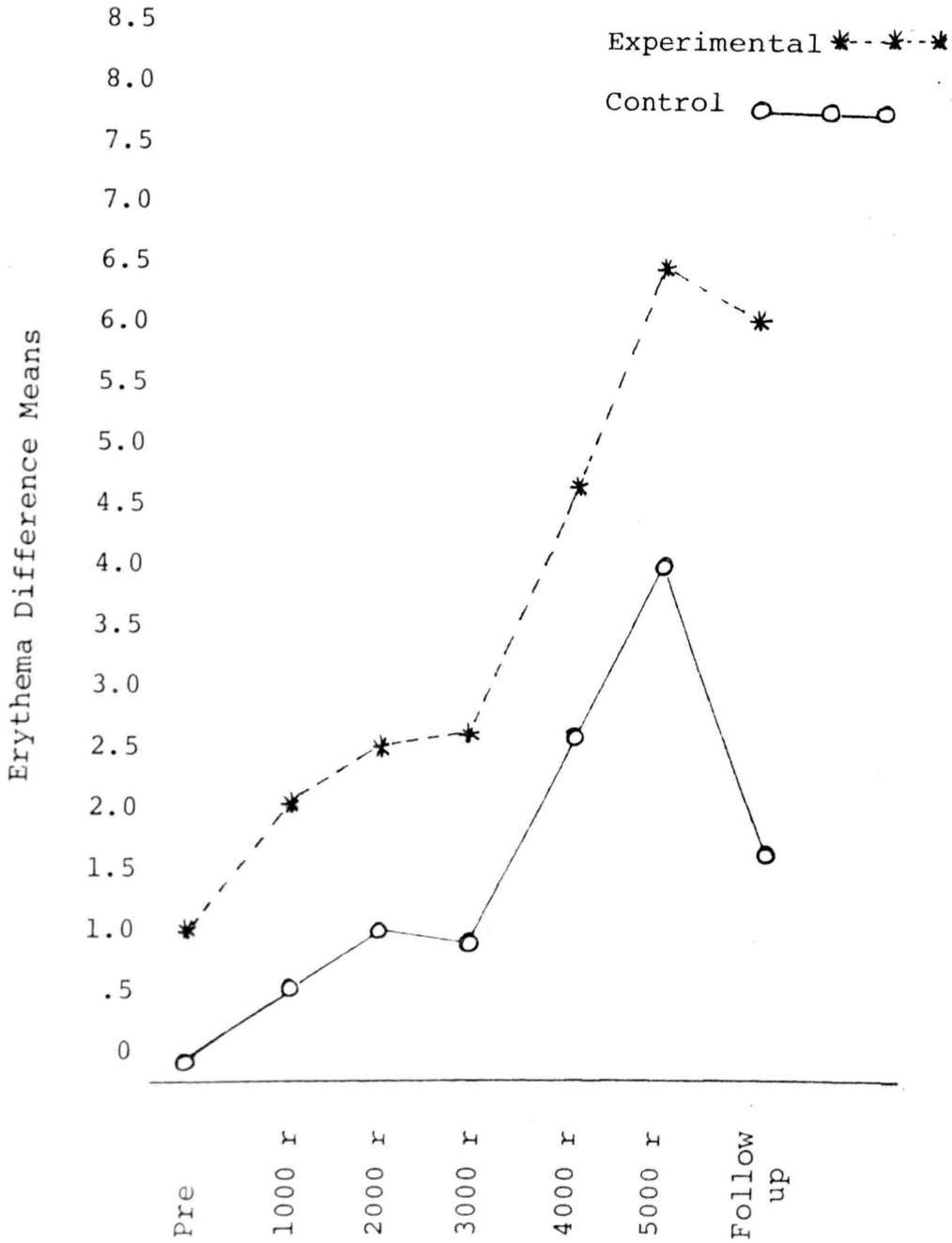


Figure 6. Back erythema difference means of experimental and control groups.

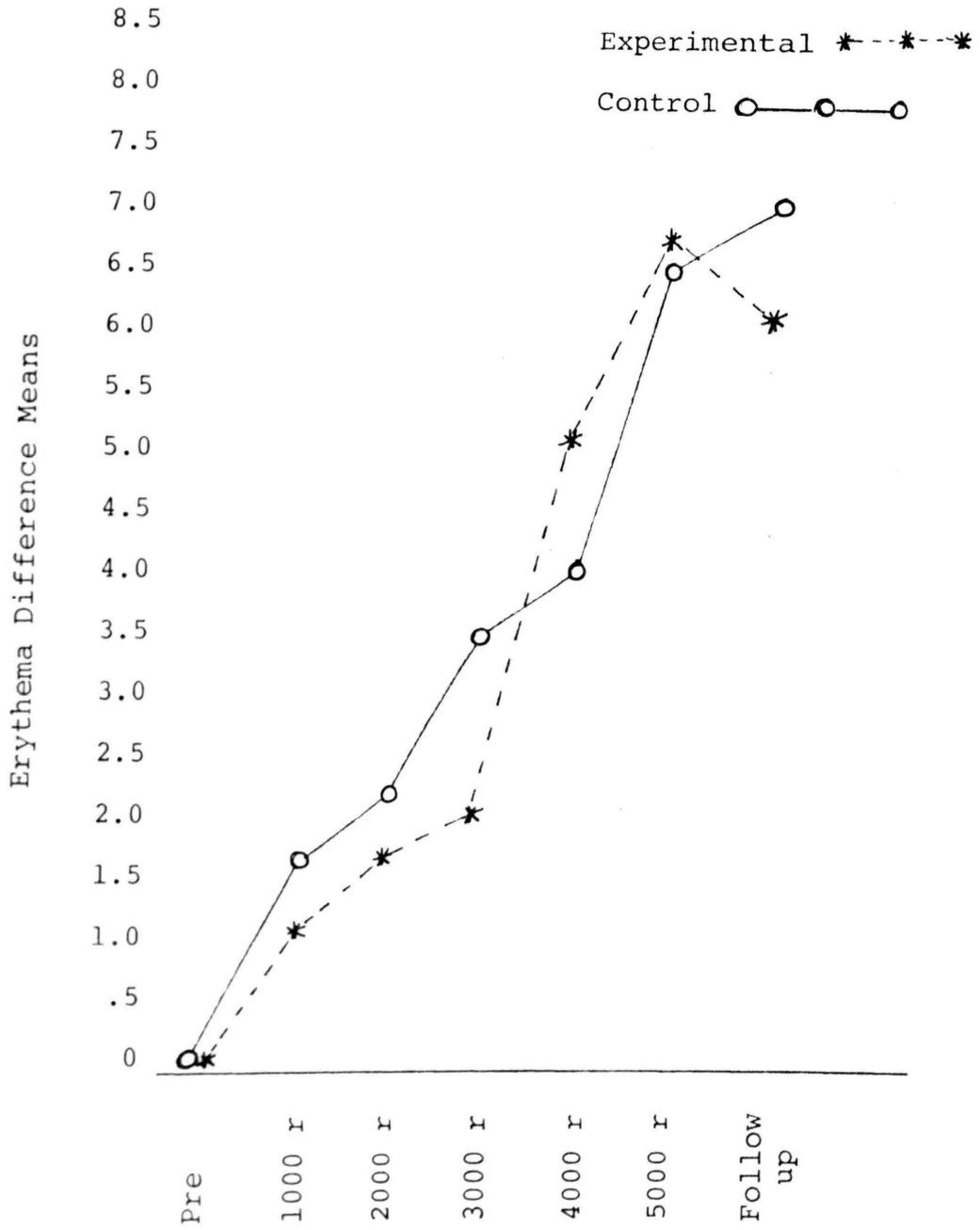


Figure 7. Right head & neck erythema difference means of experimental and control groups.

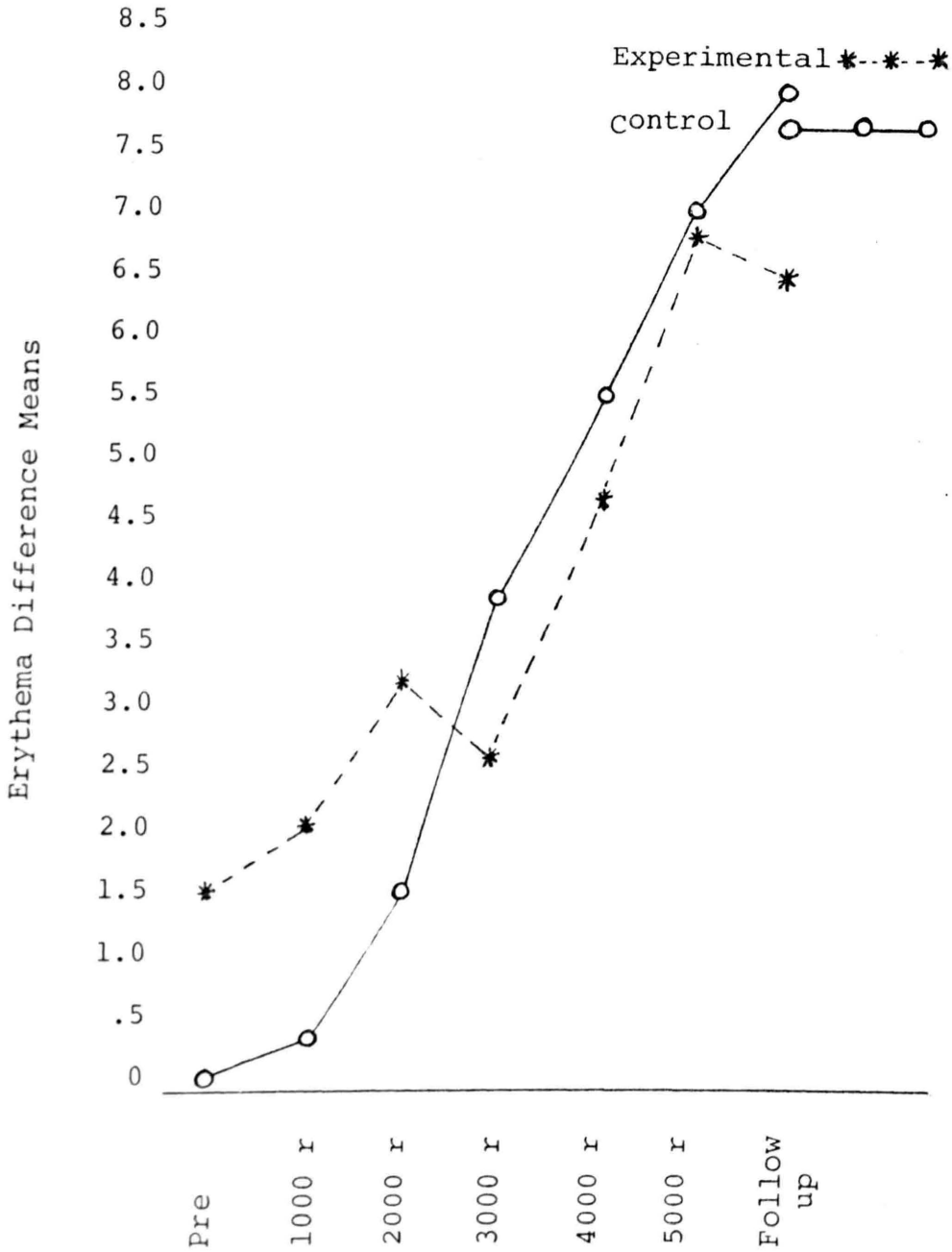


Figure 8. Left head & neck erythema difference means of experimental and control groups.

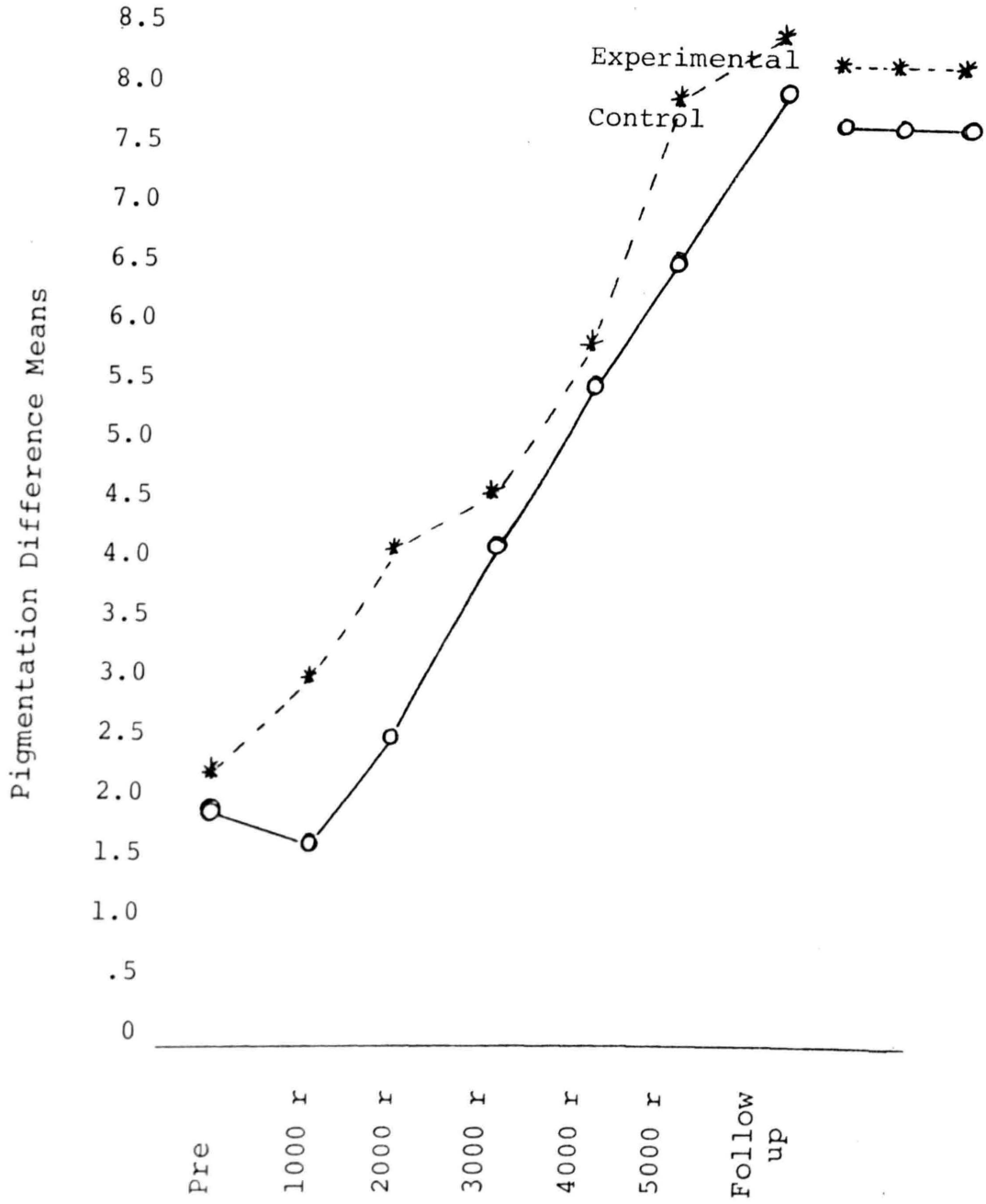


Figure 9. Chest pigmentation difference means of experimental and control groups.

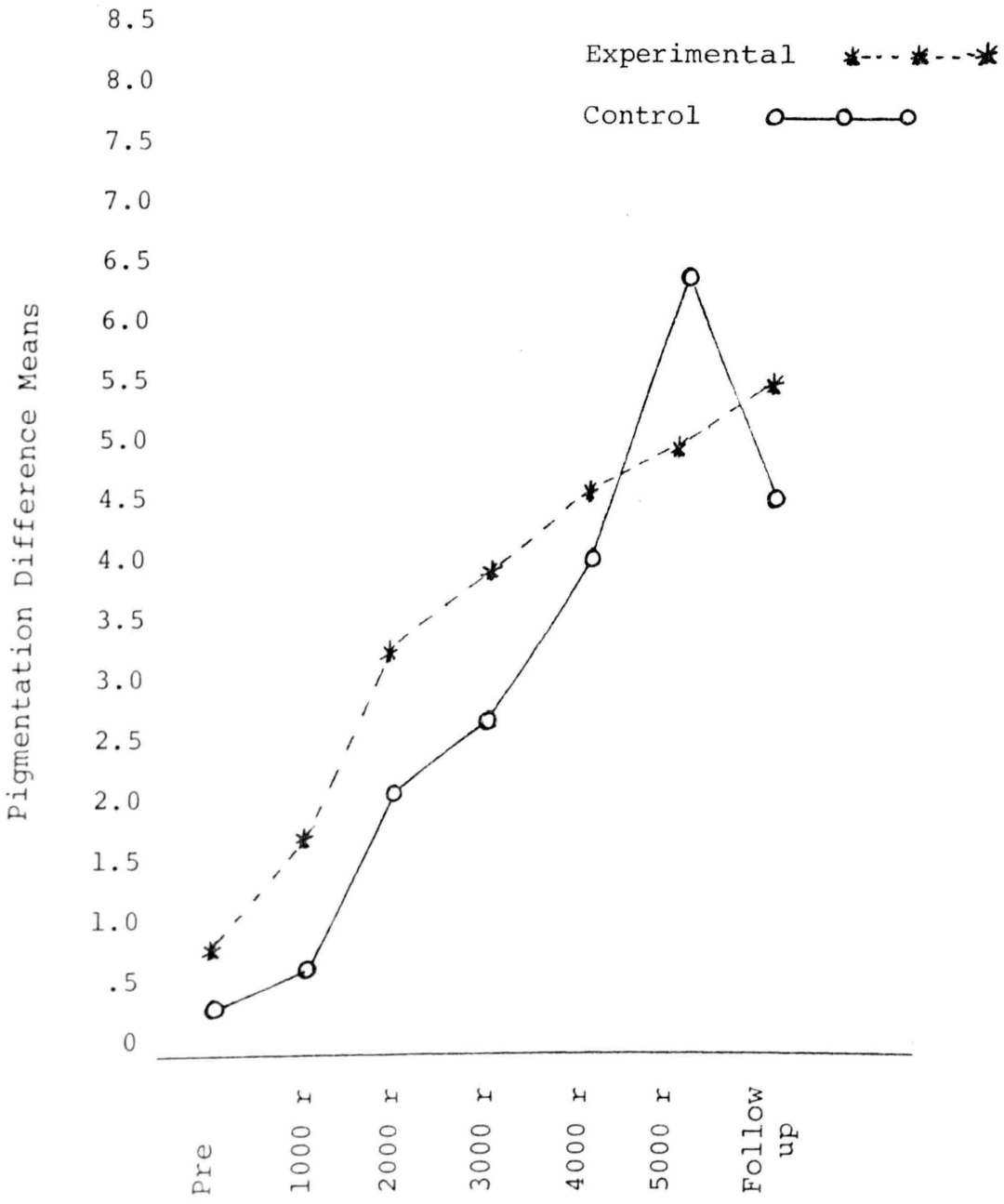


Figure 10. Back pigmentation difference means of experimental and control groups

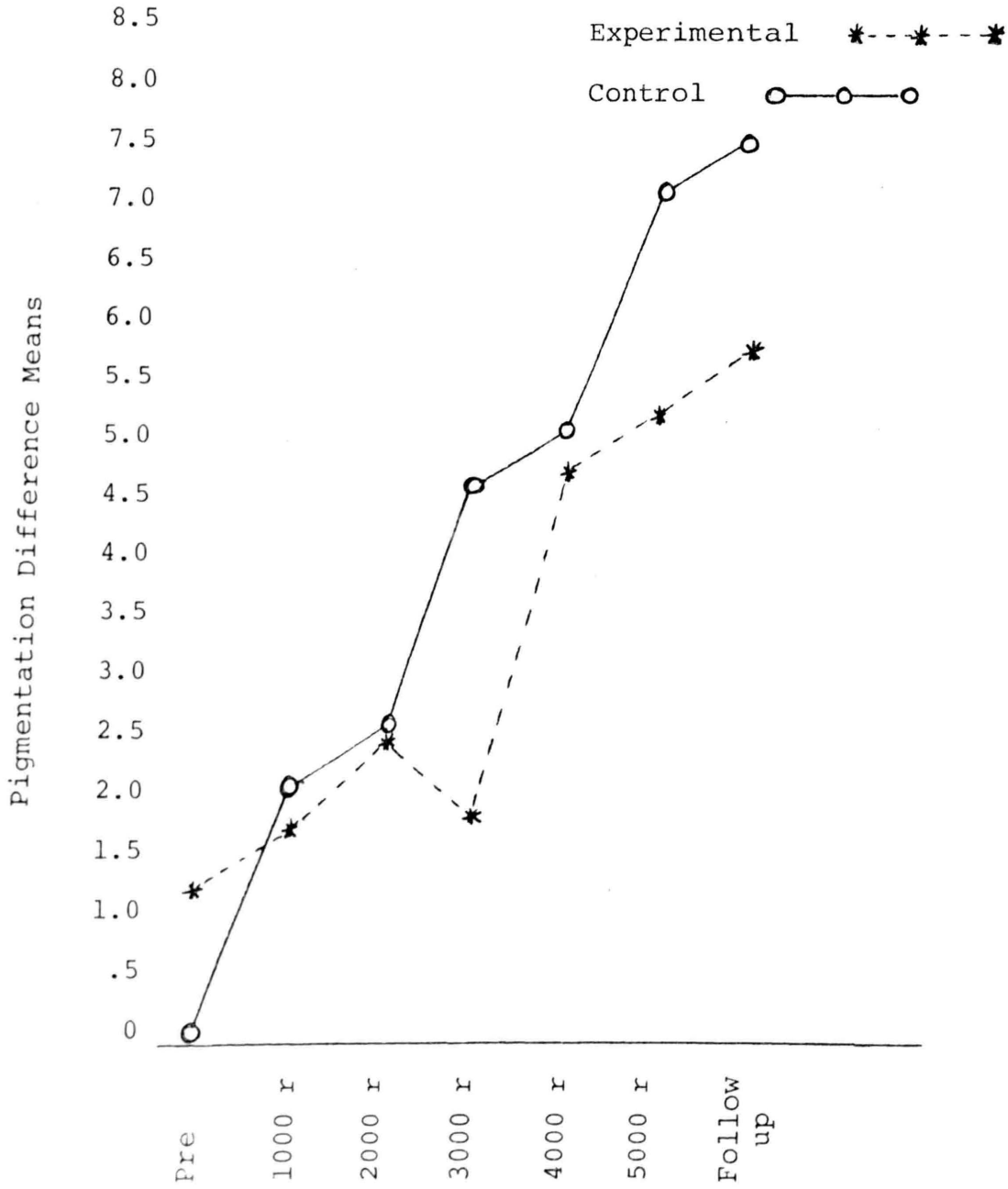


Figure 11. Right head & neck pigmentation difference means of experimental and control groups.

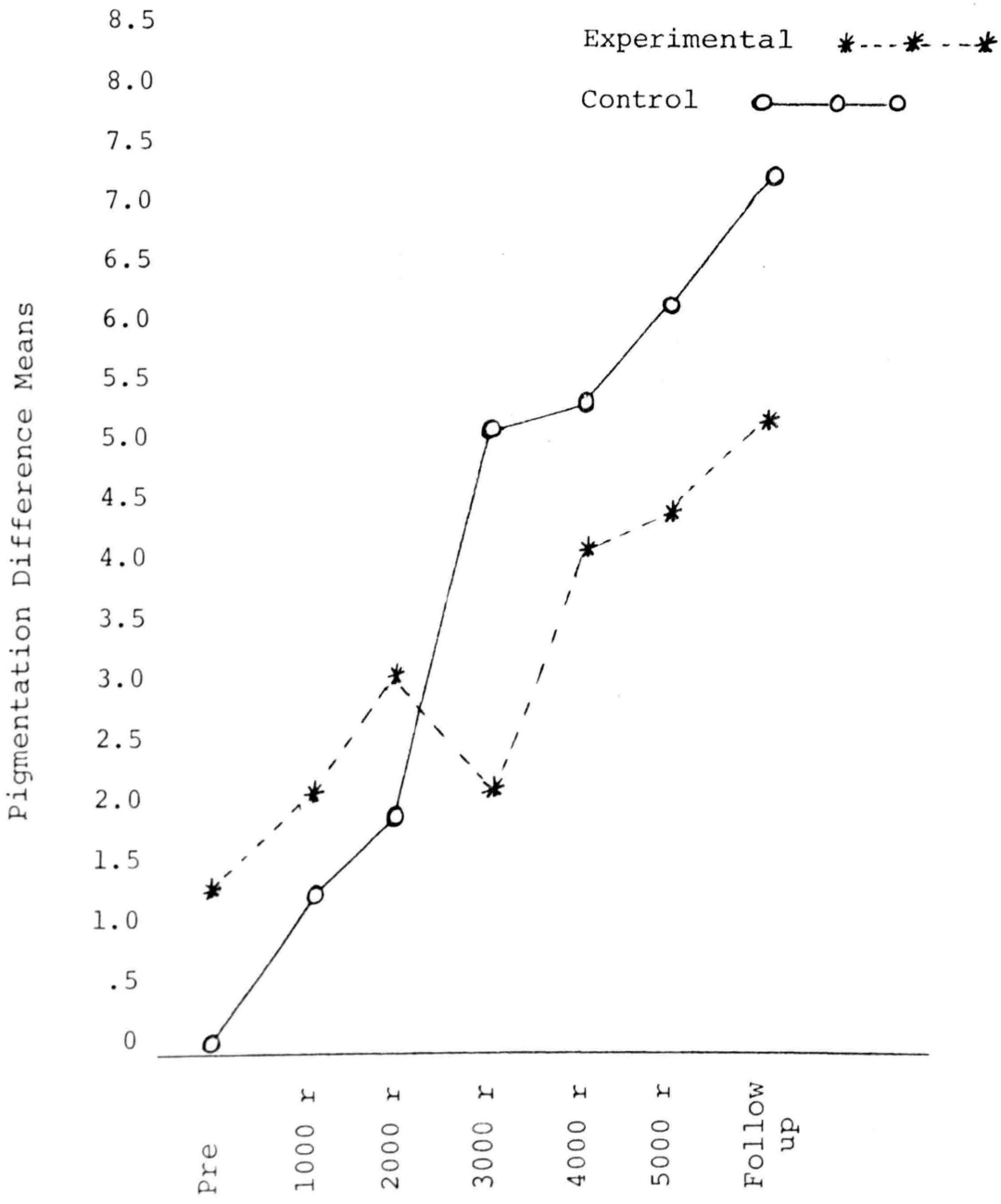


Figure 12. Left head & neck pigmentation difference means of experimental and control groups.

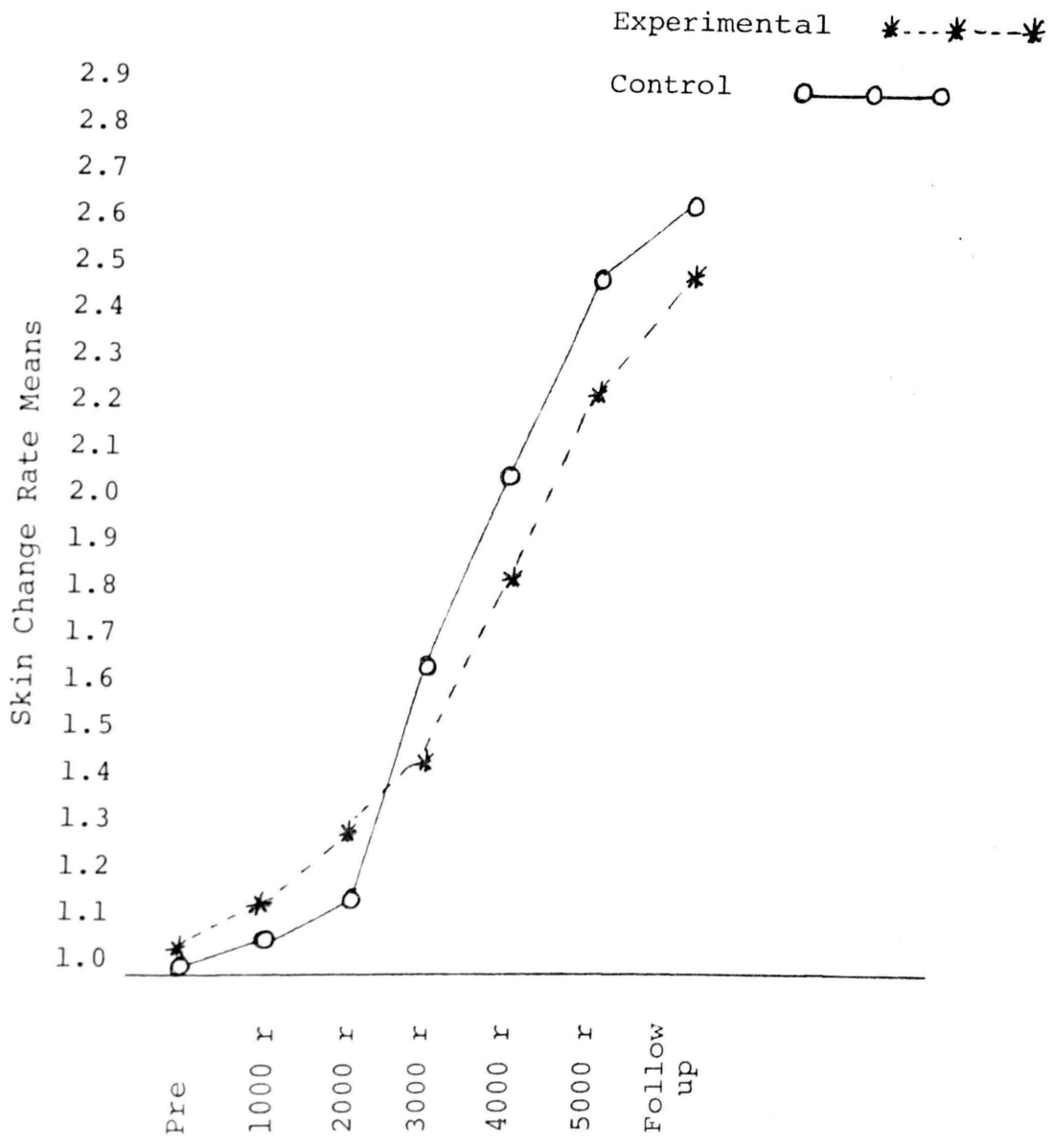


Figure 13. Chest skin change rate means of experimental and control groups.

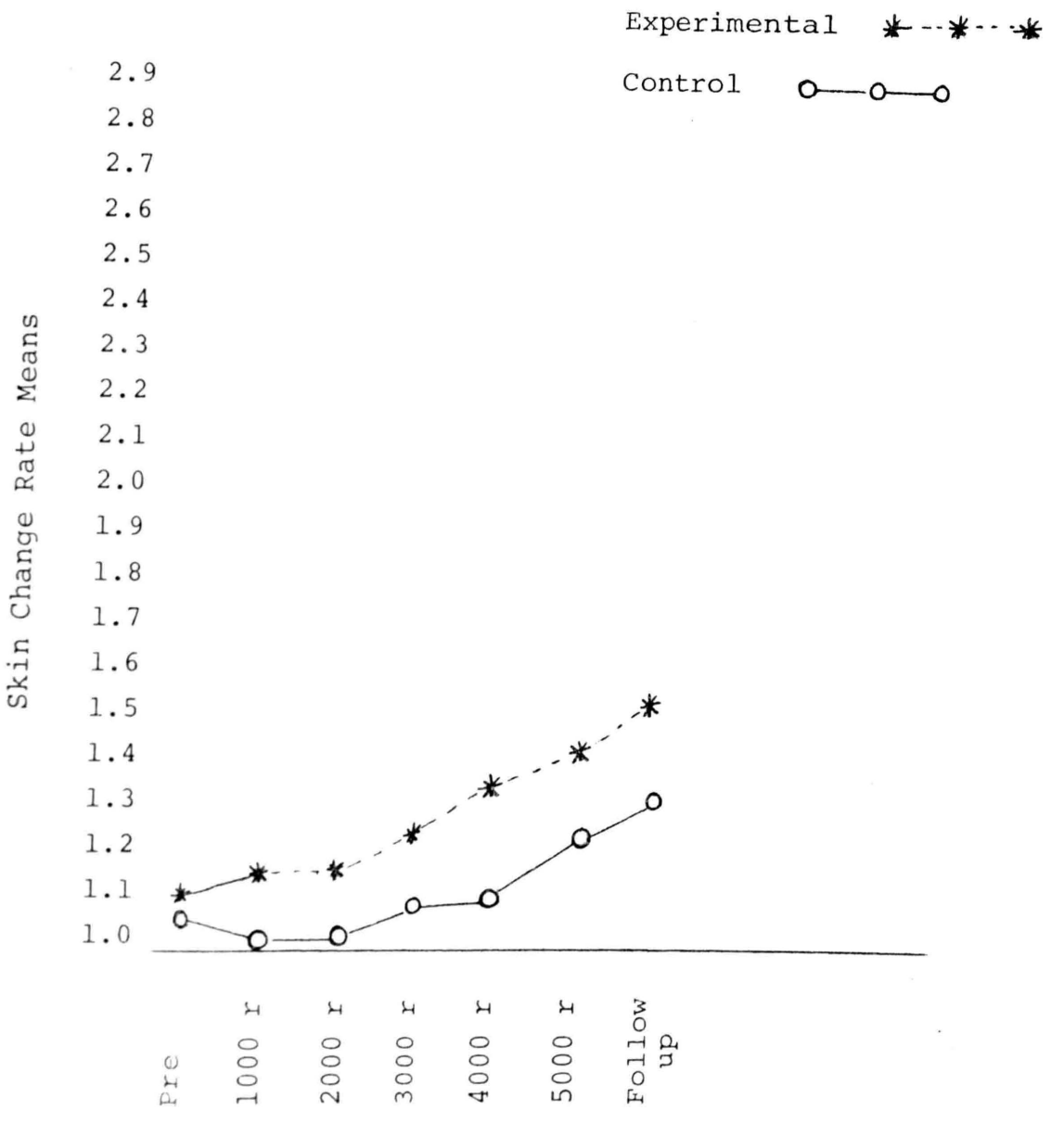


Figure 14. Back skin change rate means of experimental and control groups.

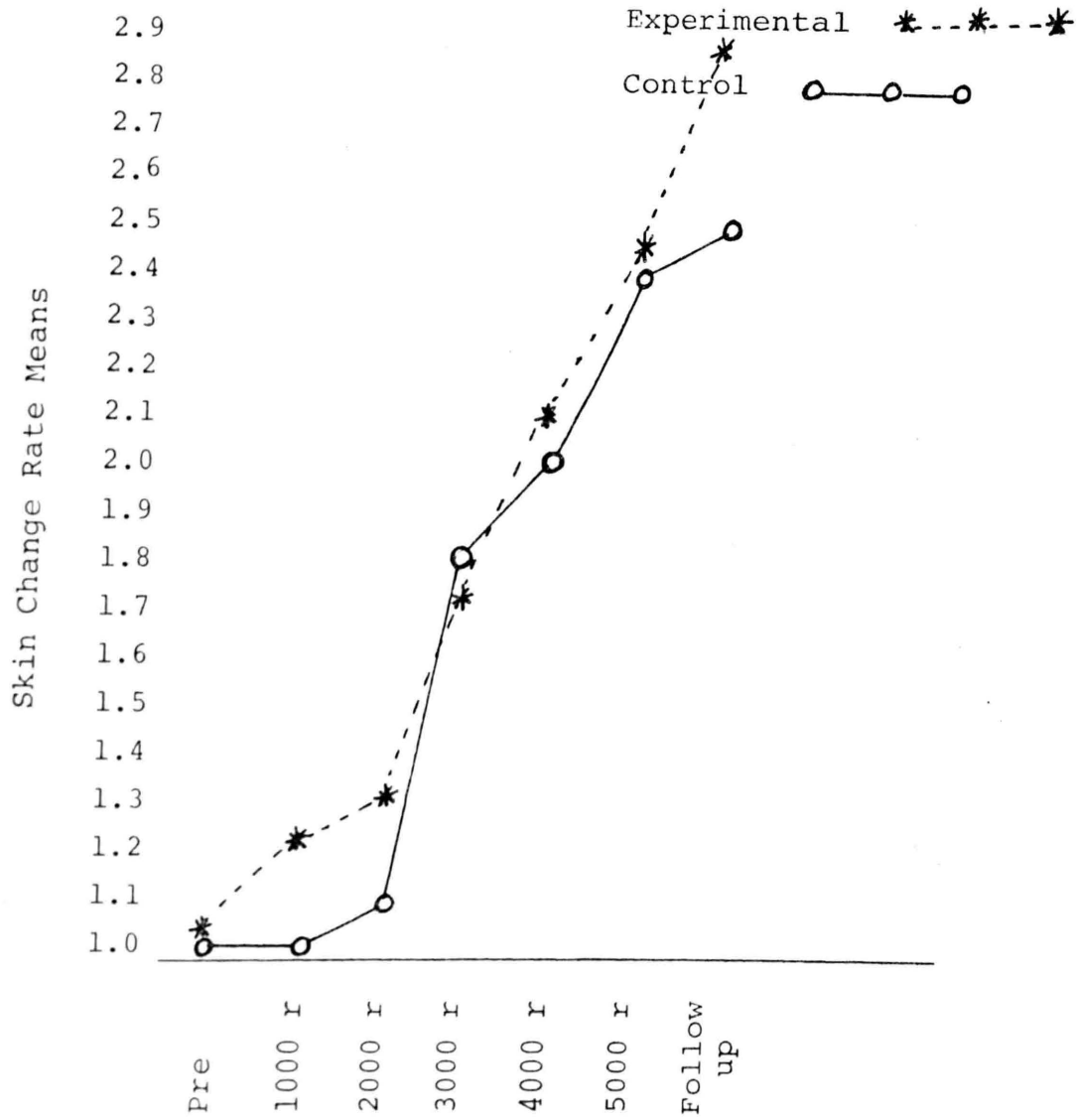


Figure 15. Right head & neck skin change rate means of experimental and control groups.

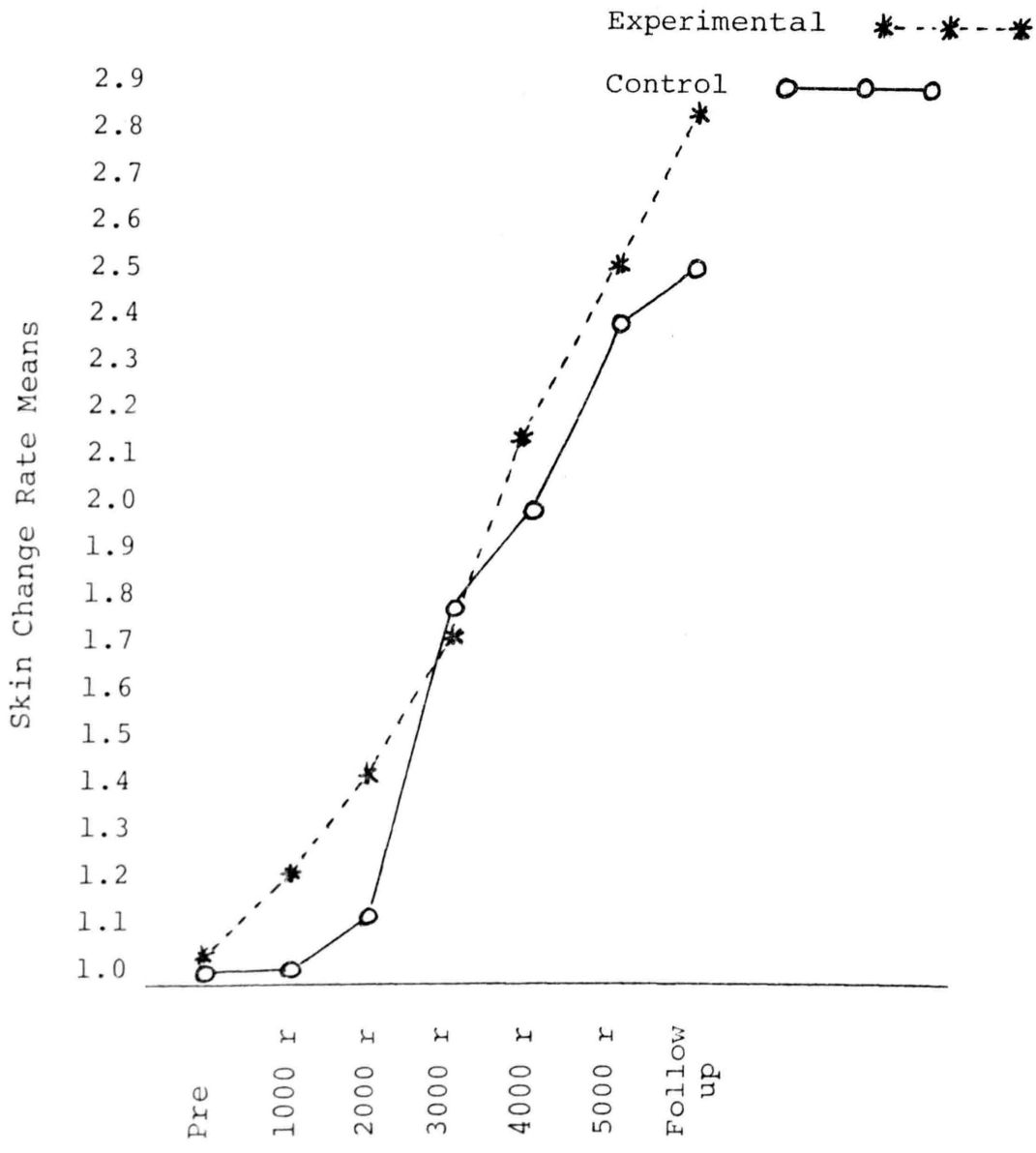


Figure 16. Left head & neck skin change rate means of experimental and control groups.

Findings

The findings of the statistical analysis will be presented for each of the hypotheses. Additional findings will also be presented.

Hypothesis I

There is no significant difference in the increase in erythema of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe.

An analysis of variance was done on the erythema difference scores for each of the four different anatomical sites: chest, back, right head and neck, and left head and neck. (Tables 1, 2, 3, and 4) A 2x7 repeated measures design was used with repetition over factor B, radiation dose. Factor A represents the experimental variable, no-bathe and bathe.

On all four different anatomical sites, erythema difference scores increased as the radiation dose increased. (Factor B) However, this increase does not differ significantly in the no-bathe group from the bathe group. (Factor A) Therefore, the hypothesis was not rejected.

Table 1

Anova for Chest Erythema Difference Scores

Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	61.715	61.715	.881	7.243	.01
B	6	1595.219	265.87	55.05	2.751	.01*
AB	6	59.93	9.98	2.06	2.751	.01
Sa	46	3220.116	70.00			
BSa	276	1334.28	4.83			

Accept H_o N=48 *= significant value

Table 2

Anova for Back Erythema Difference Scores

Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	113.157	113.157	8.74	9.527	.01
B	6	336.477	56.08	18.76	3.07	.01*
AB	6	32.96	5.49	1.84	3.07	.01
Sa	13	168.212	12.94			
BSa	78	232.85	2.99			

Accept H_o N=15 *=significant value

Table 3

Anova for Right Head & Neck Erythema Difference Scores Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	16.41	16.41	.29	7.959	.01
B	6	1184.13	197.36	25.05	2.94	.01*
AB	6	40.29	6.72	.85	2.94	.01
Sa	22	1246.92	56.68			
BSa	132	1039.58	7.88			

Accept H_o N=24 *= significant value

Table 4

Anova for Left Head & Ncek Erythema Difference Scores Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	2.32	2.32	.027	7.959	.01
B	6	1114.26	185.71	20.12	2.940	.01*
AB	6	101.70	16.95	1.83	2.940	.01
Sa	22	1113.87	85.68			
BSa	132	1219.18	9.23			

Accept H_o N=24 *= significant value

Hypothesis II

There is no significant difference in the increase in pigmentation of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe.

An analysis of variance was done on the pigmentation difference scores for each of the four different anatomical sites: chest, back, right head and neck, and left head and neck. (Tables 5, 6, 7, and 8) A 2x7 Repeated measures design was used with repetition over factor B, radiation dose. Factor A represents the experimental variable, no-bathe and bathe.

On all four different anatomical sites, pigmentation difference scores increased as the radiation dose increased . (Factor B) However, this increase does not differ significantly in the no-bathe group from the bathe group. (Factor A) Therefore, the hypothesis was not rejected.

Hypothesis III

There is no significant difference in the degree of skin reaction to Cobalt-60 radiation as measured by the Baker-Leith Rating Scale in patients who bathe and those who do not bathe.

Table 5

Anova for Chest Pigmentation Difference Scores

Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	43.44	43.44	.89	7.243	.01
B	6	1475.91	245.99	48.52	2.751	.01*
AB	6	78.55	13.09	2.58	2.751	.01
Sa	46	2244.85	48.80			
BSa	276	1399.25	5.07			

Accept H_o N=48 *= significant value

Table 6

Anova for Back Pigmentation Difference Scores

Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	12.015	12.015	.59	9.527	.01
B	6	306.583	51.1	14.16	3.07	.01*
AB	6	19.234	3.21	.889	3.07	.01
Sa	13	264.41	20.34			
BSa	78	281.66	3.61			

Accept H_o N=15 *= significant value

Table 7

Anova for Right Head & Neck Pigmentation Difference Scores Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	31.58	31.58	.44	7.959	.01
B	6	624.87	104.52	14.52	2.94	.01*
AB	6	66.25	11.04	1.54	2.94	.01
Sa	22	1564.41	71.11			
BSa	132	947.74	7.17			

Accept H_o N=24 *= significant value

Table 8

Anove for Left Head & Neck Pigmentation Difference Scores Between the Bathe and No-Bathe Groups

Source	df	SS	MS	F	E(F)	p
A-Bathe	1	24.55	24.55	.384	7.959	.01
B	6	600.52	100.09	18.20	2.94	.01*
AB	6	112.72	18.78	3.41	2.94	.01*
Sa	22	1404.01	63.81			
BSa	132	725.34	5.50			

Accept H_o N=24 *= significant value

A Man-Whitney U test was done on the highest rate given to each subject for each of the three anatomical sites; chest, back, and head and neck. (Table 9, 10, and 11)

Table 9

Man-Whitney U for Chest High Rate Between The Bathe and No-Bathe Groups

Source	Rank Sum	U	Z	p	Significance
Nobathe	617.5	266	.4437	.3409	.01
Bathe	558.5				

Accept H_o N=48 *= significant value

Table 10

Man-Whitney U for Back High Rate Between the Bathe and No-Bathe Groups

Source	Rank Sum	U	Z	p	Significance
Nobathe	81.5	36	1.061	.1562	.01
Bathe	38.5				

Accept H_o N=15 *= significant value

Table 11

Man-Whitney U for Head & Ncek High Rate

Between the Bathe and No-Bathe Groups

Source	Rank Sum	U	Z	p	Significance
Nobathe	164.0	98	1.535	.0655	.01
Bathe	136.0				

Accept H_o N=24 *= significant value

On all three different anatomical sites, the highest rate given to the subjects who did not bathe during therapy did not vary significantly from the highest rate given to the subjects who did bathe. Therefore, the hypothesis was not rejected.

Additional Findings

Correlation Between Instruments

A Pearson Correlation Coefficient was done to determine the relationship between the largest erythema difference score and the highest rate assigned from the Baker-Leith Rating Scale for each subject in each of the anatomical groups. This same procedure was done to determine the relationship between the largest pigmentation

difference score and the highest rate assigned from the Baker-Leith Rating Scale. (Table 12)

Table 12

Pearson Correlation Between High Rate and High Difference Scores

Source	N	x	y	rxy
Chest	48	High Erythema Dif	High Rate	-.149
		High Pigmentation Dif	High Rate	-.01
Back	15	High Erythema Dif	High Rate	-.366
		High Pigmentation Dif	High Rate	-.183
Rt Head & Neck	24	High Erythema Dif	High Rate	.386
		High Pigmentation Dif	High Rate	.282
Lt Head & Neck	24	High Erythema Dif	High Rate	.206
		High Pigmentation Dif	High Rate	.179

On all four anatomical sites, there was no significant correlation between the highest erythema difference score and the highest rate given from the Baker-Leith Rating scale. There was also no significant correlation between the highest pigmentation difference score and the highest rate given from the Baker-Leith Rating scale. Figures 17 and 18 shows the scatter diagrams of the high erythema and pigmentation difference scores and high rates for the

chest. Figures 19 and 20 shows the scatter diagrams for the back. Figures 21 and 22 shows the scatter diagrams for the right head and neck and Figures 23 and 24 shows the scatter diagrams for the left head and neck.

Summary

1. There was no significant difference found in the increase in erythema of the skin exposed to Cobalt-60 radiation in those patients who bathed and those who did not bathe.
2. There was no significant difference found in the increase in pigmentation of the skin exposed to Cobalt-60 radiation in those patients who bathed and those who did not bathe.
3. There was no significant difference found in the degree of skin reaction to Cobalt-60 radiation as measured by the Baker-Leith Rating Scale in patients who bathed and those who did not bathe.
4. There was no significant correlation found between the largest erythema difference score and the highest rate given from the Baker-Leith Rating scale.
5. There was no significant correlation found between the largest pigmentation difference score and the highest rate given form the Baker-Leith Rating scale.

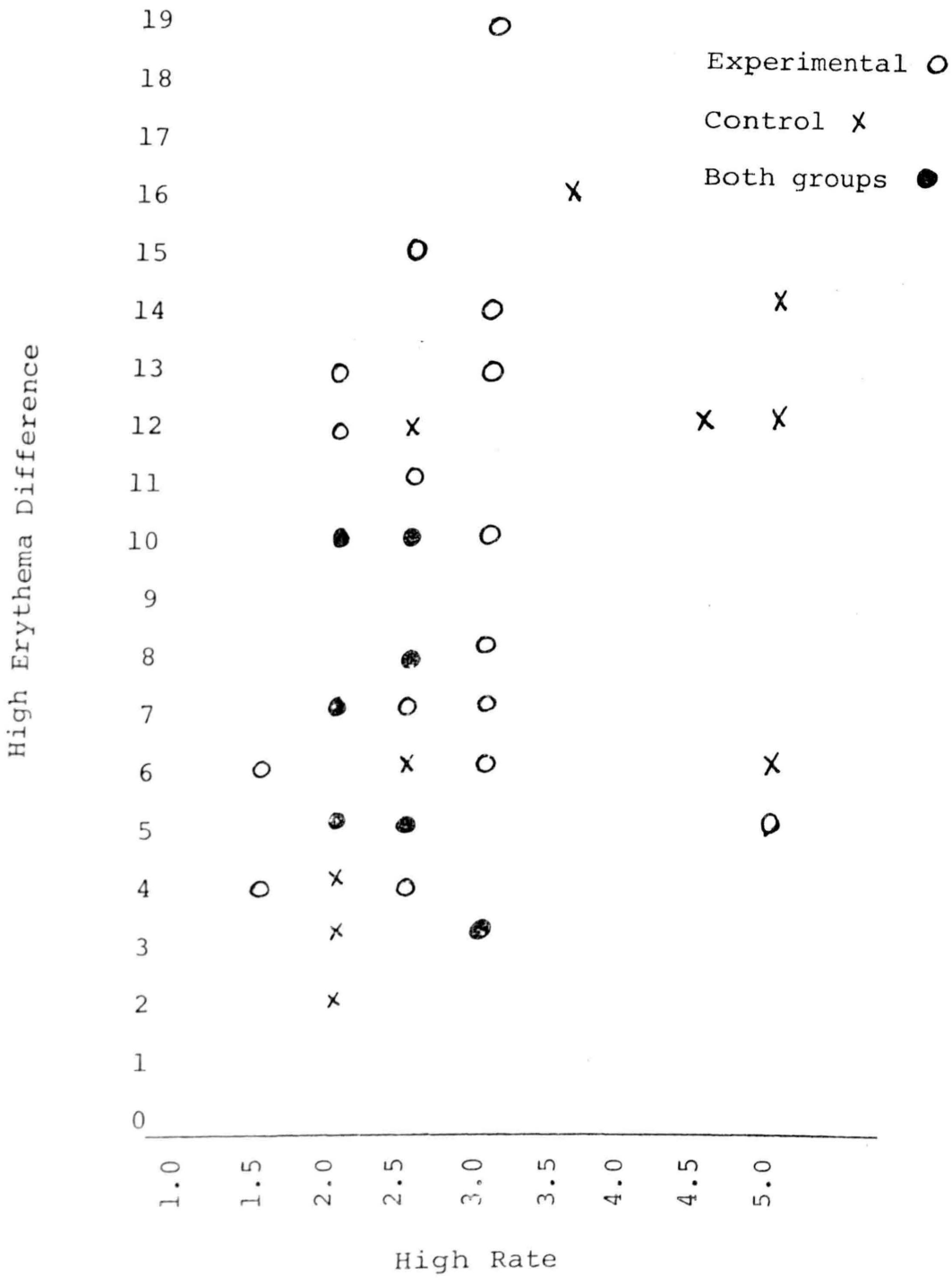


Figure 17. Chest scatter diagram of high erythema difference score and high rate for experimental and control groups.

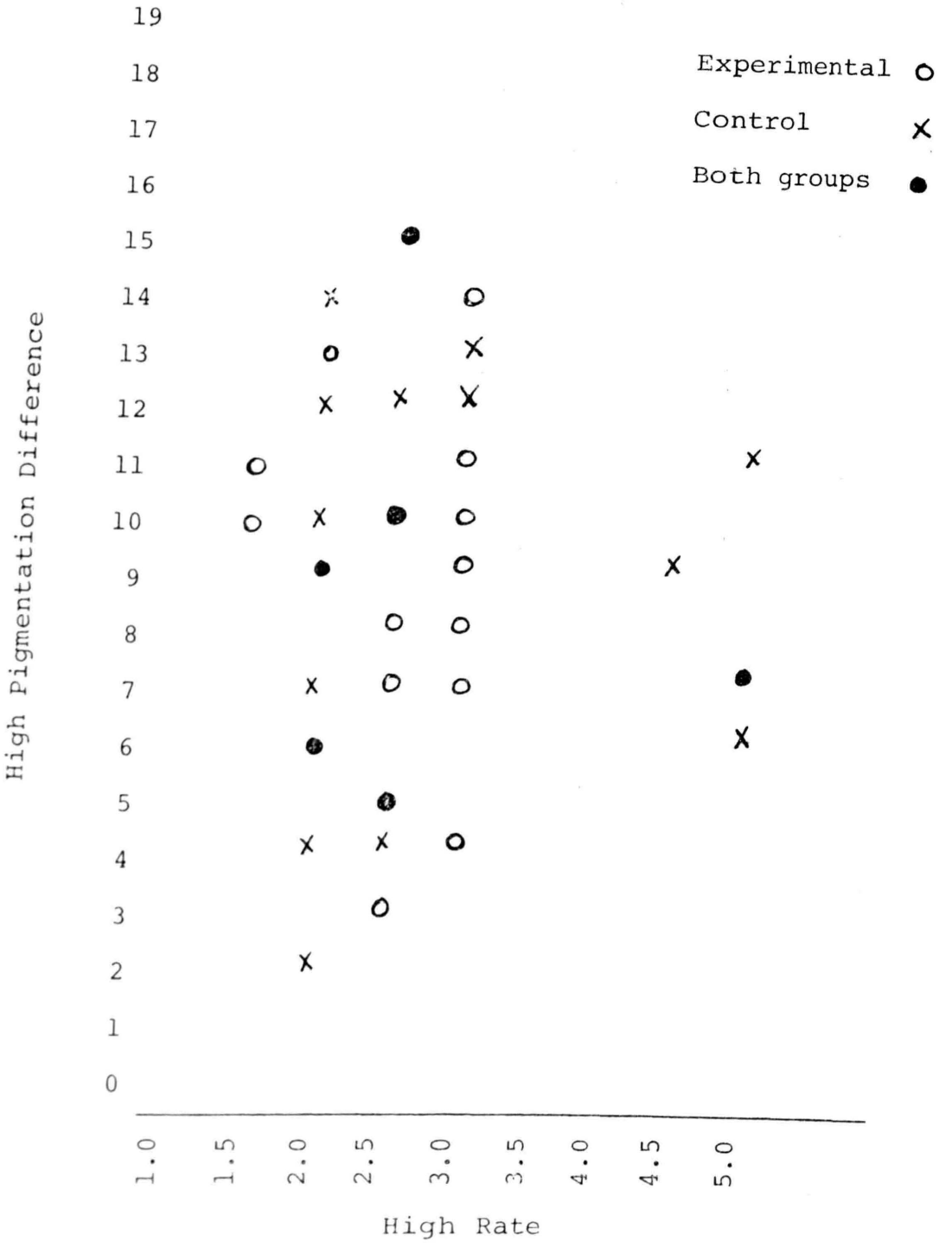


Figure 18. Chest scatter diagram of high pigmentation difference score and high rate for experimental and control groups.

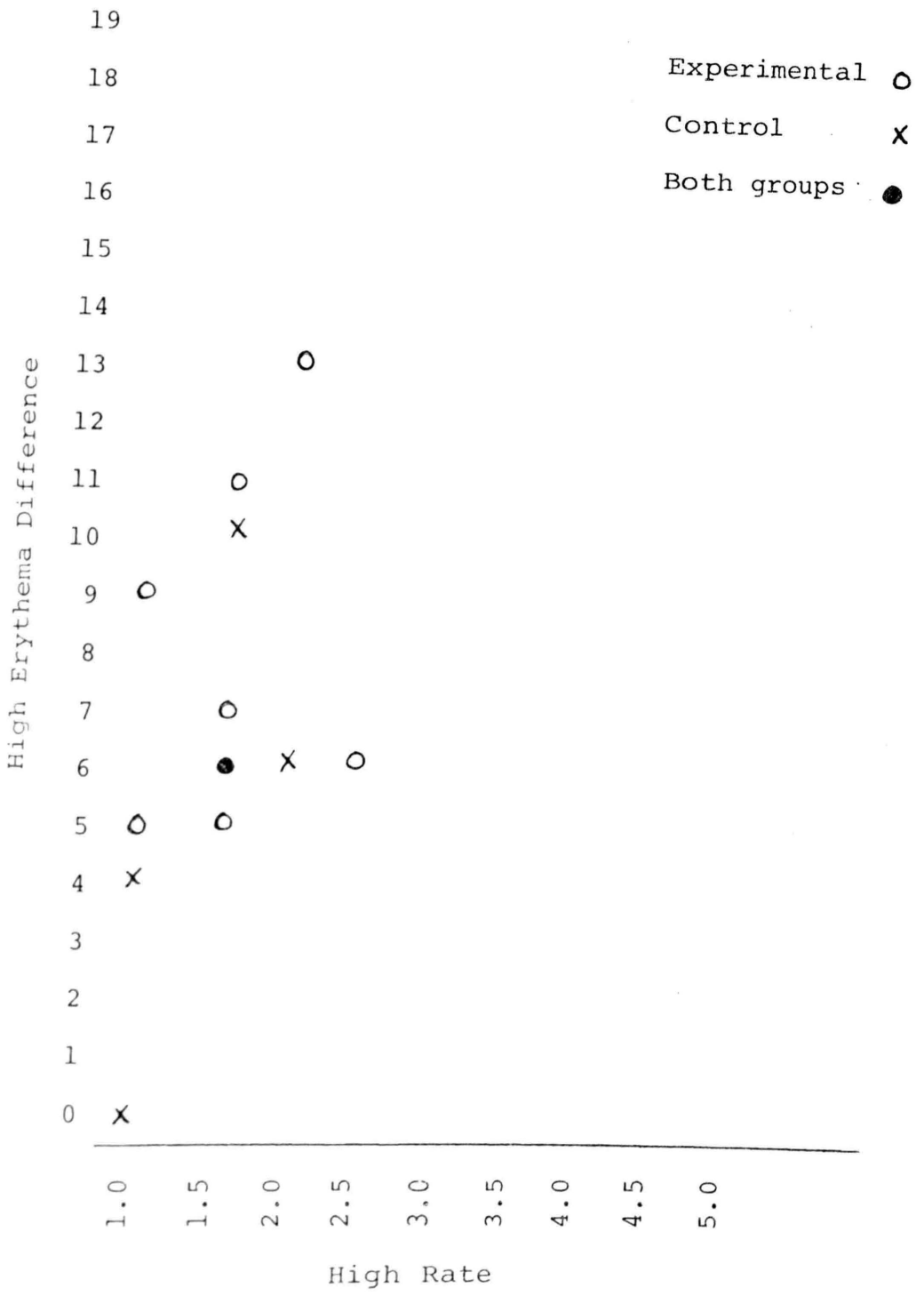


Figure 19. Back scatter diagram of high erythema difference score and high rate for experimental and control groups.

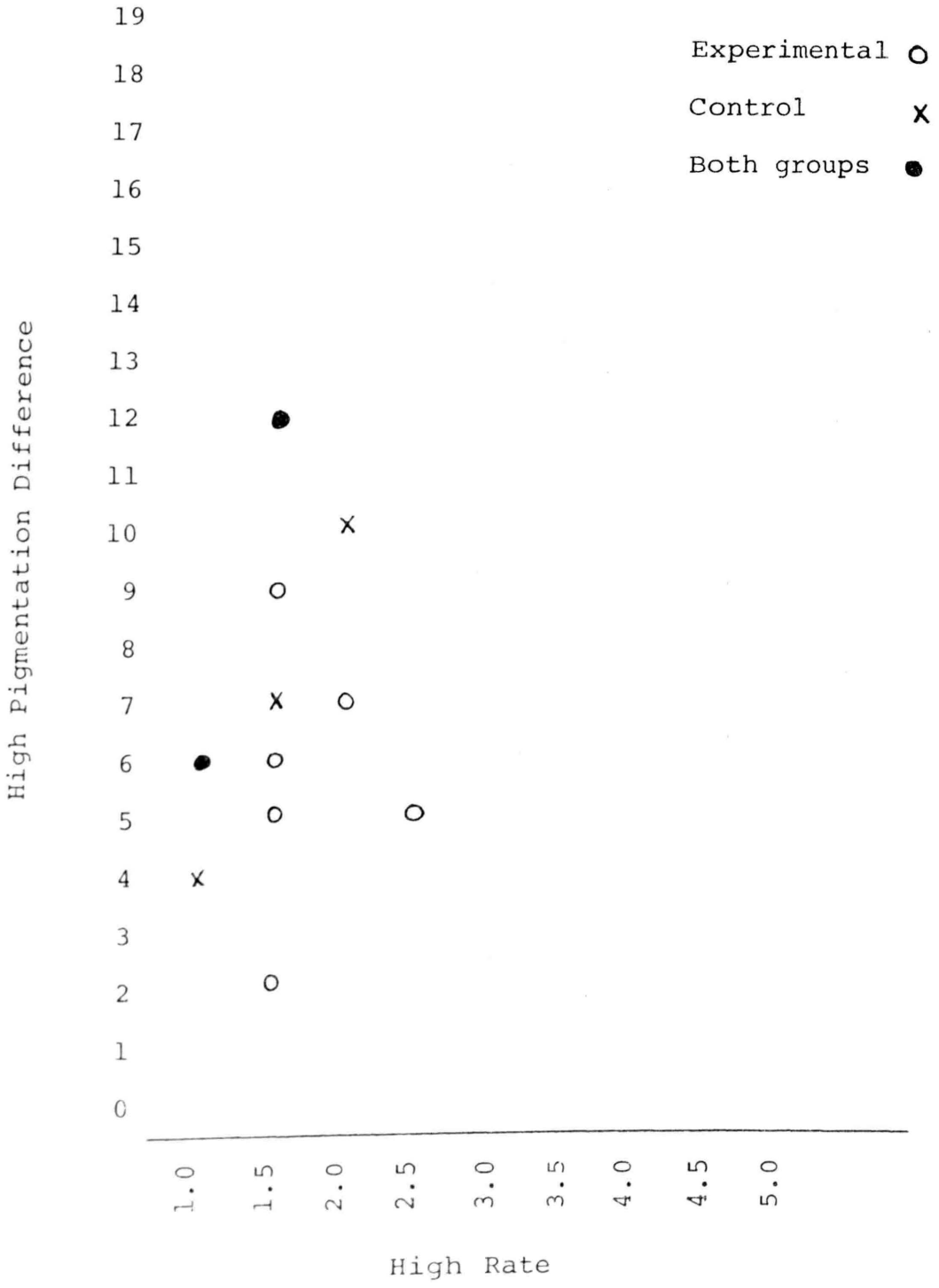


Figure 20. Back scatter diagram of high pigmentation difference score and high rate for experimental and control groups.

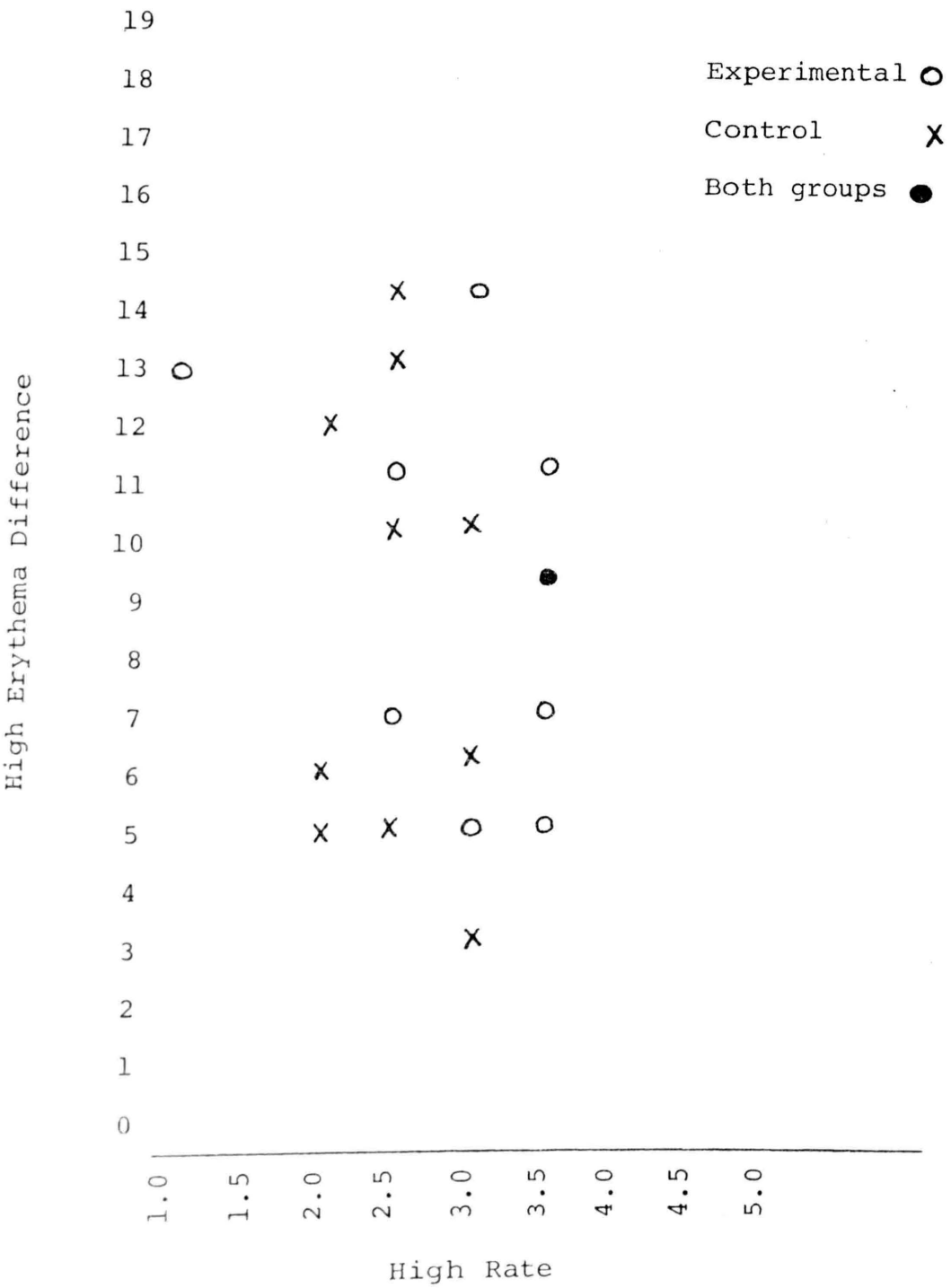


Figure 21. Right head & neck scatter diagram of high erythema difference scores and high rate for experimental and control groups.

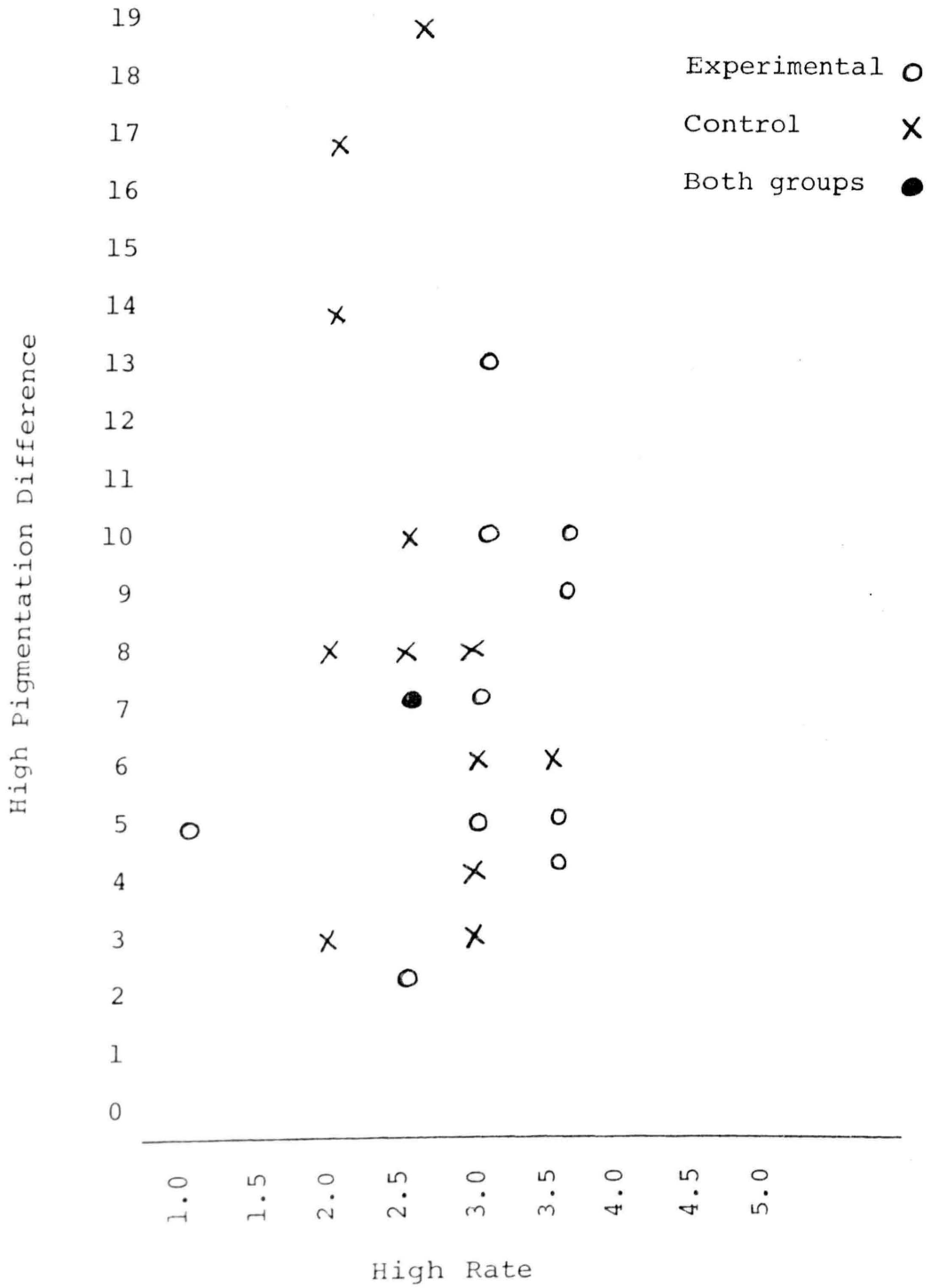


Figure 22. Right head & neck scatter diagram of high pigmentation difference scores and high rate for experimental and control groups.

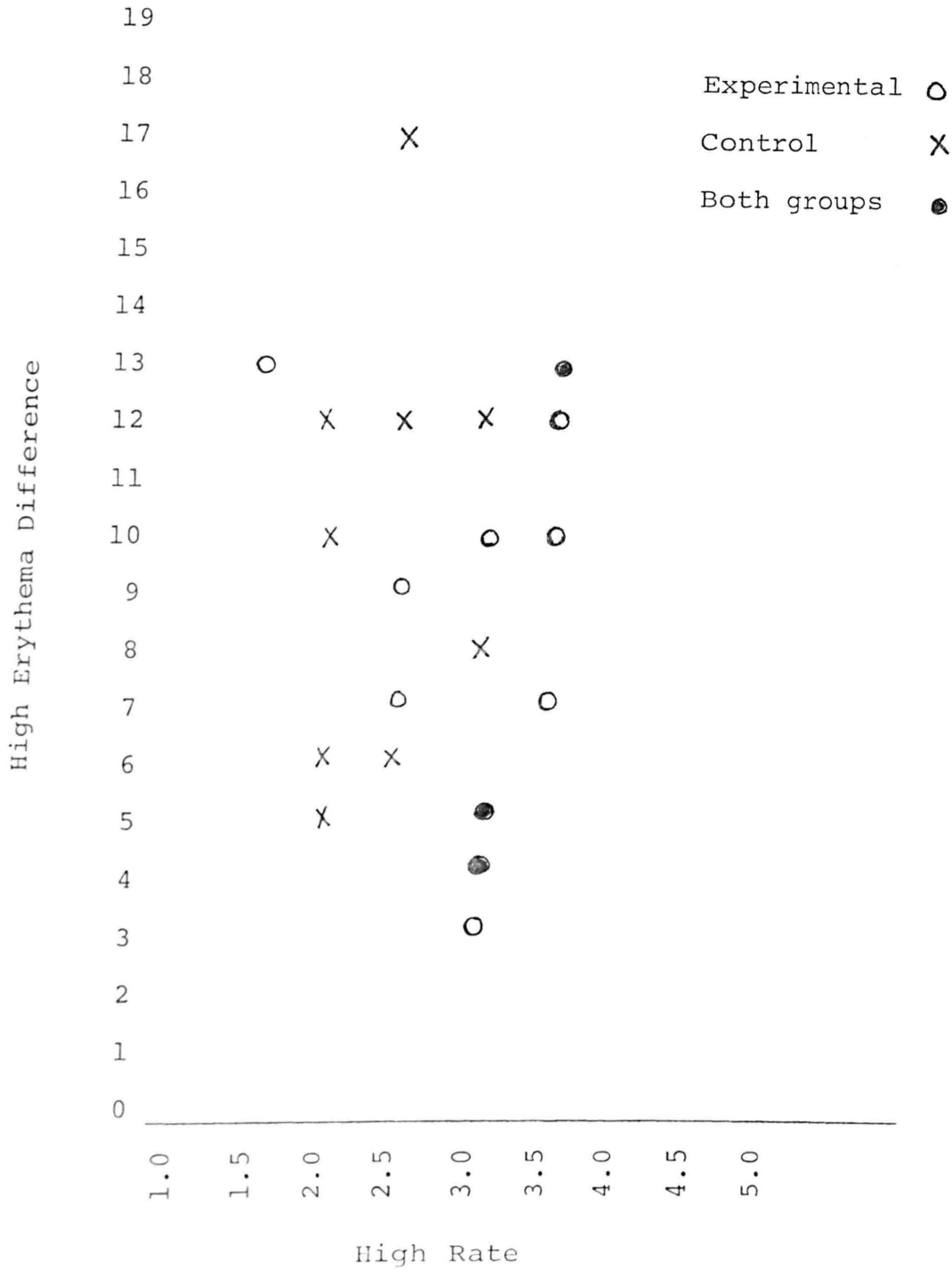


Figure 23. Left head & neck scatter diagram of high erythema difference scores and high rate for experimental and control groups.

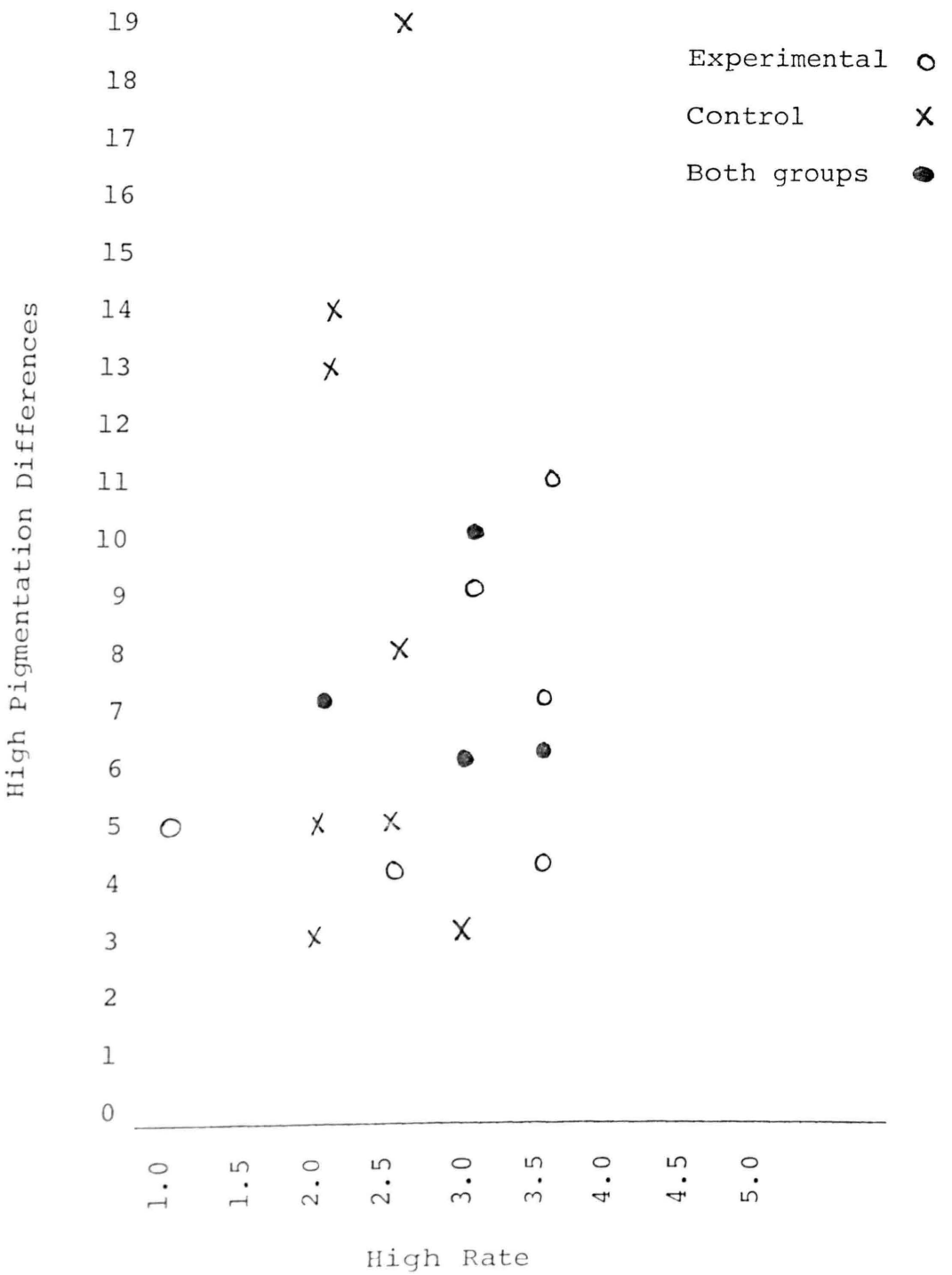


Figure 24. Left head & neck scatter diagram of high pigmentation difference scores and high rate for experimental and control groups.

CHAPTER 5

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The problem of this study was to determine the effects of bathing or not bathing on the degree of skin reaction occurring in patients receiving Cobalt-60 radiation therapy to the chest, back, or head and neck. A quasi experimental study was done using a 2 x 7 repeated measures design.

This study was conducted at the Wm. and Elizabeth Moncrief Radiation Center in Fort Worth, Texas. The 67 subjects who participated in this study were being treated with Cobalt-60 radiation therapy to the chest, back, or head and neck. They had seven different medical diagnoses of cancer. Twenty-eight, or 41%, had lung cancer, twenty-six, or 38%, had breast cancer, and ten, or 14%, had primary brain tumors. Forty-one subjects, or 61.2%, were female and twenty-six, or 38.8%, were male. Fifty-six, or 83.6%, were white, and eleven, or 15.4% were black. The ages of the subjects ranged from twenty to eighty with 85% of them being over forty years of age.

The subjects were randomly assigned to the experimental and control groups by the use of a table of random

numbers. The control group was given oral and written instructions for skin care that included bathing the portal of entry daily with water only. The experimental group was given oral and written instructions for skin care that excluded bathing the portal of entry during the treatment period.

Observations were made on each subject seven different times: before treatment started, after 1000 rads, 2000 rads, 3000 rads, 4000 rads, 5000 rads, and two weeks after the final treatment. Each observation consisted of three different measurements. The Photovolt 670 was placed on the radiated skin and on the normal skin using light of wavelengths of 578 millimicrons to measure erythema and 660 millimicrons to measure pigmentation. The third measurement was the assignment of a rate of skin change using the Baker-Leith Rating Scale. Erythema and pigmentation difference scores were obtained by subtracting the photovolt readings of the radiated skin from the photovolt readings of the normal skin. Therefore, each observation consisted of an erythema difference score, a pigmentation difference score, and a rating from the Baker-Leith Rating Scale.

Using a 2 x 7 repeated measures design, an analysis of variance was done on the erythema difference scores

for each of the four different anatomical sites: chest, back, right head and neck, and left head and neck. The level of significance was set at the .99 percentile ($\alpha = .01$) An analysis of variance was also done on the pigmentation difference scores.

A Man-Whitney U test was done on the highest rate from the Baker-Leith Rating Scale given to each subject during the treatment period. The level of significance was set at the .99 percentile ($\alpha = .01$).

A Pearson Correlation Coefficient was done on the largest erythema difference score and the highest rate from the rating scale to determine if there was a correlation between the two research instruments. This procedure was also done comparing the largest pigmentation difference score and the largest rate from the rating scale.

Discussion of Findings

Hypothesis 1 states: There is no significant difference in the increase in erythema of the skin exposed to Cobalt-60 radiation in those patients who bathe and those who do not bathe. The analysis of variance done on the erythema difference scores failed to show a statistical difference between the experimental (no-bathe) and the control (bathe) groups. However, the analysis did show a

significant increase in erythema difference scores as the radiation dose increased. These findings were consistently found on all anatomical sites tested. (See Tables 1, 2, 3, and 4)

The increase in erythema difference scores seen as the radiation dose increased is consistent with studies done by Chu et al. (1960) and Turesson and Notter (1975). There was no literature found to support or refute the findings concerning bathing and not bathing.

The difference between the experimental (no-bathe) groups and the control (bathe) groups was very small. With the exception of the back, the obtained F was less than .1 for all sites while the expected F was greated than 7. (See Tables 1, 2, 3, and 4) It would appear that, in this group of subjects, bathing did not seem to affect the increase in erythema that occurred. However, when a null hypothesis is accepted, it is possible that a difference exists and a type II error is committed.

Chu et al. (1960) did report that selecting arbitrary days to measure changes may result in inadequate data because erythema is cyclic and strong reactions may be overlooked. The subjects in this study were measured just after each 1000 rads of radiation and two weeks after the last treatment. There was some fluctuation noted in the

individual subjects but the group means show a gradual rise with the experimental (no-bathe) groups fluctuating slightly more than the control (bathe) groups. (See Fig. 5, 6, 7, and 8)

Crust formation on the skin that occurred after 3000 rads of therapy may have blocked the reflection of light from the Photovolt 670. The experimental (no-bathe) groups may have had more crust formation than the control (bathe) groups. This would result in lower erythema difference scores for this group during the final period of treatment when the greatest degree of skin reaction was occurring. However, the mean erythema difference scores demonstrate a steady rise in erythema through the two week follow up period on all anatomical sites for both groups of subjects. (See Fig. 5, 6, 7, and 8)

Erythema difference scores were obtained by subtracting the erythema reading of the radiated skin from the erythema reading of the normal skin. This was done to remove the variability of the individual subject, i.e. metabolic rate, blood flow, normal skin color variations. Removing this much variance may not have left enough difference to be statistically significant when comparing the two groups.

Hypothesis 2 stated: There was no significant difference in the increase in pigmentation of the skin exposed

to Cobalt-60 radiation in those patients who bathe and those who do not bathe. The analysis of variance done on the pigmentation difference scores failed to show a statistical difference between the experimental (no-bathe) and the control (bathe) groups. However, the analysis did show a significant increase in pigmentation difference scores as the radiation dose increased. These findings were consistent for all anatomical sites tested. (See Tables 5, 6, 7, and 8)

The increase in pigmentation difference scores seen as the radiation dose increased is consistent with studies done by Chu et al. (1960) and Turesson and Notter (1975). There was no literature found to support or refute the findings concerning bathing and not bathing.

The difference between the experimental (no-bathe) groups and the control (bathe) groups was very small. With the exception of the back, the obtained F was less than .1 for all sites, while the expected F was greater than 7. (See Tables 5, 6, 7, and 8) As was the case in erythema, pigmentation increase in this group of subjects does not appear to be affected by bathing. Again, however, the possibility of a type II error must be considered. Crust formation and the use of difference scores may be responsible for accepting a false hypothesis.

Mass and Brand (1969) stated that multiple suberythema radiation doses may produce cellular damage that results in increased production of melanin. Thus erythema is not a prerequisite for changes in pigmentation. Truesson and Notter (1975) and Chu et al. (1960) both demonstrated that erythema and pigmentation developed concomitantly. The erythema difference means (see Fig. 9, 10, 11, and 12) document an increase in pigmentation difference scores as the radiation dose increases. This increase occurred approximately at the same rate as the erythema difference means did.

Hypothesis 3 states: There is no significant difference in the degree of skin reaction to Cobalt-60 radiation as measured by the Baker-Leith Rating Scale in patients who bathe and those who do not bathe. The Man-Whitney U test done on the highest rate of skin change given to each subject did not reveal a statistical difference between the experimental (no-bathe) and the control (bathe) groups. This finding was consistent for all anatomical sites tested. (See Tables 9, 10, and 11)

Baker and Leith (1975) developed this grading system to evaluate skin response during the acute injury phase of radiation therapy. This scale does not reflect all the changes that occur during therapy. Therefore, the rate

assigned to an individual may be the same when some degree of change has occurred.

The mean rates demonstrate that the rates increased as the radiation dose increased. (See Fig. 13, 14, 15, and 16) This increase was slightly greater in the experimental (no-bathe) group on the head and neck site. The patients receiving radiation to the head tended to develop a crusty surface if they did not bathe. This may account for the lower erythema and pigmentation difference means in this group in relation to the high rate means. The crust formation was not as apparent on the chest, probably because clothing rubbed the surface cells off. The pigmentation and erythema difference means were more consistent with the rate means on the chest.

The mean rates also document less skin reaction on the back than on other anatomical sites tested. However, the pigmentation and erythema difference means on the back do not support this. This documents the ability of the Photovolt 670 to register changes that are not readily apparent by visual inspection.

Additional Findings

Erythema is generally more marked above the second intercostal space than below it, due to the difference in

sympathetic tone in this region (Truesson & Notter, 1976). The data did demonstrate a wide range of erythema difference scores. However, these did not vary much from site to site. All chest measurements were taken below the second intercostal space. Chest erythema difference scores ranged from 2 to 19, while back erythema difference scores ranged from 4 to 13. The left side of the head and neck had a slightly wider range (3 to 17) than the right side (3 to 14).

Separation of the hair shaft from the basilar portion occurs during the third to twelfth week (Berdjes, 1971). The subjects in this study receiving radiation to the head lost the major portion of their hair between 3000 rads and 4000 rads. This was seen as frequently in the group that did not bathe as it was in the group that bathed. However, the subjects who could not get water on their hair had multiple problems with oily hair and itchy scalp.

In severe cases of radiation dermatitis, the epidermis undergoes necrosis, either because of radiation death of the basal cells or because of loss of blood supply due to vascular damage in the dermis. The epidermis will detach itself from the dermis (Lever, 1975). Of the sixty-seven patients in this study, five (7%) developed severe skin reactions. These were all females who were receiving

radiation to the chest wall after a mastectomy. Two of these subjects developed this reaction in the axilla and along the healed incision on the chest wall. The other three subjects had reactions limited to the axilla area only. One of these five subjects was in the no-bathe group and four were in the bathe group. One was black while the other four were white. There was no significant increase in the rise of erythema and pigmentation difference scores that could predict that this reaction would occur. Two of these five subjects had some denudation at their last treatment (5000 rads). The other three developed denudation during the two weeks following treatments. Although the subjects complained of management problems, they all stated that the area was not particularly painful. They were treated with a cortisone cream and the areas healed within four weeks.

Subjects with high erythema and pigmentation difference scores did not always have high rates of skin change, Also, subjects with high rates of skin change did not always have a high erythema and pigmentation difference score. For example, one subject had an erythema difference score of 19 with only a 3.0 rate of skin change. Another subject had a 5.0 rate of skin change with only a 5 erythema difference score. In an effort to demonstrate this

statistically, a Pearson Correlation Coefficient was done comparing the highest rate given to the largest erythema difference score and the largest pigmentation difference score. No significant correlation was found. (See Table 12) Scatter diagrams show that the high rates tended to cluster between 2.0 and 3.0, while high erythema difference scores and high pigmentation difference scores varied widely. (See Fig. 17, 18, 19, 20, 21, 22, 23, and 24) This supports the idea that the rating scale used does not reflect all the changes that occur to the skin during radiation therapy. It also documents that the photovolt 670 registers changes that are not readily apparent visually.

Conclusions and Implications

Based on the results of this study, several conclusions can be drawn that have implications for assessing, planning, and implementing nursing care of the patient receiving Cobalt-60 radiation therapy. Findings from this study suggest that bathing the portal of entry with water does not influence the degree of skin response to Cobalt-60 radiation to the chest, back, or head and neck. Apparently bathing with water and gently patting dry does not produce a stress to the horny layer that is sufficient enough to result in

an increase in the reaction that occurs from radiation exposure at 200 rads a day for a total dose of 5000 rads.

Since bathing is a behavior that contributes to the physical, social, and psychological well-being of the patient, nurses can bathe the portal of entry with water. However, since a reaction does occur, care should be taken to do this with the least amount of stress to the skin as possible. Patients should be given instructions to pat the area dry rather than rub or scrub the area.

Results of this study suggest that, as the radiation dose increases, the skin reaction will increase. This skin reaction will include erythema, increased pigmentation, and a dry, flaky surface. This reaction begins with the first treatment of 200 rads. Several treatments may be given before a visible reaction occurs. The maximum skin reaction may not occur until several weeks after the last treatment is given.

Nurses must be skillful in assessing skin changes during the early weeks of therapy. They must be aware that changes are occurring even though they may not be visible. Patients need to have teaching reinforced frequently. They may not comply with the directions given since they can not see any skin changes during the first few weeks of therapy. Patients need to be taught that skin reaction will occur

even after the therapy is completed. Precautions should be taken to protect the skin after the last radiation treatment.

Five subjects in this study did develop a severe skin reaction which included denudation, or loss of the epidermis. This occurred in an area that was uneven, the axilla. The study did not show that these five subjects had more erythema and pigmentation changes than those subjects who did not develop denudation. Additional data would be needed to determine if there is a predictable relationship between these variables.

Nurses assess and evaluate the status of the patient receiving Cobalt-60 radiation. Since a greater reaction is likely to occur where there are uneven areas in the portal of entry, nurses should make judgements of skin response based on their assessment of the uneven areas such as the axilla, groin, and behind the earlobe. Patients should be taught to avoid activities that increase the stress to the skin in these areas.

Recommendations for Future Study

As a result of this study, the following recommendations are made for future research:

1. Expand the Baker-Leith Rating Scale to include rates for skin changes that occur after a distinct erythema

reading of 2.0 and before a moist desquamation reading of 4.0. The expanded scale should be tested for reliability and validity.

This recommendation is based on this researcher's experience of observing visual changes which are not described in the rating scale. Between 2.0 and 4.0 the skin often turned darker brown and developed a dry, crusty appearance. These descriptions are not included in the rating scale.

2. Replicate the study using subjects receiving radiation to an uneven area such as the axilla, groin, or behind the ear. Include a group of subjects that are instructed to use a non-deodorant soap that has a ph of 7.0. Compare this group with a group of subjects that uses water only on the portal of entry.

This recommendation is based on this researcher's experience of noting that the axilla was the area most likely to develop a severe skin reaction. If bathing is a factor related to this reaction, if would be more apparent statistically if the area chosen to measure has a greater skin reaction.

APPENDIX A

CONSENT FORM

CONSENT FORM

TEXAS WOMAN'S UNIVERSITY

Title of Project: The Effects of Bathing on Skin Exposed to Cobalt-60 Teletherapy

Consent to Act as a Subject for Research and Investigation:

I have received an oral description of this study, including a fair explanation of the procedures and their purpose, any associated discomforts or risks, and a description of the possible benefits. An offer has been made to me to answer all questions about the study. I understand that my name will not be used in any release of the data and that I am free to withdraw at any time. I further understand that no medical service or compensation is provided to subjects by the university as a result of injury from participation in research.

_____ _____

Signature Date

_____ _____

Signature of Witness Date

Certification by Person Explaining the Study:

This is to certify that I have fully informed and explained to the above signed person a description of the listed elements of informed consent.

_____ _____

Signature Date

_____

Position

_____ _____

Witness Date

APPENDIX B

REPORT TO HUMAN RIGHTS COMMITTEE

TEXAS WOMAN'S UNIVERSITY
Box 23717 TWU Station
Denton, Texas 76204

HUMAN SUBJECTS REVIEW COMMITTEE

Name of Investigator: Patricia Bohannan Center: Denton

Address: 1409 Woodvine Date: 6-23-80

Euless, Texas 76039

Dear Ms. Bohannan

Your study entitled The Effects of bathing on skin exposed to Cobalt - 60 Teletherapy

has been reviewed by a committee of the Human Subjects Review Committee and it appears to meet our requirements in regard to protection of the individual's rights.

Please be reminded that both the University and the Department of Health, Education, and Welfare regulations typically require that signatures indicating informed consent be obtained from all human subjects in your studies. These are to be filed with the Human Subjects Review Committee. Any exception to this requirement is noted below. Furthermore, according to DHEW regulations, another review by the Committee is required if your project changes.

Any special provisions pertaining to your study are noted below:

_____ Add to informed consent form: No medical service or compensation is provided to subjects by the University as a result of injury from participation in research.

_____ Add to informed consent form: I UNDERSTAND THAT THE RETURN OF MY QUESTIONNAIRE CONSTITUTES MY INFORMED CONSENT TO ACT AS A SUBJECT IN THIS RESEARCH.

_____ The filing of signatures of subjects with the Human Subjects Review Committee is not required.

_____ Other:

_/_ No special provisions apply.

cc: Graduate School
Project Director
Director of School or
Chairman of Department

Sincerely,

Marilyn Hinson

Chairman, Human Subjects
Review Committee
at Denton

REPORT TO HUMAN RIGHTS COMMITTEE

Description of Study

The purpose of this study is to determine if a daily bath with water only affects the degree of skin reaction that occurs in patients receiving Cobalt-60 teletherapy to the chest and/or neck. A photoelectric reflection meter will be used to measure erythema and pigmentation. The reflection meter has a beam of light that is directed to the skin. The reflection of this light is then measured on an attached meter. This is a non-invasive procedure.

Eighty adults between the age of twenty-one and seventy will be measured. Each subject will be measured every week and once two weeks after therapy is completed. This study will be done at The Wm. A. and Elizabeth B. Moncrief Radiation Center in Fort Worth, Texas.

Potential Risks

The patients who are assigned to the control group will be asked not to put anything on the portal of entry for five weeks. The practice of allowing patients to bath the portal of entry with water only is currently being practiced at the radiation center. Therefore, for purposes of this study, the more conservative practice of

not bathing the portal of entry will be introduced to provide a control group for this study.

The length of time necessary to do each measurement will be less than ten minutes at the most. The test will be done at the same time the subject is at the center for therapy.

Rights and Welfare

Each subject will be asked to sign a consent form that will also be signed by the investigator and the medical radiotherapist. All subjects will be informed of their rights to withdraw from the study at any time without any effect to the manner in which they are being treated. Each subject will be given an identification number and their names will not be used in any way in any reports. The subjects in this study will have access to any nursing services needed from the investigator, who is an oncology clinical specialist.

Informed Consent

Each person will be given a full oral explanation of the study that includes the risks and benefits. Confidentiality will be assured and the right to withdraw at any time will be explained. Attached to this report are copies

of the consent form and a written description of the oral explanation.

Signature of Approval _____ Date _____
Program Director

Signature of Approval _____ Date _____
Graduate Student

Signature of Approval _____ Date _____
Dean

APPENDIX C

ORAL PRESENTATION

ORAL PRESENTATION

_____, I am doing a research study here at the center. I would like to tell you about it and ask you to participate. As your doctor has explained to you, your skin in the area that is being treated with radiation will change. These changes vary from one individual to another. However, there are some changes that almost always occur. Your skin may get slightly red at times and then this will go away. Towards the end of your treatments, it may turn a darker color, similar to a suntan. At this time, it may also become dry and flakey. This will not cause you any pain. You may have some itching and this will be relatively mild. In rare instances, some people do develop more severe reactions and the skin may weep. This is unusual however.

The question to be answered in this study is if daily bathing has any effect on this reaction. With this machine (demonstrate) I can measure the changes in your skin that are so small that they can't be seen. If you agree to participate in this study, you will be given some instructions on how to care for your skin (demonstrate). Once each week, when you come in for your treatment, I will place this light on your skin. It will take only a few

minutes to do this and it will not interfer with your treatments at all.

If you agree to participate in this study your name will not be used in any way. Also, if at anytime you want to drop out of the study you are free to do so. Do you have any questions?

APPENDIX D

INSTRUCTIONS FOR SKIN CARE

FOR EXPERIMENTAL GROUP

INSTRUCTIONS FOR SKIN CARE

1. Do Not use soap or water on the area being treated. You may take a bath but you must take special precautions not to get soap or water on the treatment area. Do not remove markings.
2. Do not scrub the treatment skin with washcloth or brush.
3. Do not soak the treatment skin.
4. Do not use alcohol base products, talcum, creams, ointments, or deodorants on the area.
5. Do not apply hot water bottles, heating pads, or not compresses.
6. Keep pressure over avea at a minimal. A bra should be worn only when absolutely necessary. Lying on the area for extended periods should be avoided. Do not massage, rub, or wear clothing that will rub the treatment area.
7. Keep the area dry. Cotton clothing should be worn next to the skin.
8. Do not expose the treatment area to sunlight.
9. Do not use any adhesive material on the treatment area.
10. If you have any questions concerning your care, please contact me immediately by phone.

Pat Bohannan, R.N.

923-7393 - Radiation Center; 921-7651 - T.C.U.;
267-7103 - Home

APPENDIX E

INSTRUCTIONS FOR SKIN CARE

FOR CONTROL GROUP

INSTRUCTIONS FOR SKIN CARE

1. Do Not use soap on the area being treated. Cleanse once daily with a gentle flow of tepid water. Do not rub briskly. Pat dry. Do not remove markings.
2. Do not scrub the treatment skin with washcloth or brush.
3. Do not soak the treatment skin.
4. Do not use alcohol base products, talcum, creams, ointments, or deodorants on the area.
5. Do not apply hot water bottles, heating pads, or hot compresses.
6. Keep pressure over area at a minimal. A bra should only be worn when absolutely necessary. Lying on the area for extended periods should be avoided. Do not massage, rub, or wear clothing that will rub the treatment area.
7. Keep the area dry. Cotton clothing should be worn next to the skin.
8. Do not expose the treatment area to sunlight.
9. Do not use any adhesive material on the treatment area.
10. If you have any questions concerning your care, please contact me immediately by phone.

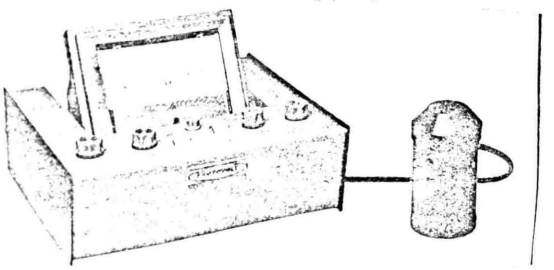
Pat Bohannan, R.N.

923-7393 - Radiation Center; 921-7651 - T.C.U.;
267-7103 - Home

APPENDIX F

PHOTOVOLT 670

PHOTOVOLT



The 670 makes appearance control a scientific fact, not a guessing game. Tells you in numbers if the color you have today, is the same you had yesterday. Surface appearance can then be duplicated any time no matter what happens to the sample. Fading or color drift in production is easily controlled. You can match samples submitted by your customer or sales department, and eliminate endless discussions.

The Photovolt 670 is the work horse for factory, control laboratory or research department. It aids in maintaining control of the appearance of any industrial product. It can be helpful in medical research, air pollution — in any application where ordinarily the eye is used for grading. Anyone can operate the 670. Simply set the instrument to a permanent standard, then place the search unit on the sample and read! An accessory digital readout device is available to attach to the built-in recorder outlet. With it, the numbers are instantly readable . . . eliminates possible misreading of the meter . . . reduces fatigue to a minimum.

The 670 is ruggedly constructed . . . will maintain its accuracy under the most severe factory vibrations. Unique four-position tilting meter makes reading easy and glare-free. Contains modern solid state circuitry . . . maintenance-free and immune to usual voltage fluctuations. It is the ideal instrument in virtually every industry, and evaluates samples in terms of a large number of standard procedures. The chart shown on the opposite page lists the general areas of use. For specific applications in your own industry, consult the Photovolt Technical Service Laboratory. You will always find Photovolt ready to assist you, as will our dealers, who are located throughout the United States and in foreign countries.

SPECIFICATIONS:

Readability – Better than 0.5° a.

Controls – Instrument, On-Off
Lamp, On-Off
High-Low Sensitivity Switch
Sensitivity Control
Zero suppression control

Meter – 4 position tilting frame, 5½" taut band, mirrored scale 0-100° a.

Scale Expansion – Any 10° a range can be expanded over the full meter.

Outlets – Search Unit, Recorder – adjustable, 900 to 1100 mv (serves also for Digital readout).

Electrical – Standard 3 prong power cord with ground. Line operated, fully stabilized, 50-60 Hz, 90 to 130 and 180 to 250 volt. Power consumption, 50 watts.

Dimensions – Flat housing 12"x12"x4". Weight 15 lbs.

APPENDIX G

BAKER-LEITH RATING SCALE

GRADING SYSTEM FOR SKIN IRRADIATION REACTION

Tissue grade and appearance in acute injury phase:

1.0 No different from before treatment

1.5 Slight erythema

2.0 Distinct erythema

2.5 Dry desquamation

3.0 Powder appearance of skin-edematous

3.5 Dry with suggestions of incepient skin break

4.0 Moist desquamation

4.5 Moist desquamation with small areas of necrosis

5.0 Significant amount of necrosis with loss of dermis (similar to 3rd degree burn)

(Baker & Leith, 1975)

APPENDIX H

AGENCY PERMISSION

TEXAS WOMAN'S UNIVERSITY
COLLEGE OF NURSING

AGENCY PERMISSION FOR CONDUCTING STUDY

THE Wm. A. And Elizabeth B. Moncrief Radiation Center

GRANTS TO Patricia A. Bohannan
a student enrolled in a program of nursing leading to a Doctor of Philosophy Degree at Texas Woman's University, the privilege of its facilities in order to study the following problem:

To determine if a daily bath during treatment effects the degree of skin reaction that occurs in patients receiving Cobalt-60 teletherapy to the neck and/or chest.

The conditions mutually agreed upon are as follows:

1. The agency (may) (may not) be identified in the final report.

2. The names of consultative or administrative personnel in the agency (may) (may not) be identified in the final report.

3. The agency (wants) (does not want) to conference with the student when the report is completed.

4. The agency is (willing) (unwilling) to allow the completed report to be circulated through interlibrary loan.

5. Other This agency would like a copy of the final report for their library.

Date: 8/24/80

Signature of Agency Personnel

Patricia Bohannan
Signature of Student

Signature of Faculty Advisor

APPENDIX I

DATA SHEET

DATA SHEET

Patient No. Age Sex Diagnosis

Treatment Field and Points of Measurement

Pretreatment Skin color

Dose	E	Port	P	E	Normal	P	E	Change	P	Rate

Additional Data:

REFERENCE LIST

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