The influence of occupational and geographic characteristics on the pattern of cancer incidence in Montana : an exploratory descriptive study
by Kathy Smith Stillson

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Nursing
Montana State University

Abstract:
The purpose of this study was to explore and describe occupational and geographic differences between the five Montana Health Planning Districts and to determine their possible influence on the pattern of cancer incidence in this rural State. The study explored the questions: what are the occupational and geographic characteristics of the five Districts, what was the incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in the five Districts from 1986 through 1988, and, are there occupational and geographic influences which may have resulted in a higher incidence of specific types of cancer in certain areas of Montana? The study utilized existing data on the five Montana Health Planning Districts to describe primary occupations and geographic factors of topography, wind, and water run-off for the Districts. The study utilized data on 2,217 cases of cancer reported to the Montana Central Tumor Registry to describe the incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in Montana by District from 1986 through 1988.

Data analysis showed the highest incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in Districts 1,2, and 3 where the primary occupation was agriculture and shared geographic factors included flat terrain, high cross-winds, and minimal water run-off. The lowest incidence of leukemia, lymphoma, prostate and bladder cancer was in District 5 where the primary occupations included tourism and logging and geographic characteristics included mountainous terrain, low winds, and high water run-off. District 4 shared similar occupational and geographic characteristics with all four of the other Districts and cancer incidence which tended to fall in the middle ranges. The study showed contrasting results for brain cancer, with the third highest incidence in District 3 and the lowest incidence in District 4.

The researcher concluded that occupational and geographic characteristics found in the five Montana Health Planning Districts showed a pattern which coincided with patterns of specific cancer incidence within the State.

THE INFLUENCE OF OCCUPATIONAL AND GEOGRAPHIC CHARACTERISTICS ON THE PATTERN OF CANCER INCIDENCE IN MONTANA: AN EXPLORATORY DESCRIPTIVE STUDY

by

Kathy Smith Stillson

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Kathy Smith Stillson

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies of Montana State University.

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Signature Kathy Smith Stillson

Date May 23, 1991

This study is dedicated to my parents who gave me life, love, intelligence, determination and an awareness of God the Father and my Savior Jesus. Through this awareness I gained the strength to persevere no matter what the odds.

VITA

Kathy Smith Stillson was born in Huntington, New York to Ada and Henry Smith. She obtained most of her early education in Illinois. She graduated from Prospect High School in Mount Prospect, Illinois and attended Northern Illinois University. She graduated in 1974 from Northern Illinois University with a Bachelor of Science degree in Nursing and a minor in Russian.

Ms. Stillson's professional work experience has included medical surgical nursing at Mount Sinai Hospital in Minneapolis, Minnesota. She was also employed at St. Joseph's Medical Center in rural Brainerd, Minnesota where she worked as a primary nurse on the medical surgical unit, and as a charge nurse on the chemotherapy and extended care unit. Prior to entering graduate study, Ms. Stillson continued her career as a staff nurse and supervisor in a rural long term care facility in Dillon, Montana.

In June 1988, Ms. Stillson began graduate study at Montana State University in the rural nursing program with a concentration in geriatric and community health nursing. She continued part time employment as a research assistant on the Montana Family Cancer Project and the Family Health Study while attending graduate school. Ms. Stillson has obtained a graduate minor in Adult and Community Education and has also participated in part time employment as a research assistant on the Bilingual Studies Project concerned with alcoholism and chemical abuse among Native American children.

Ms. Stillson is a member of the Zeta Upsilon chapter of Sigma Theta Tau International, the honor society for nursing. She will receive her Master of Nursing degree in June 1991.

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ABSTRACT

The purpose of this study was to explore and describe occupational and geographic differences between the five Montana Health Planning Districts and to determine their possible influence on the pattern of cancer incidence in this rural State. The study explored the questions: what are the occupational and geographic characteristics of the five Districts, what was the incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in the five Districts from 1986 through 1988, and, are there occupational and geographic influences which may have resulted in a higher incidence of specific types of cancer in certain areas of Montana?

The study utilized existing data on the five Montana Health Planning Districts to describe primary occupations and geographic factors of topography, wind, and water run-off for the Districts. The study utilized data on 2,217 cases of cancer reported to the Montana Central Tumor Registry to describe the incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in Montana by District from 1986 through 1988.

Data analysis showed the highest incidence of leukemia, lymphoma, brain cancer, prostate and bladder cancer in Districts 1, 2, and 3 where the primary occupation was agriculture and shared geographic factors included flat terrain, high cross-winds, and minimal water run-off. The lowest incidence of leukemia, lymphoma, prostate and bladder cancer was in District 5 where the primary occupations included tourism and logging and geographic characteristics included mountainous terrain, low winds, and high water run-off. District 4 shared similar occupational and geographic characteristics with all four of the other Districts and cancer incidence which tended to fall in the middle ranges. The study showed contrasting results for brain cancer, with the third highest incidence in District 3 and the lowest incidence in District 4.

The researcher concluded that occupational and geographic characteristics found in the five Montana Health Planning Districts showed a pattern which coincided with patterns of specific cancer incidence within the State.

CHAPTER ONE

INTRODUCTION

Cancer is the second leading cause of death in Montana (Bureau of Records and Statistics, 1988). The incidence of cancer in Montana has reflected the national averages which increased from 1979 to 1985 and decreased slightly in 1986. However, the following five types of cancer in Montana exceeded the nationally expected incidence for the same time period: leukemia in men, lymphomas in women, and cancers of the brain, prostate, and urinary bladder in both men and women (Montana Central Tumor Registry, 1988). Several studies have identified these five diagnoses as being linked to cancer incidence in rural states, such as Iowa and Kentucky, which are dominated by the occupation of agriculture (Burmeister, 1981; Donham, Berg, & Sawin, 1980; Milham, 1971). Agriculture, as described in these studies, involved the activities of farming and ranching. These studies are especially important to Montana which is also a rural state with an occupational focus of farming and ranching.

Similar to cancer incidence rates which exceeded the national figures for 1979 to 1985, cancer survival rates for Montana during this same time period varied from the national averages. Survival rates for Montana were below the national average from 1979 to 1985, even though advances in technology and new methods of diagnosis and treatment improved national survival rates (Bureau of Records and Statistics, 1988b; Chodak & Schoenberg, 1984; Feldman, Kessler, Myers, & Naughton, 1986; National Cancer Institute, 1989; U.S. Cancer, 1987). Both cancer incidence and cancer survival

rates for Montana indicate that there may be other environmental characteristics unique to this State which could have influenced these findings.

The occupation of an individual or group is an environmental factor which has been shown to influence the incidence of cancer in given populations (Iorio, 1985; Mausner & Kramer, 1985; Robbins, Cotran, & Kumar, 1984). Studies in Iowa (Burmeister, 1981; Burmeister, Vanlier, & Isacson, 1982), Utah (Schumacher, 1985), Oregon and Washington (Milham, 1971), Nebraska (Blair, 1979), Minnesota (Blair, Malker, Cantor, Burmeister, & Wiklund, 1985), and Texas (Mills, 1984) addressed the relationship between occupation and the incidence of certain types of cancer among agricultural workers. Since one of the leading occupations in Montana is agriculture, the possible relationship between the occupation of agriculture and the incidence of specific cancers in Montana is a health concern.

In addition to the link between occupation and cancer, other studies have shown that geographic influences may also affect cancer incidence (Robbins, et al., 1984). Wind and water, which vary with the topography of an area, are geographic influences that have been identified as methods of transmission for carcinogens introduced into the environment (Seiber & Woodrow, 1983; Van Driesche, Carlson, Ferro, & Clark, 1987).

Currently, environmental and occupational health research is attempting to identify occupational and geographic characteristics which may influence the incidence of a specific disease, such as cancer, in population groups (Field, 1979; Woods & Catanzaro, 1988). Differences in occupational and geographic characteristics and the incidence of cancer in different areas, could identify health hazards which contribute to

the development of cancer. Knowledge of occupational and geographic health hazards which contribute to the development of cancer could be used to identify populations at risk. By identifying populations at risk, health education and other preventative health programs could be developed and implemented by health professionals to reduce the incidence of cancer.

Information on why certain areas of Montana have a higher incidence of cancer than other areas has not been researched. This study will describe and explore information on the pattern of cancer incidence relative to occupational and geographic characteristics in rural Montana. Examination of these characteristics in this study will help to provide direction for further research on cancer incidence in Montana and other rural states.

Problem Statement

The purpose of this study was to explore and describe occupational and geographic differences between the five Health Planning Districts (Appendix A), and to determine their possible influence on the pattern of cancer incidence in the rural state of Montana.

Definition of Terms

Cancer Incidence: The rates of newly occurring cases of lymphoma, leukemia, brain cancer, prostate, and bladder cancer which were reported to the Montana Central Tumor Registry from January 1, 1986 through December 31, 1988.

Cancer Patterns: The occurrence of non random groups of one or more cancer diagnoses in the five Health Planning Districts of Montana.

Health Planning Districts: The five divisions, by county groups, of the population of Montana which coincide with the divisions outlined in the 1968 report by the Montana State Board of Health for the state-wide health planning agenda.

Geographic Characteristics: are defined in this study as water run-off, wind direction, and wind velocity which vary with the topography in each of the five Montana Health Planning Districts.

Occupational Characteristics: are defined in this study as employment in ranching, farming, logging, tourism, service professions, government service and transportation.

Assumptions

1. Information on the incidence of cancer was accurately reported to the Montana Central Tumor Registry in compliance with Montana State Law.

2. Information obtained from the Montana Central Tumor Registry accurately reflected the incidence of cancer in Montana.

3. Occupational and geographic characteristics can contribute to an increased risk in the development of cancer.

4. Individuals represented by the cancer cases reported to the Montana Central Tumor Registry were residents of Montana at the time of diagnosis.

Limitations

1. Due to differences in disease reporting by states, and differences in the population, occupational and geographic characteristics, this study cannot be generalized.

Delimitations

1. Cancer incidence in this study was limited to the State of Montana.

2. Sources of data were secondary from reports compiled by the Montana Central Tumor Registry.

3. Information from the Montana Central Tumor Registry on cancer incidence was limited to reports recorded from January 1, 1986 through December 31, 1988.

4. Because there were no established regulations for cancer incidence reporting in Montana prior to 1985, and the year 1985 was considered to be a start up year for current reporting regulations and cancer incidence, this study was limited to complete reports recorded between January 1, 1986 and December 31, 1988.

5. Because the Montana Central Tumor Registry data did not include information on gender, differences in cancer incidence by gender were not included in this study.

Conceptual Framework

In an effort to explore and describe the influence of occupational and geographic characteristics on the patterns of cancer incidence in rural Montana, this study utilized an epidemiological framework. The science of epidemiology uses an epidemiological framework to study patterns of disease and factors that influence the patterns of disease in human population groups (Mausner & Kramer, Valanis, 1986). Population groups in Montana were explored and described in this study using the epidemiological Wheel Model (Figure 1). According to the Wheel Model, disease cannot be attributed to any one factor, but rather to three interacting factors: the causative agent(s), a susceptible host (human), and the environment (Mausner & Kramer, 1985; Turner & Chavigny, 1988; Valanis, 1986). Factors affecting the development of disease are divided into two groups, intrinsic or host influences and extrinsic or environmental influences (Mausner & Kramer, 1985).

Environmental or extrinsic influences can be classified as biological, physical and social. The Wheel Model depicts these influences as they relate to the human host and it stresses the etiologic factors of a disease as opposed to the agent of disease. The hub of the wheel represents the human host with genetic make-up as its core. In this study, population groups exposed to occupational and geographic disease producing or potentiating influences are considered to be the host or core of the model. Surrounding the core is the environment, represented schematically by the three environmental influences of biological, physical and social factors (Mausner & Kramer, 1985). The

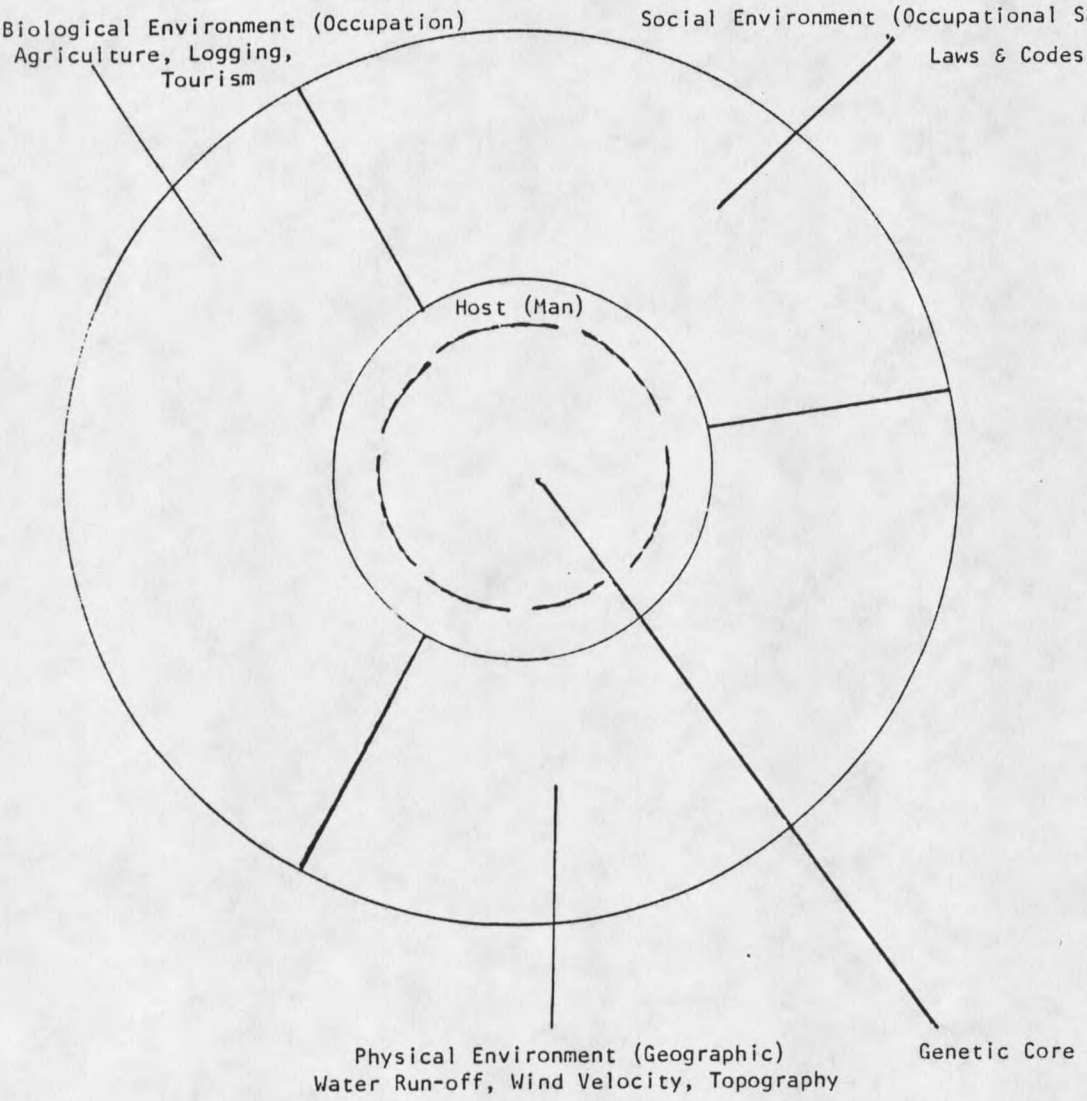

Figure 1

THE WHEEL MODEL OF MAN AND ENVIRONMENTAL INTERACTIONS

Source: Modified and Adapted from Mausner & Bahn, 1985

biological environment includes vectors and reservoirs for the transmission of disease. Reservoirs may include other human beings, animals, or the soil (Mausner & Kramer, 1985; Valanis, 1986). Reservoirs of the biological environment are most often associated with infectious diseases where the infectious agent lives and multiplies in the reservoir. Reservoirs of the biological environment can also be conceptualized as harboring substances, such as chemicals or bacteria, which may influence the development of cancer.

The physical environment includes the geological structure of an area and the availability of sources for the transmission of disease producing elements. Sources include the presence or absence of water flow and the force and direction of wind currents. These components of weather and climate are important influences in the transmission of an agent from the reservoir to the host (Valanis, 1986).

The social environment includes the attitudes and culture of a locality as well as the overall social, economic and political conditions of the area (Mausner & Kramer, 1985). Political conditions include the structure of law enforcement, codes and regulations affecting a population group. The adequacy of enforcement of these laws, codes and regulations control health-related environmental hazards that are found at the occupational site. The amount of control of a health-related occupational hazard, such as pesticide usage in agriculture, could affect the level of influence that the hazard has on the development of disease.

The environmental components of the Wheel Model vary in relative size depending on the disease under consideration (Mausner & Kramer, 1985). For

example, the genetic core would be relatively large in a study of hereditary diseases. Since this study described and explored the occupational and geographic influences on the incidence of cancer in rural Montana, the genetic core is depicted as small while the biological, physical, and social components of the environment dominate the model.

Prevention of disease is an integral part of health promotion. Mausner and Kramer (1985) advocate the use of epidemiology to provide a systematic approach to examining factors that influence the incidence of disease. According to Mausner and Kramer (1985), health professionals in the field of community or public health are concerned with population health. The authors stated that the nurse in this role is primarily concerned with the health and disease in the community. Mausner and Kramer indicated that nursing evaluates the health status of all members of the community, including those members who would benefit from, but do not seek, professional health care.

White (1983) emphasized that when knowledge of disease development is ascertained and disseminated, then primary prevention can become a reality. Knowledge of the causes, characteristics, development, and incidence of disease allows for planning of preventative programs and services. Levels of a disease occurrence, described in a way which allows measurement, can then be used to assess the community for improvement and maintenance of its health status (Coutts & Hardy, 1985).

Nurses provide health education purposefully to eliminate the deficit between health information and health practices. Redman (1988) stated, "Alternative approaches

to change in health behavior, such as legislation and environmental controls, ultimately depend on education for acceptance by people" (p. 7). Because nurses have direct access to the clients and groups in their community they are the most likely health professionals to become involved in transmission of health-related information through health education. Knowledge about occupational and geographic characteristics that could influence the incidence of cancer could assist nurses and other health professionals in the development of adequate prevention programs and services.

The community health nurse, by using the nursing process of assessment, planning, implementation, and evaluation and the Wheel Model for guides, could use the information described in this study as part of a community needs assessment. For example, nurses could use the information provided in this study to assess whether cancer incidence and occupational and geographic characteristics of the District in which they serve are potential risk factors for cancer incidence in those Districts. Identification of potential risk factors for cancer incidence in a District would help to identify an educational deficit for clients in that District.

The community health nurse could use the identification of a community educational deficit as a basis for planning and implementing prevention programs and services. Programs and services could include the dissemination of information on occupational safety risks, and information on how to minimize the environmental impact of occupation related practices, e.g., the use and application of agri-chemicals. Dissemination of information could be initiated at the local, District, and State levels to familiarize a wide variety of individuals who may be affected by occupational risk

practices. Familiarizing local individuals, legislators, and communities with potential risk factors and prevention information could improve health practices by eliminating a knowledge deficit.

CHAPTER TWO

LITERATURE REVIEW

Introduction

Hammond (1974), found that there is support for a long standing contention that 85% or more of all human cancers are related to environmental factors. He noted that cancer death rates of migrant children are closer to those of the new country than to the country of origin. According to Hammond, since immigration does not change the genetics of an individual, the environment must be the influencing factor in the change of cancer incidence.

Hammond's (1974) findings were corroborated by Robbins, et al. (1984), who pointed out that the rate of stomach carcinoma is seven times higher in Japan than in the United States. Japanese persons born of immigrant parents had mortality rates comparable to those of the U.S. rather than those of their heritage country. Elements of the environment that influence the health of immigrants include biologic environmental factors, such as conditions of the soil, geographic factors of the physical environment, such as the influences of wind and water, and social factors, such as laws and regulations governing occupational safety.

This chapter is a review of literature related to geographic and occupational influences on the incidence of cancer. The first section describes cancer statistics for Montana in comparison to national statistics. The second section examines the relationship between the occupations of farming and ranching and the diagnosis of

cancer. The third section addresses occupational safety considerations pertinent to this study. The fourth section explores geographic location as an influence in the development of cancer, and the last section describes the occupational and geographic characteristics of Montana.

Montana Cancer Incidence in Contrast to the U.S.

Unlike some states where cancer statistics have been monitored since 1950 (Mausner & Kramer, 1985), the 1988 Montana Central Tumor Registry (MCTR) report stated that data collection for Montana was only sporadic prior to 1981 when reporting became mandated by legislation. The first two years of data collection were considered a period of program initiation. Therefore, monitoring of cancer incidence and mortality in Montana has covered a brief nine years and may explain why there is a paucity of studies which examine the incidence of cancer in this state.

The American Cancer Society (1990) reported that the four most common types of cancer in the United States are lung, breast, prostate and colo-rectal cancer. In 1988 The Montana Central Tumor Registry (MCTR) compared, in table format, the 1977-1981 National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program estimates to the actual number of cancer cases reported in Montana for this five-year period. This comparison showed cancer incidence trends in Montana which are in contrast to the national findings. The report showed that the actual incidence of lung, breast and colon cancer in Montana, fell below SEER Program expected incidence rates for that time period. Incidence rates for prostate cancer,

exceeded the SEER predictions. In contrast to the U.S. trend, the incidence of prostate cancer was found to exceed that of lung cancer in Montana.

The 1968 report by the Montana State Board of Health outlined a state-wide health planning agenda which divided the state into five Health Planning Districts (Taylor, 1976). Using these districts as reporting areas, the 1988 MCTR report listed cancer incidence both across the entire state and by Health Planning Districts. In all five Montana Health Planning Districts, both prostate cancer and cancer of the urinary bladder exceeded nationally expected incidence rates. Incidence of brain cancer, lymphomas in women, and leukemia in men exceeded the SEER Program expected rates in Districts one, two, three, and four, but fell below the SEER predictions in District five.

Based on data from the SEER program (1984-1986), the American Cancer Society (ACS) estimated that Montana will have 3,300 new cases of cancer in 1990 (1990, p. 20). Using the Bureau of the Census (1989) population estimates, this incidence represents a new case of cancer developing in one out of every 250 people in the State. The incidence and predicted prevalence of cancer indicated in the SEER and ACS reports mandate the need to examine factors which may influence these findings.

Occupational Influences and Cancer

Although the specific etiology of cancer remains unknown, Salazar (1988) noted that there is strong evidence to link the occurrence of many cancers to the environment and identifiable lifestyle factors such as occupation. Consideration of the occupational hazards inherent to agricultural pesticide usage lends support to the author's contention. Salazar recommended that the way to decrease the number of deaths attributable to agri-chemical exposure is to avoid or reduce the number of known carcinogens. Knowledge of which cancers occur in a given agricultural environment is the first step in identifying potential carcinogens used that need to be reduced or avoided.

Iorio, 1985, referred to the agricultural worker as, "occupational health's neglected client," (p. 566), and stressed the hazards of chemical and gaseous exposures. Iorio stated that the agricultural worker is exposed in daily practice to pesticides including herbicides, defoliants, fungicides, rodenticides and insecticides. Supporting statements by Dean (1990) noted that farm and ranch workers have been targeted as populations at risk related to their long-term exposure to pesticides. These two articles by Salazar and Iorio stress the importance of potential occupational influences on cancer incidence.

Van Driesche, Carlson, Ferro, & Clark, (1987) and Moses (1989) supported Iorio's 1985 findings that agricultural chemicals potentiate cancer incidence. Robbins, Cotran, & Kumar (1984) identified pesticides as a cause of skin cancer as well as a

cause of kidney and lung damage that may predispose an individual to the development of cancer.

A case-control study conducted by Milham (1971) reviewed state death files for 408 farmers and 324 matched control cases in Oregon and Washington from 1950 to 1967. This study attempted to substantiate prior findings in California, and the United States as a whole, and to examine in more detail an association between farming and leukemia mortality risk. For the cases studied, 99.1% of the death certificates stated occupation and diagnosis at the time of death. The cases studied were reported in the leukemia-lymphoma group of cancers. Milham reported findings consistent with the hypothesis that agricultural environments contain agents which may cause leukemia and lymphomas.

In 1976, Milham extended the 1971 case-control study to examine in more detail the farming-cancer association among residents of Oregon and Washington from 1950 to 1971. The study found increased mortality due to cancer of the stomach, brain and kidney in addition to the earlier findings of increased mortality due to leukemia and lymphomas among farm populations. A recent report by Dean (1990) of The Montana Central Tumor Registry supported these findings which stressed the environmental linkage of long-term exposure to pesticides as a cause of cancer, specifically, in children and in adults between 55 and 79 years of age.

Burmeister (1981), reported on a five-year Iowa mortality study of 6,402 farmers compared with 13,809 nonfarmers. Death certificates for the years 1971 to 1978 provided both the usual occupation of the deceased and the diagnosis. Again, the

agricultural environment was identified as an influential factor in cancer incidence and mortality. Burmeister found cancer of the stomach, colon, pancreas, skin, kidney, bladder, prostate and lip, as well as leukemia, Hodgkin's disease and non-Hodgkin's lymphoma to have significantly elevated cancer mortality rates in the farming population.

In a study conducted by Donham, Berg, and Sawin (1980), increases in leukemia were found in Iowa among farmers having large herds of cattle. Cattle ranching is a major agri-business in Montana. The 1987 Bureau of the Census reported over one and a quarter million head of cattle in Montana for 1987-1988. Since the 1987 Montana Vital Statistics indicated a 2% rise in the incidence of leukemia in Montana for both men and women from 1986 to 1987, the size and concentration of the cattle industry in Montana may indicate a similar relationship to that found by Donham, et al. (1980).

Brownson, Reif, Chang, and Davis (1990) conducted a case-control study to examine the occupational risk factors associated with the incidence of brain cancer in Missouri. The study identified 312 brain cancer cases and 1,248 cancer control cases through the Missouri Cancer Registry for the period 1984 through 1988. The Registry data were compiled from cases reported by public and private hospitals. Data on occupation were abstracted from hospital records and submitted as part of the cancer incidence reporting. Findings of the study indicated a moderately elevated risk in men employed in agriculture of developing brain cancer.

Several studies that examined the influence of agricultural occupations, such as farming and cattle ranching, have been conducted over the last three decades. Support has been given to the findings which indicate that agricultural environments contain agents which may increase the risk of developing cancer. However, the studies reported are few and isolated to specific states. No studies have been reported that examine the agricultural environment in association with cancer incidence in Montana.

Occupational Safety Influences

The Occupational Health and Safety Act was enacted in 1970. This legislation stated that industrial management is responsible for providing a safe and healthful environment for its workers (Turner & Chavigny, 1988). The U.S. Department of Agriculture (USDA), in 1986, estimated an annual agricultural work force of approximately two million hired workers and three million farmers and their families. Farm workers, however, are excluded from federal laws that protect other workers, including the Occupational Safety and Health Act which governs standards of health and safety in the workplace (Moses, 1989).

Farm safety in Montana is assisted through publications from the Montana Extension Service. Extension publications warn agricultural workers of some known hazards of pesticide usage such as poisoning, blindness, burns, explosions, fire, and suffocation. The publications also instruct the agricultural worker on how to safely handle agri-chemicals such as pesticides, rodenticides and nematicides (Linn, 1984; Linn, 1989a). In addition, Extension Service publications give special instructions on

how to launder pesticide contaminated clothing (Linn, 1989b). These instructions are only recommended, not legally mandated. Legal mandates for the handling and disposing of hazardous wastes, including registered pesticides, chemical fertilizers, and organic solvents (from farm machinery parts cleaning) are covered under the federal Resource Conservation and Recovery Act and its state companion, the Montana Hazardous Waste Act. However, the regulations adopted under the hazardous waste program, both federal and state, have an exemption for the individual farm or ranch: "A farmer disposing of waste pesticides from his own use, which are hazardous wastes, is not required to comply with the (hazardous waste) standards in this subchapter for those wastes, provided he triple-rinse each pesticide container in accordance with Administrative Rules of Montana (ARM) 16.44.307 (5), and disposes of the pesticide residues on his own farm in a manner consistent with the disposal instructions on the pesticide label," (State of Montana, 1987; Linn & Thorvilson, 1989).

According to Roy Linn, Farm Safety and Agricultural Energy Specialist with the Montana Extension Service (personal communication, November 8, 1990), the Extension Service has attempted to assist the Montana agricultural worker in developing and maintaining as safe a working environment as possible. However, according to Linn, there are no state or federal laws or regulations which mandate any form of occupational safety codes or regulations for the agricultural industry in Montana. Without codes and regulations to mandate safe practices in the agricultural environment, environmental safety in Montana is strictly a matter of personal choice or conscience.

Montana State law in cooperation with Federal law does require a license to use any of the ten Food and Drug Administration controlled pesticides. However, no license is required for noncontrolled pesticides supplied through over-the-counter sales. This information was supplied by Greg Johnson, Coordinator of the Montana Pesticide Certification Program (Montana State University, February 13, 1991).

Geographic Influences and Cancer

Studies for four decades have considered the content of soil and water to be a potential influence on the incidence of cancer in specific populations (Foster, 1989; Warren, Delavault, & Cross, 1967). A 1968-1969 study conducted and reported by Kmet and Mahboubi studied environmental influences on the incidence of esophageal cancer in the Littoral of Iran. The study included 100 people diagnosed with esophageal cancer during that time period and 160 control subjects living in the same region. In addition to examination of dietary habits and use of substances, such as tobacco and opium, examination of the soil for minerals or contaminants and subsequent examination of the water contents was addressed. Although mineral content of the soil and water were not considered primary influences on the incidence of esophageal cancer in this study, trace elements found in the soil and bedrock formations were also found in the water for the region (Kmet & Mahboubi, 1972). Bedrock formations influence water run-off and water content of an area.

Bedrock geology determines what trace elements, such as selenium and calcium, and what pollutants, such as pesticides and fertilizer chemicals, are filtered out or

passed on into the groundwater of an area (Warren, 1967). Those substances that enter groundwater are consumed domestically through drinking water. Nationwide, 50% of the urban domestic water supply is from groundwater, while 90-95% of the domestic water supply to rural areas is from groundwater (Moses, 1989; Mott & Snyder, 1988).

In addition to the influence of groundwater contents and consumption on the incidence of disease, the patterns and magnitude of wind currents in a region also influences the incidence of disease. Wind currents determine how far airborne carcinogens are spread. Carcinogens become airborne in environments where chemicals are spread through the use of aerial application methods, such as in pesticide applications in agriculture. The concern in aerial application of chemicals comes with consideration of "drift". Drift is the distance that particles, such as chemicals and water droplets, travel by air currents. This distance is determined by the size of the particles and wind conditions including direction and velocity (Moses, 1989). Residents of agricultural regions are exposed to pesticides through the drift of airborne residues which expose anyone downwind of a treated area (Seiber & Woodrow, 1983; Van Driesche, Carlson, Ferro, & Clark, 1987). Studies have shown that significant concentrations of pesticides and agri-chemicals applied by ground rigs or aerial application can drift up to a mile or more even when wind conditions are calm (Akesson, 1964; Matthews, 1982).

Drift of particulate matter, mutagens, and their influence on disease was examined in a 1978 study by Warren, Rogers, Medvec, and Roach. The study set up a mutagen screening program in Anaconda-Deer Lodge and Butte-Silver Bow, an area

with high lung cancer rates. One hundred sixty-four children in grades three and four in the cities of Anaconda and Butte participated in the study between May and October of 1978. The study showed that higher concentrations of mutagens were found in the urine of children living in a specific area of Butte than in other areas of Butte or Anaconda. This was termed "geographic isolation" of a "high risk area" in the city. Air quality and currents in this isolated area were determined to be a primary influence on the results of the study (Warren, Rogers, Medvec, and Roach, 1979).

Occupational and Geographic Characteristics of Montana

Montana is a highly agricultural rural state, with farming and ranching being one of the top three occupations in 43 of the 56 counties, and one of the top five occupations in an additional eight counties. The primary crops are hay, wheat and barley. In addition, large herds of cattle and sheep are spread throughout the State's Health Planning Districts with the exception of District 5. Figure 2 shows the primary occupations in the Health Planning Districts. District 5, in contrast to the rest of the State, is non-agricultural, with tourism, logging and related manufacturing industries as primary occupations. Tourism is also a primary occupation in District 4, followed by agriculture (Martin & Meagher, 1989).

Montana does not have uniform topographic characteristics. There is a distinct contrast between the topography of northwestern Montana and the remainder of the State. This contrast becomes very apparent when a topographic map of Montana is superimposed on a map of the State's five Health Planning Districts (Figure 3).

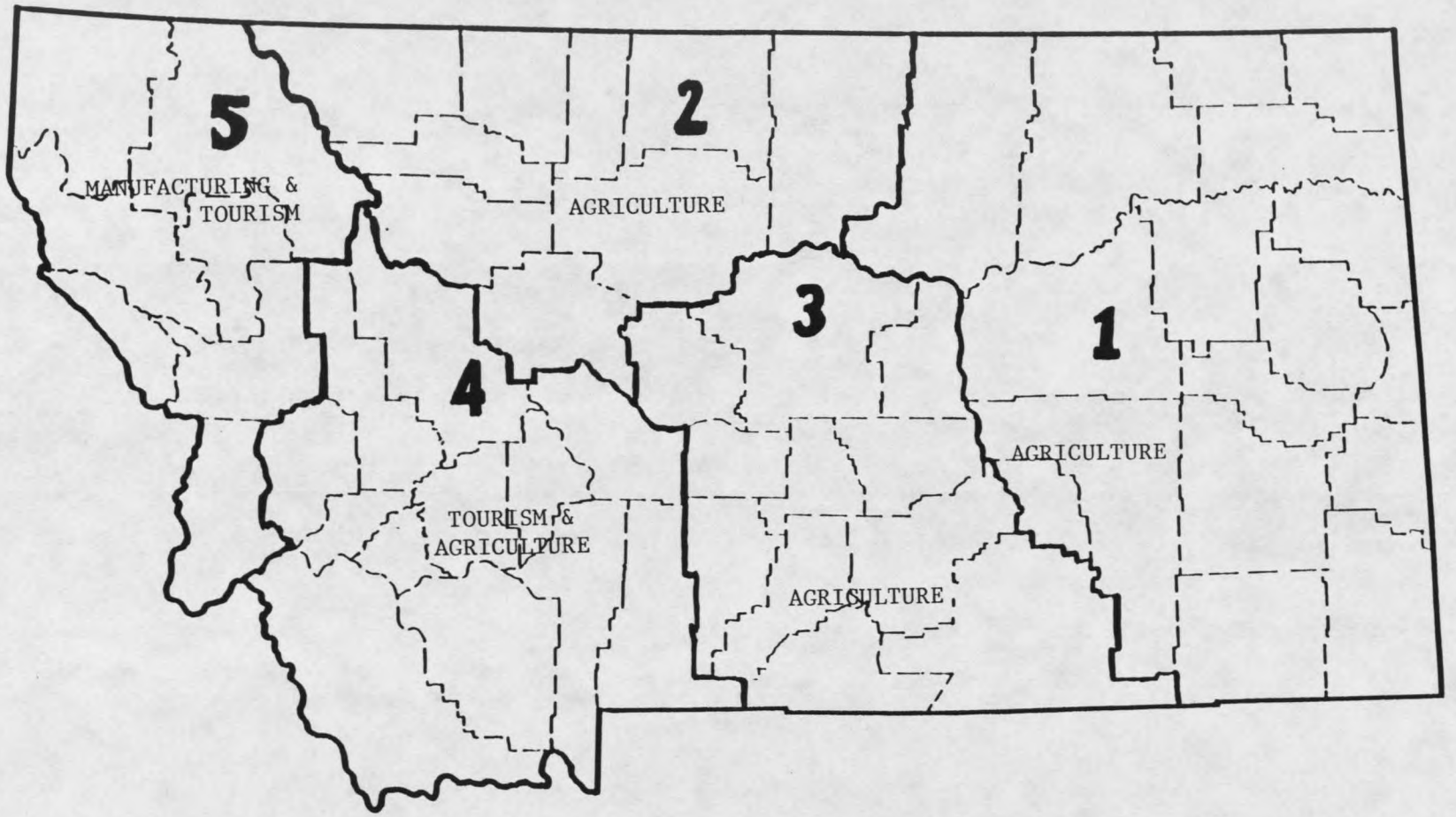

Figure 2

PRIMARY OCCUPATION IN HEALTH PLANNING DISTRICTS

Source: Facts on File, Inc., 1984 .

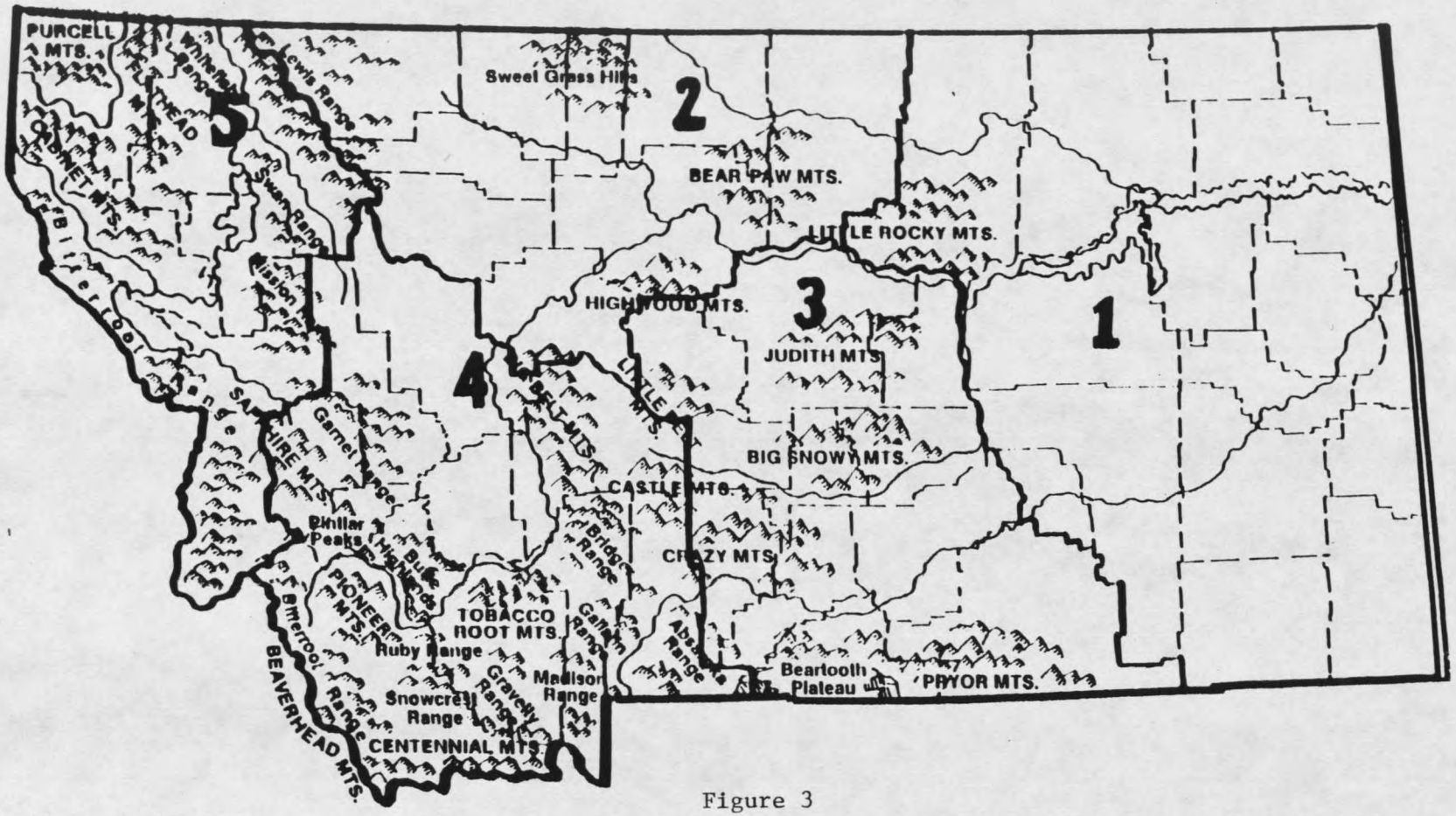

Figure 3

TOPOGRAPHIC CHARACTERISTICS
OF THE MONTANA HEALTH PLANNING DISTRICTS
Source: Facts on File, Inc., 1984.

Although the 1968 divisions of the Health Planning Districts were not intended to reflect either topographic or geographic differences (Taylor & Fitzpatrick, 1976), District 5 is markedly different in topography (mountains versus flatlands) and foliage (thick forests versus grasslands) from the other four districts. Van der Leeden (1975), noted that Montana is by nature a dry state. Although rainfall may approach the average as compared with other states, high temperatures, sparse foliage, and high winds eliminate much of the precipitation in the eastern two-thirds of Montana. The study reported an annual average water run-off of one inch or less for this region. In contrast, van der Leeden stated that the western third of the State which is both mountainous and wooded, traps and holds the precipitation. The annual water run-off for this region of the State, Montana Health Planning District 5, exceeds 40 inches annually (Ruffner & Bair, 1987; van der Leeden, 1975). Characteristics of water run-off influence the biologic environment of an area. Depending upon the chemical properties of a pesticide and the hydrogeological aspects of a region, Van Driesche, et al. (1987) stated that certain chemicals and pesticides can leach downward into the groundwater. In areas with limited runoff, these substances remain trapped in the local water source. In areas with high levels of water run-off, chemicals that may have entered the water are partially dispersed into the surrounding territory. Montanans utilize 8.8 million gallons of groundwater for domestic purposes thus potential exposure to these chemicals is high (van der Leeden, 1975).

Wind velocity also influences the physical environment of an area (Van Driesche, et al., 1987). The wind velocities across Montana are frequently above

average as compared to the majority of the U.S. with speeds equal to or in excess of 11 miles per hour (Georesearch, 1987). With this level of wind movement, herbicide drift is of paramount concern to those residing in the vicinity of a spraying operation (Seiber & Woodrow, 1983; Van Driesche, et al., 1987).

According to Ruffner & Bair (1987), prevailing wind directions for the fifth district of Montana are from the southwest and west which take airborne substances away from the region. The fifth district of Montana is mountainous with low wind speeds in the valleys and frequent periods of air stagnation which may inhibit the introduction of airborne toxins into this geographic area (Georesearch, 1987). Figure 4 shows the prevailing wind directions in the Montana Health Planning Districts.

The Montana Central Tumor Registry, the on-going database in Montana since 1979, records the cases of cancer within the State. The Registry data has not been used to document relationships between diagnoses, occupation, and District of residence (Personal communication, Montana Central Tumor Registry, 1989). Since differences in occupation and geographic influences exist between District 5 and the other four Health Planning Districts, these characteristics could be examined in relation to how they may influence cancer incidence in each of the Districts.

Summary

Studies reported in the literature have identified relationships between the constructs of cancer incidence, occupation, and geographic location of the person with cancer. Although several of these studies were conducted in states that are rural and

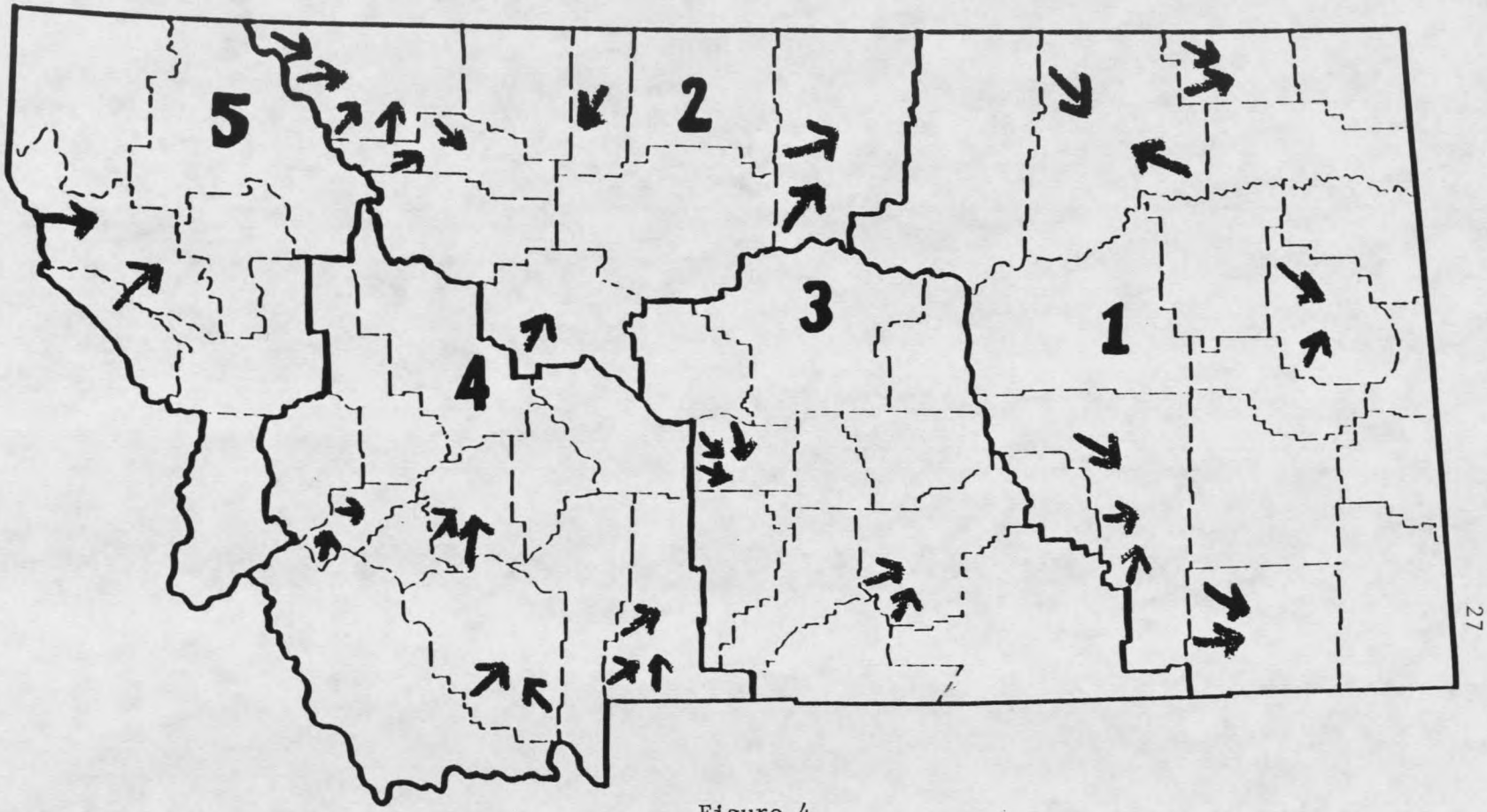

Figure 4

PREVAILING WIND DIRECTIONS
OF THE MONTANA HEALTH PLANNING DISTRICTS
Source: Georesearch, Inc., 1987.

dominated by the occupation of agriculture, none were conducted in Montana. Because Montana is a rural state with cancer incidence rates that exceed the national average for leukemia in men, lymphomas in women, and cancer of the brain, prostate and urinary bladder, there is a need to explore and describe the constructs of cancer incidence, occupation, and geographic characteristics within this State. Exploration and description of these constructs could contribute to future research in determining the relationship between occupational and geographic influences in the incidence of cancer in Montana.

Occupational and geographic characteristics of the five Montana Health Planning Districts showed similarities between four of the Districts. Distinct occupational and geographic differences from the other four Districts existed in the fifth Health Planning District. In the review of literature, differences in occupational and geographic characteristics have been shown to influence the incidence of cancer.

CHAPTER THREE

METHODOLOGY

The purpose of this study was to explore and describe the occupational and geographic differences between the five Montana Health Planning Districts, and to determine their possible influence on the pattern of cancer incidence in the rural state of Montana. Studies in other rural areas have shown that the occupation of a population, such as farming and ranching, and geographic characteristics of an area, such as water runoff and wind patterns, can influence the incidence of cancer. In an attempt to obtain information on occupational and geographic characteristics which may influence the incidence of cancer in Montana, this study explored the occupational and geographic differences between the five Health Planning Districts in the rural state of Montana.

Research Design

The research design for this study was a descriptive epidemiological design. According to Mausner and Kramer, 1985, a descriptive epidemiological design is appropriate for exploring relevant occupational and geographic influences in the development of a disease such as cancer. Information for this study was obtained from data compiled by the Montana Central Tumor Registry (MCTR) on the incidence of cancer in the five Montana Health Planning Districts. Data were compared in the five Health Planning Districts to determine differences in cancer incidence between the five Districts. Information on occupational and geographic characteristics of the five Health

Planning Districts was obtained from compiled existing data on the state of Montana. Due to differences in disease reporting by states and differences in population, occupational, and geographic characteristics, the results of this study cannot be generalized.

Population and Study Setting

The sample population for this study included 2,217 cases of cancer reported to the Montana Central Tumor Registry (MCTR) between January 1, 1986 and December 31, 1988. These 2,217 cases represented five types of cancer including leukemia, lymphomas, and cancer of the brain, prostate and urinary bladder. In 1985, Montana State Law mandated the reporting of all diagnosed cases of cancer by independent laboratories and hospitals. Data used in this study was supplied to the MCTR under this law by 66 hospitals, including the Veterans Administration Hospital, the Northern Rockies Treatment Center and four independent Montana laboratories (Montana Tumor Registry, 1990). The MCTR cited an 80-90% completeness rate in reporting for this data. (Montana Tumor Registry, 1988). Only those types of cancer that were previously shown to be influenced by rural occupational and geographic characteristics were included in this study population of cancer cases.

The setting for this study was the state of Montana which is divided into five Health Planning Districts. Approximately four-fifths of Montana is flat or rolling hills with sparse foliage and dominated by farming and ranching. The remaining area in the fifth Health Planning District, in addition to having few farms or ranches, is

mountainous with thick forests. The primary industries for the fifth District are logging, manufacturing of paper products, and tourism. These distinct differences in occupational and geographic characteristics between the five Health Planning Districts permitted a comparison of cancer incidence between the five Districts.

Study Instrument and Procedure

The data collection instrument for this study was a computer print out provided by the Montana Central Tumor Registry. The computer print out included the total number of cancer cases by year of incidence, type of cancer, and county of residence for each case of cancer. Print outs also included the percent of cancer incidence for the total population of each county for the years 1986 through 1988.

This study was conducted between January 1989 and March 1991. Permission to conduct the study was obtained from the Montana Tumor Registrar (Appendix B). Prior to conducting the study, the yearly Montana Vital Statistics and Tumor Registry Reports for 1986 through 1989 were examined to determine the type and availability of data collected by the Montana Central Tumor Registry (MCTR) on cancer incidence. Following the determination that adequate data was available for the study, a summary of the study proposal was submitted to the Montana State University Human Subjects Review Committee (Appendix C). Complete anonymity was maintained throughout the study because no identifying data was supplied by the MCTR for the 2,217 sample cases. This study was exempted by the Human Subjects Review Committee (Appendix D).

The Montana Central Tumor Registry (MCTR), the on-going database in Montana since 1979, records the incidence cancer cases within the state. Montana State Law provides for the free use of this data which has been accumulated by the State Tumor Registry, providing there is no case identifying information included. In response to a written request for data (Appendix E), computer print outs for the five types of cancer including leukemia, lymphomas, and cancer of the brain, prostate and urinary bladder were received. The computer print outs showed a table for each type of cancer in which incidence was shown in cross-tabs format by county and by year of diagnosis. The computer print out showed a cumulative analysis of 2,217 cases. The years 1986 through 1988 were selected for this study with the assistance of the Tumor Registrar because the recording of these three years was completed. Prior to 1986, reporting procedures were not refined and enforced for complete information.

Data analysis included a description of the occupational and geographic characteristics of the five Montana Health Planning Districts to determine the similarities and differences between the five Districts. The Montana Central Tumor Registry data on cancer incidence for the five types of cancer including leukemia, lymphomas, and cancer of the brain, prostate and urinary bladder included in the study were presented in table form. Tables included the counties in each of the five Health Planning Districts, types of cancer, and year of diagnosis. The five Health Planning Districts were then compared for incidence of the five types of cancer included in the study. In an effort to determine a potential influences of environmental factors on the incidence of cancer, comparisons were made between the four Montana

Health Planning Districts, which have a primary occupation of agriculture and similar geographic characteristics, and the fifth Montana Health Planning District which has primary occupations of tourism and logging, and dissimilar geographic characteristics. A map was drawn for each of the five cancer diagnoses, leukemia, lymphomas, and cancers of the brain, prostate and urinary bladder, to show a more visible record of cancer incidence data received from the MCTR. Data were analyzed by frequency and percent.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

A descriptive epidemiologic design was used in this study to explore and describe occupational and geographic differences between the five Montana Health Planning Districts, and to determine their possible influence on the pattern of cancer incidence in the rural state of Montana. Analyses of data included: a description of the Health Planning Districts in Montana, including occupational and geographic characteristics, and cancer incidence in Montana for the years 1986 through 1988. Information on the occupational and geographic characteristics of the five Health Planning Districts was obtained from compiled existing data on the State of Montana (Bureau of the Census, 1990; Georesearch, 1987; Martin & Meagher, 1989; Murray & Reeves, 1972; Van der Leeden, 1975). Information on cancer incidence in the five Health Planning Districts was compiled by and obtained from the Montana Central Tumor Registry.

Description of Montana Health Planning Districts

Characteristics of the five Montana Health Planning Districts included county composition, population, and primary occupations within each District. Geographic characteristics of wind, water, and water consumption statistics within each District were also included.

Table 1 shows the county composition of each Health Planning District in Montana. District 1, located in the eastern portion of the state was the largest

geographic area with a total of 17 counties. District 5 was the smallest area with a total of seven counties. Districts 2, 3, and 4 were approximately the same size with nine to 12 counties in each of these Districts. Of the five Districts, District 1 was the most rural.

Table 1. Montana Health Planning Districts by County, 1986.

District 1	District 2	District 3	District 4	District 5
Carter	Blaine	Big Horn	Beaverhead	Flathead
Custer	Cascade	Carbon	Broadwater	Lake
Daniels	Choteau	Fergus	Deerlodge	Lincoln
Dawson	Glacier	Golden Valley	Gallatin	Mineral
Fallon	Hill	Judith Basin	Granite	Missoula
Garfield	Liberty	Musselshell	Jefferson	Ravalli
McCone	Pondera	Petroleum	Lewis & Clark	Sanders
Phillips	Teton	Stillwater	Madison	
Powder River	Toole	Sweet Grass	Meagher	
Prairie		Wheatland	Park	
Richland		Yellowstone	Powell	
Roosevelt			Silver Bow	
Rosebud				
Sheridan				
Treasure				
Valley				
Wibaux				

Source: Bureau of Records and Statistics, 1988 January.

Table 2 shows the estimated total population of each Health Planning District in 1986 by number and percent. District 1, which covers the largest geographic area, had the smallest population percentage (12.3 percent) of the five Health Planning Districts. District 5, which covered the smallest geographic area, had the largest population percentage (25.9 percent). The population percentage of Districts 2, 3, and 4 varied from 17.4 to 23.2 percent. The estimated total State population for 1986 was 818,800. Nationally, Montana ranks fourth in size and forty-third in total population size (Bureau of the Census, 1991). The 1986 population estimates were selected for this study because they represented the closest approximation to the population for Montana at the time the cancer incidence statistics were compiled. The 1980 U.S. Census figures varied from the 1986 estimates by a minimum of 2.5% for the 1980 figures for District 3 to a maximum of 10.2% for the 1980 figures for District 1. The 1990 U.S. Census figures varied from the 1986 estimates by a minimum of 0.5% for District 5 to a maximum of 13% for District 1. The figures for the 1980 and 1990 census were sometimes higher than the 1986 estimates and sometimes lower than the 1986 estimates. Since there was no consistency in the variations, the choice to use the 1986 estimates was at the discretion of the researcher. The population of the Health Planning Districts was used to figure cancer incidence rates within each district.

Table 2. Montana Health Planning Districts by Number, Population and Percent, 1986.

Health Planning District	Population 1986	Percent of Total Population
1	101,000	12.3%
2	142,400	17.4%
3	173,400	21.2%
4	189,700	23.2%
5	212,300	25.9%
Total State Population	818,800	100%

Source: Martin, D., & Meagher, T. (1989)

Table 3 shows the composition of primary occupational categories reported for Montana as defined by the County Business Patterns of the U.S. Bureau of the Census (1990). Montana is considered to be a rural agricultural state. Agriculture was the primary occupation in 45% of all counties in Montana and it was the primary occupation in Districts 1, 2, and 3 (Martin & Meagher, 1989). Services and retail sales covered a multiplicity of professions associated with tourism, another major industry in Montana. The dominant occupational category for District 4 was the service industry. Services and retail trade also included occupations common to most populated areas in the United States, such as education and health care. Manufacturing was a dominant occupation in District 5 and included various occupations in the logging industry. Mining was included because it has been the only other epidemiological study in

Table 3. Occupational Categories in Montana by Type of Occupation, 1986 and 1987.

Agriculture	Services	Manufacturing	Retail	Mining
Crop Services	Hotels & Lodging	Food Products	Home & Garden	Metal Mining
Farm Labor	Personal Services	Textile Products	General Materials	Bitum. Coal
Farm Mgmt	Business Services	Apparel & Textiles	Food Stores	Oil & Gas
Soil Preparation	Auto Services & Garages	Logging & Mills	Auto Dealer Service Stations	Non-Metal Mining
Landscape & Horticulture	Misc. Repair Services	Furniture	Apparel Stores	
Veterinary Services	Motion Pictures	Paper & Paper Prod.	Home Furnishing	
	Amusements Recreational Services	Printing & Publishing	Eating & Drinking Places	
	Health Services	Chemical Products	Misc. Retail	
	Legal Services	Petroleum & Coal Prod.		
	Educational Services	Rubber & Plastics		
	Social Services	Leather Products		
	Museums, Botanical & Zoological Gardens	Stone, Clay & Glass Products		
	Membership Organization	Primary Metal Industry		
	Misc. Services	Fabricated Metal Prod.		
		Machinery, non-Electric		

Source: Martin & Meagher, 1989.

Montana concerned with occupational influences on cancer incidence (Newman, Archer, Saccomanno, Kuschner, Auerbach, Grondahl, & Wilson, 1976; Warren, Rogers, Medvec, & Roach, 1979).

Table 4 shows the total number of persons who reported employment in Montana by District in 1986 (Meagher & Martin, 1989). The Census and Economic Information Center in Helena, Montana registered employment for 50% (406,700) of the total population in Montana. However, these figures have the limitation of frequently not reporting employment by a spouse or dependent child in a family operation such as a farm or ranch. A 1980 national survey of American farm women (Jones and Rosenfeld, 1981) emphasized the significance of this limitation. All five of the Montana Health Planning Districts reported approximately 50 percent employment of the total population in each District.

Table 4. Employment in Montana by Total Population and by District, 1986.

Health Planning District	District Population	Number Employed
1	101,000	49,094
2	142,400	72,164
3	173,400	89,212
4	189,700	97,258
5	212,300	98,972
State Total	818,800	406,700

Source: Martin, D., & Meagher, T. (1989).

Table 5 shows the average county percentage of persons employed in the five Health Planning Districts for each of the five occupational categories. The five occupational categories in this table represented 28% (227,131) of the total population for Montana in 1986. The five occupational categories represented 56% of all those employed in Montana in 1986. Of the five occupational categories, the majority of employment (25 percent) in agriculture was in District 1 and 3. District 5 had the lowest employment in agriculture (8 percent).

Table 6 shows the topographic characteristics in each of the five Montana Health Planning Districts. Districts 1, 2, and 3 were almost identical with plains and grasslands predominating. District 4 featured both mountains and grasslands. District 5 was covered by a series of mountain ranges. Although small mountainous to hilly ranges extended into Districts 1, 2, and 3, these topographic features tended to be isolated and did not dominate these districts.

Table 5. Primary Occupational Employment in Montana by District, 1986.

Health Planning District	Agriculture	Services	Manu-facturing	Retail Trade	Mining
1	25%	15%	12%	2%	3%
2	21%	20%	14%	2%	2%
3	25%	18%	15%	3%	2%
4	12%	19%	16%	5%	2%
5	8%	20%	17%	14%	<1%

Source: Martin, D., & Meagher, T. (1989).

Table 6. Topographic and Ground Cover Characteristics of Montana by District, 1984.

Health Planning District	Topography of the District	Predominant Ground Cover
1	Plains/Grasslands	Crops/Grass/Brush
2	Plains/Grasslands	Crops/Grass/Brush
3	Plains/Grasslands	Crops/Grass/Brush
4	Grasslands/ Mountains	Crops/Grass/Brush Areas of Woods
5	Mountainous	Heavily Wooded/ Areas of Crops/ Areas of Brush

Source: Facts on File. (1984).

Crops, grass, and brush were the predominant ground cover in Districts 1, 2, and 3. District 5 was predominantly wooded. District 4 had a variety of ground cover.

Table 7 describes the average wind velocity for Montana by District. The average wind velocity varied from a maximum of 12 miles per hour (mph) in District 2 to a minimum of 5.5 mph in District 5. The wind directions varied across Montana with winds from the southwest and west predominating. Many areas of Montana exceeded the average wind velocities found in other areas of the U.S. (Georesearch, 1987). District 5 had many parallel mountain ranges with deep valleys between them. These valleys lie perpendicular to the prevailing wind directions. The wind speeds in these valleys are generally low due to the depth and narrowness of the valleys and the prevailing wind directions. Due to the factors of wind direction and the depth and

narrowness of the valleys, periods of air stagnation are common in District 5 (Georesearch, 1987).

Table 7. Wind Characteristics of Montana by District, 1987.

Health Planning District	Average Wind Velocity
1	10.3 mph
2	12.0 mph
3	8.8 mph
4	11.1 mph
5	5.5 mph

Source: Georesearch, Inc. (1987).

Table 8 shows the average annual water run-off in Montana by district. Water run-off remained relatively consistent from year to year. Districts 1, 2, and 3 were very dry with an average water run-off of 0-1 inch per year. District 4 had a water run-off of 5-20 inches per year due to increased vegetation and wooded mountainous areas which support many rivers and streams. District 5 had a water run-off which exceeded 40 inches per year. This water run-off results from thick vegetation, mountainous terrain, and numerous rivers, streams and lakes. The water run-off in District 5 was two to four times the water run-off of District 4, and up to 40 times the water run-off of the other three Districts.

Table 8. Average Annual Water Run-off in Montana by District, 1975.

Montana Health Planning District	Inches Per Year
1	0-1
2	0-1
3	0-1
4	5-20
5	over 40

Source: Van der Leeden, F. (1975).

Table 9 shows the domestic water consumption in Montana for 1975. The Montana population consumed over 11 times as much groundwater as surface water. This finding supported other research findings that 90-95 percent of all domestic water consumption in rural populations comes from groundwater (Moses 1989; Mott & Snyder, 1988).

Table 9. Domestic Water Usage in Montana, 1975 [In million gallons per day].

Total Population Served	Domestic Use			
	Water Withdrawn			Total Water Consumed (Percent)
	Ground	Surface	All	
799,000	8.8	.7	9.5	100%

Source: Van der Leeden, F. (1975).

Cancer Incidence in Montana 1986-1988

The incidence of the five types of cancer addressed in this study, leukemia, lymphoma, prostate, brain and bladder cancer, as reported to the Montana Central Tumor Registry from January 1, 1986 through December 31, 1988, are shown in Tables 10 through 14. Cancer incidence statistics for these five types of cancer were reported by county in data supplied by the Montana Central Tumor Registry. Analysis of the cancer incidence data was done for each of the five types of cancer and reported as composite data for the counties in each of the five Montana Health Planning Districts. Data did not differentiate between cancer incidence for men and cancer incidence for women. Each of the cancer incidence tables shows the number of cases that occurred in each Planning District for 1986-1988, the percent of total state incidence for the years 1986-1988, and the average incidence of each specific type of cancer per 100,000 population per year over a three-year period.

Table 10 shows the incidence of leukemia in Montana from 1986-1988. The total number of reported cases was 256. The highest incidence of leukemia was found in Districts 1 and 2. The lowest incidence of leukemia was found in District 5. The incidence of leukemia in Districts 1, 2, 3, and 4 exceeded the incidence of leukemia in District 5 by as little as 54 percent in District 3 and as much as 87 percent in Districts 1 and 2 per 100,000 population. Figure 5 shows the distribution of leukemia incidence for each of the five Health Planning Districts.

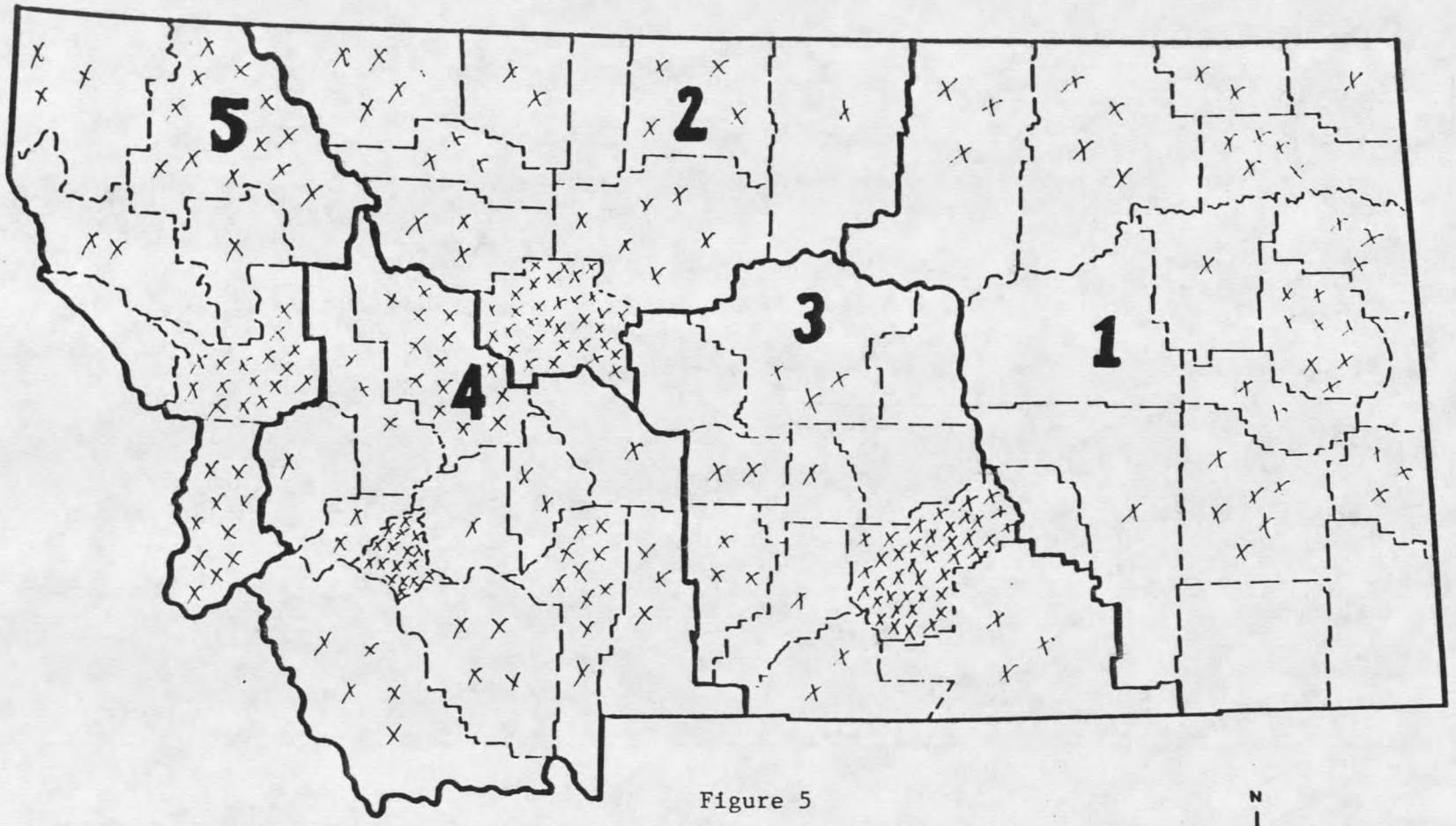

Figure 5

LEUKEMIA INCIDENCE IN THE
MONTANA HEALTH PLANNING DISTRICTS, 1986-1988.
Source: Montana Central Tumor Registry, 1991.

Table 10. Incidence of Leukemia in Montana by District, 1986-1988.

Health Planning District	Gross Incidence 1986-1988	Percent of Total State Incidence 1986-1988	Incidence Per 100,000 Population Per Year
1	39	15.2%	12.9
2	55	21.5%	12.9
3	55	21.5%	10.6
4	63	24.6%	11.1
5	44	17.2%	6.9
Total Cases 1986-1988 = 256			

Source: Montana Central Tumor Registry, 1990.

Table 11 shows the incidence of lymphoma in Montana from 1986-1988. The total number of reported cases was 287. The highest incidence of lymphoma was found in District 3. The lowest incidence of lymphoma was found in District 5. The incidence of lymphoma in Districts 1, 2, 3, and 4 exceeded the incidence of lymphoma in District 5 by as little as 51 percent in District 2 and as much as 97 percent in District 3 per 100,000 population. Figure 6 shows the distribution of lymphoma incidence for each of the five Health Planning Districts.

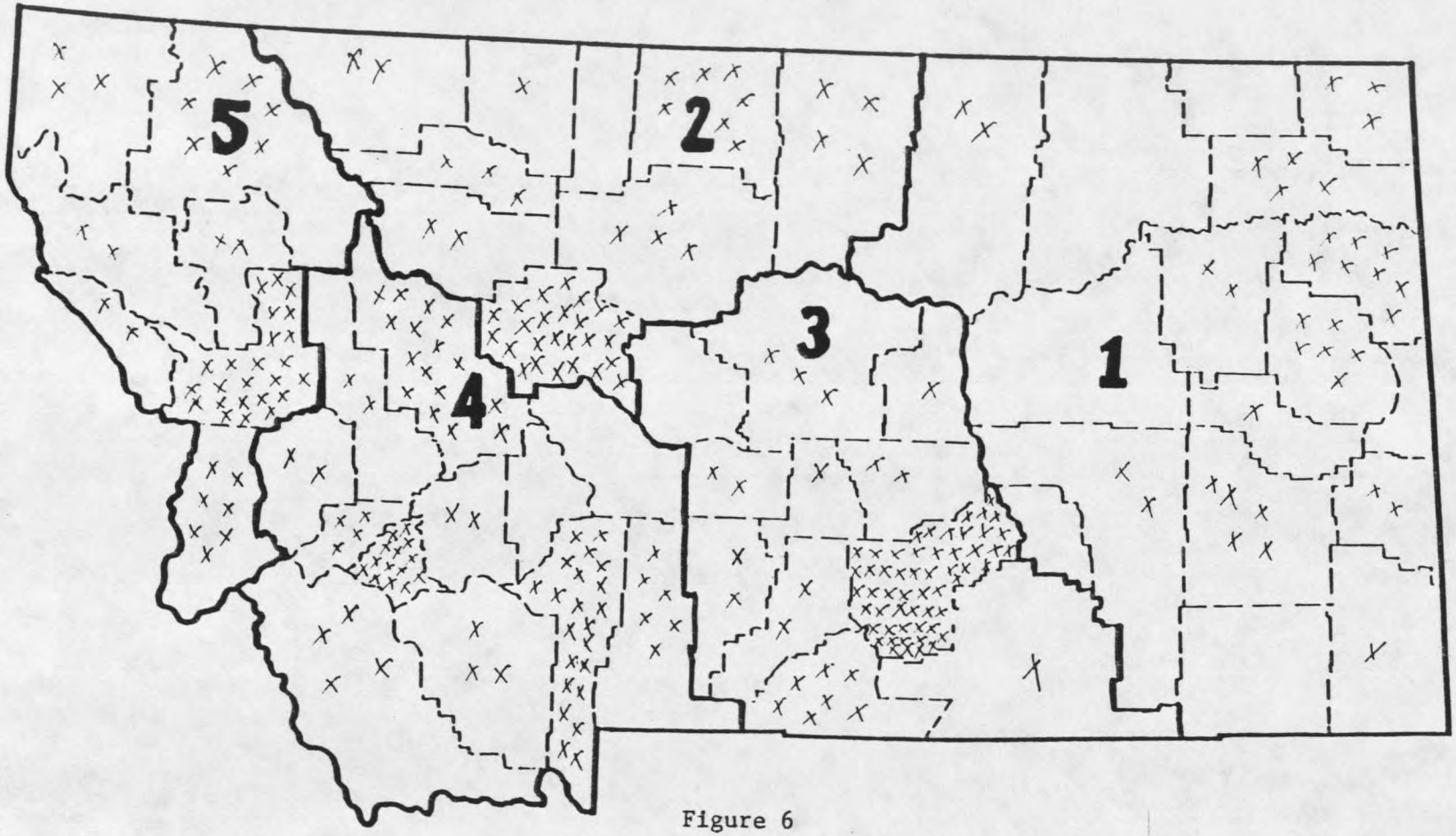

Figure 6

LYMPHOMA INCIDENCE IN THE
MONTANA HEALTH PLANNING DISTRICTS, 1986-1988
Source: Montana Central Tumor Registry, 1991.

Table 11. Incidence of Lymphoma in Montana by District, 1986-1988.

Health Planning District	Gross Incidence 1986-1988	Percent of Total State Incidence 1986-1988	Incidence Per 100,000 Population Per Year
1	41	14.3%	13.5
2	48	16.7%	11.2
3	76	26.5%	14.6
4	75	26.1%	13.2
5	47	16.4%	7.4
Total Cases 1986-1988 = 287			

Source: Montana Central Tumor Registry, 1990.

Table 12 shows the incidence of brain cancer in Montana from 1986-1988. The total number of reported cases was 162. The highest incidence of brain cancer was found in District 2. The lowest incidence of brain cancer was found in District 4. The incidence of brain cancer was 69 percent more per 100,000 population in District 2 than in District 4 where the incidence was the lowest. Of the five types of cancer described in this study, brain cancer showed the least variation in incidence from District to District. Of the five types of cancer reported, brain cancer was the only one that did not show the lowest incidence in District 5. The incidence of brain cancer in District 5 exceeded the incidence of brain cancer in District 1 and District 4. Figure 7 shows the distribution of brain cancer incidence for each of the five Health Planning Districts.

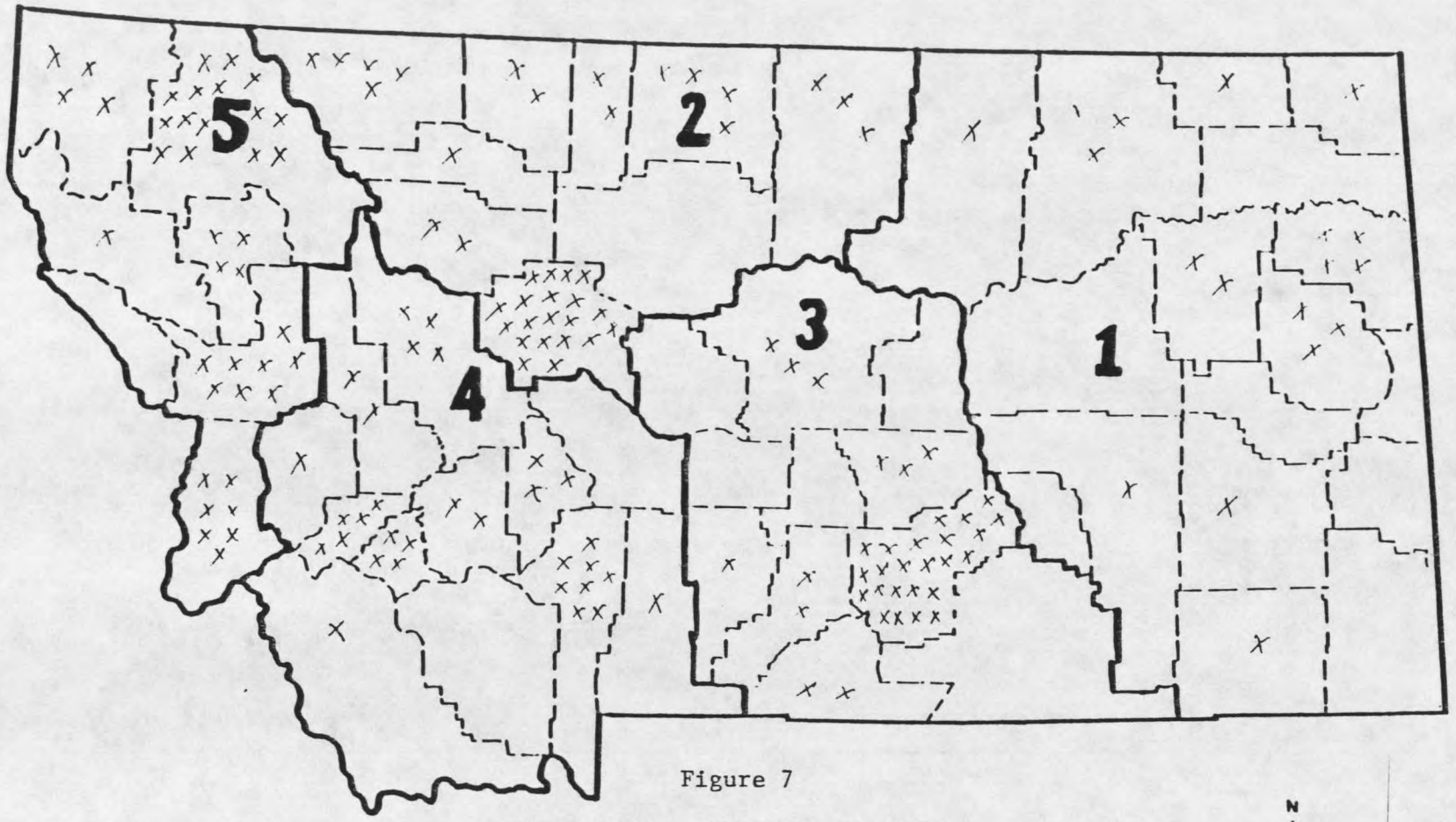

Figure 7

BRAIN CANCER INCIDENCE IN THE
MONTANA HEALTH PLANNING DISTRICTS, 1986-1988
Source: Montana Central Tumor Registry, 1991.

Table 12. Incidence of Brain Cancer in Montana by District, 1986-1988.

Health Planning District	Gross Incidence 1986-1988	Percent of Total State Incidence 1986-1988	Incidence Per 100,000 Population Per Year
1	18	11.1%	5.9
2	39	24.1%	9.1
3	35	21.6%	6.7
4	31	19.1%	5.4
5	39	24.1%	6.1
Total Cases 1986-1988 = 162			

Source: Montana Central Tumor Registry, 1990.

Table 13 shows the incidence of prostate cancer in Montana from 1986-1988. The total number of reported cases was 1083. The highest incidence of prostate cancer was found in District 3. The lowest incidence of prostate cancer was found in District 5. The incidence of prostate cancer in Districts 1, 2, 3, and 4 exceeded the incidence of prostate cancer in District 5 by as little as 3 percent per 100,000 population in District 1 and as much as 47 percent per 100,000 population in District 3. Figure 8 shows the distribution of prostate incidence for each of the five Health Planning Districts.

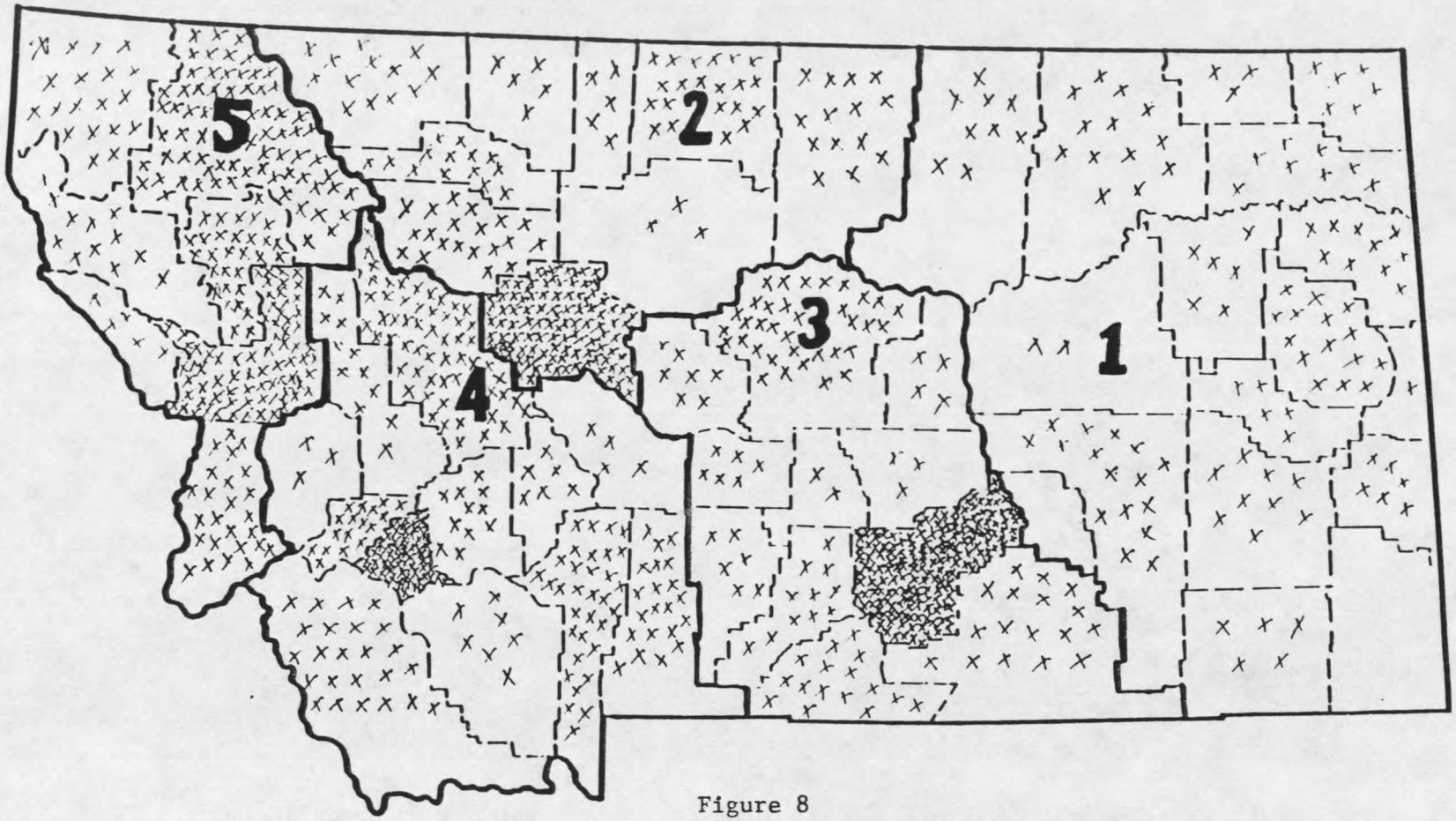

Figure 8

PROSTATE CANCER INCIDENCE IN THE
MONTANA HEALTH PLANNING DISTRICTS, 1986-1988
Source: Montana Central Tumor Registry, 1991.

Table 13. Incidence of Prostate Cancer in Montana by District, 1986-1988.

Health Planning District	Gross Incidence 1986-1988	Percent of Total State Incidence 1986-1988	Incidence Per 100,000 Population Per Year
1	114	10.5%	37.6
2	203	18.7%	47.5
3	280	25.9%	53.8
4	252	23.3%	44.3
5	234	21.6%	36.7
Total Cases 1986-1988 = 1083			

Source: Montana Central Tumor Registry, 1990.

Table 14 shows the incidence of urinary bladder cancer in Montana from 1986-1988. The total number of reported cases was 429. The highest incidence of urinary bladder cancer was found in District 2. The lowest incidence of urinary bladder cancer was found in District 5. District 1 exceeded District 5 in incidence of urinary bladder cancer by only 5 percent per 100,000 population. However, District 2 exceeded District 5 in bladder cancer incidence by 59 percent per 100,000 population. Figure 9 shows the distribution of bladder incidence for each of the five Health Planning Districts.

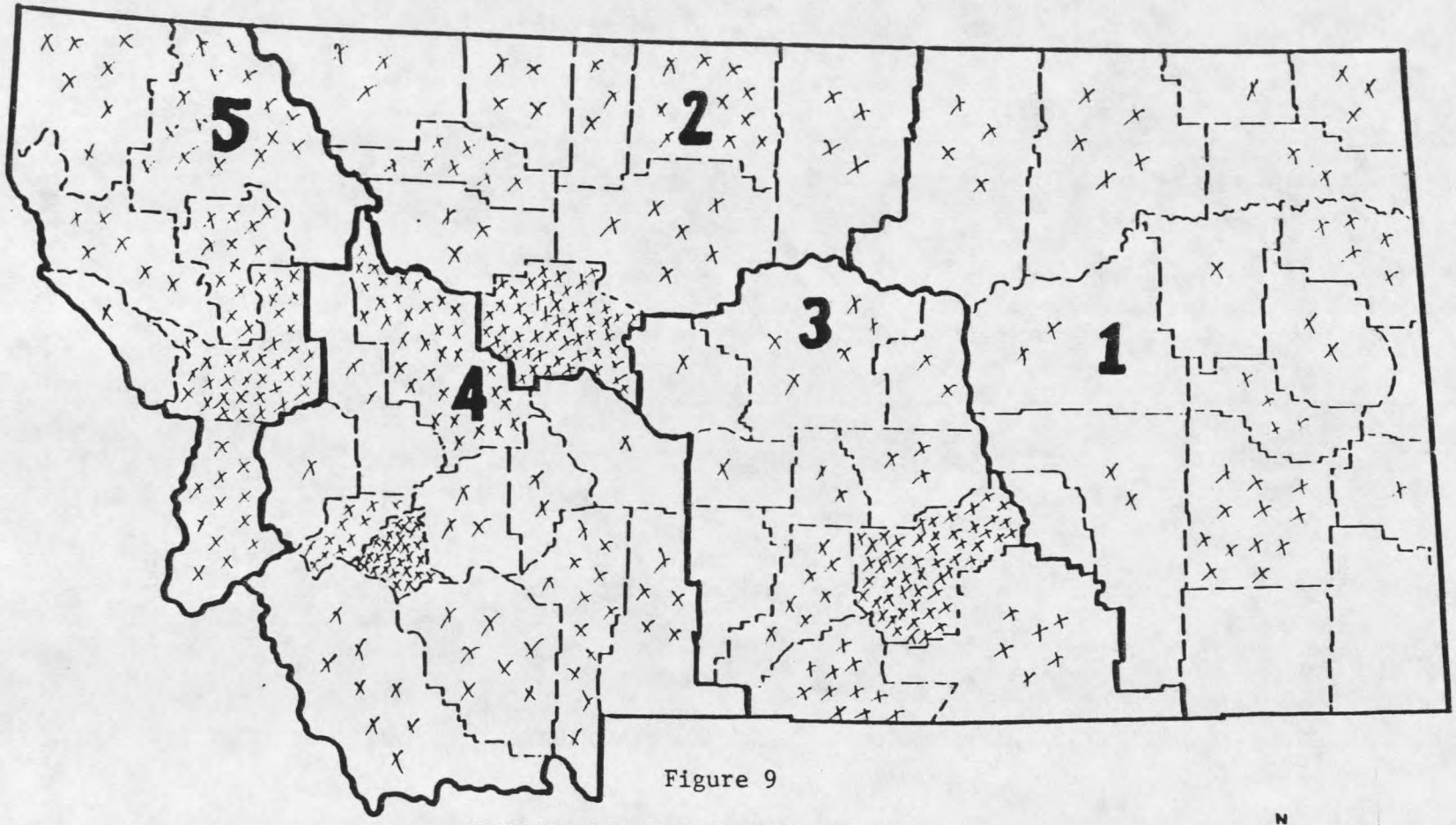

Figure 9

BLADDER CANCER INCIDENCE IN THE
MONTANA HEALTH PLANNING DISTRICTS, 1986-1988.
Source: Montana Central Tumor Registry, 1991.

Table 14. Incidence of Bladder Cancer in Montana by District 1986-1988.

Health Planning District	Gross Incidence 1986-1988	Percent of Total State Incidence 1986-1988	Incidence Per 100,000 Population Per Year
1	44	10.2%	14.5
2	93	21.7%	21.8
3	91	21.2%	17.5
4	114	26.6%	20.0
5	87	20.3%	13.7
Total Cases 1986-1988 = 429			

Source: Montana Central Tumor Registry, 1990.

Data Interpretation

Districts 1, 2, and 3 of the five Montana Health Planning Districts showed the most similarities in occupational and geographic characteristics. The population of these three Districts represented approximately 51 percent of the total population in Montana during 1986. Approximately 52 percent of the residents of Montana who were registered as employed in 1986 with the Montana Census and Economic Information Center resided in Districts 1, 2, and 3. The primary occupation in these three Districts was agriculture which employed an average of 21-25 percent of the population in the counties represented by these Districts.

The geographic characteristics for Districts 1, 2, and 3 were almost identical. The topography of these three Districts was primarily plains and grasslands. Districts

2 and 3 had several low mountain ranges. Districts 1 had one small, isolated mountain range, District 4 was partially mountainous, while District five was totally mountainous. The winds in these three Districts varied slightly with an average velocity of 10.3 mph in District 1, 12.0 mph in District 2, and 8.8 mph in District 3. The prevailing wind directions varied also within the individual District. In an agricultural environment like Montana, velocity and direction of the wind effect drift in the aerial application of agri-chemicals. Drift is the distance that particles, such as chemicals and water droplets, travel using air currents. The introduction of chemicals into a District by drift may influence cancer incidence in that District.

The geographic characteristics for District 5 included a topography which was mountainous and heavily wooded. The average wind velocity in District 5 was the lowest of the five Districts at 5.5 mph. Due to the orientation and the depth of the valleys, and the prevailing wind directions which run perpendicular to the valleys, minimal winds and periods of air stagnation are not uncommon to this District. These periods of air stagnation potentially would effect airborne transport of agri-chemicals in one of two ways. If the agri-chemicals were introduced into this area through crop dusting within District 5, they would tend to remain there. However, due to the topography of the region and these periods of air stagnation, agri-chemicals from outside District 5 would be unlikely to be carried by drift into the area.

Districts 1, 2, and 3 were much more arid than Districts 4 and 5. Water run-off was minimal. The average water run-off in Districts 1, 2, and 3 was only 0-1 inch per year. District 5 was characterized by many streams, rivers, and lakes. This

district had the highest water run-off of the five Montana Health Planning Districts. District 5 exceeded the water run-off for the other five Districts by four to 40 times with a water run-off of more than 40 inches per year.

When looking at the moisture level in District 4, again similarities with all four of the other Districts could be seen. Depending on where the readings were taken in this District, the water run-off could vary from 5-20 inches annually. Although this was only one-half to one-eighth the run-off in District 5, it was five to 20 times the run-off in districts 1, 2, and 3.

District 4 had characteristics in common with all four of the other Districts. The population in District 4 accounted for 23 percent of the total population in Montana in 1986. The three predominant occupational categories in this District were services, manufacturing, and agriculture. District 4 which is the gateway to Yellowstone National Park, shared many of the same tourism occupations seen in District 5. However, the third leading industry for this District was agriculture, which accounted for 12 percent of this District's employment. The concentration of agriculture in this District showed similarities to Districts 1, 2, and 3.

The geographic characteristics for District 4 also showed similarities to each of the other four Districts. Like Districts 1, 2, and 3, portions of District 4 had crops and grasslands with mountains similar to District 5. The winds in District 4, however were neither minimal nor stagnant, with an average annual wind velocity of 11.1 mph. The prevailing wind direction for this District was from the southwest and has been shown to be one of the highest in the State (Georesearch, 1987). The high winds in

District 4 could increase the potential spread of airborne substances which may influence the incidence of cancer in this District.

Cancer incidence for Districts 1, 2, and 3 varied according to which type of cancer was addressed. For each of the five types of cancer, the highest incidence in the State was found in one of these three Districts. The highest incidence of leukemia per 100,000 population was found to be in Districts 1 and 2. Both of these Districts had a leukemia incidence of 12.9 per 100,000 population. The highest incidence of lymphomas was in District 3 with 14.6 percent per 100,000 population. District 2 had the highest incidence of brain cancer for the State at 9.1 per 100,000 population. District 3 had the highest incidence of prostate cancer with 53.8 percent per 100,000 population. The highest incidence of urinary bladder cancer was found in District 2 with 21.8 per 100,000 population.

The cancer incidence in District 4 again tended to fall between the incidence for the other four Districts. The lowest incidence of brain cancer in Montana was in District 4, with an incidence of 5.4 percent per 100,000 population. District 5 ranked third for incidence of lymphomas at 13.2 percent per 100,000 population, and third for prostate cancer with an incidence of 44.3 percent per 100,000 population. Finally, District 4 ranks second among the districts for incidence of leukemia, 11.1 percent per 100,000 population, and second for urinary bladder cancer with an incidence of 20.0 per 100,000 population.

District 5 had more diversity in cancer incidence than the other four Districts. The population of this District represented 26 percent of the total population in

Montana in 1986. District 5 employed 24 percent of the population registered as employed in Montana for 1986. The three predominant occupational categories for this district were services, manufacturing, and retail trade. Occupations included in the service category were lodging, entertainment, and food services which are primary elements of the tourism industry. Included in the manufacturing category were logging, mills, and the paper industry which were common trades to this District. The category of retail trade covered the marketing of goods for both tourism and logging. Agriculture accounted for an average of eight percent of the employment in the counties of this District.

Cancer incidence figures for District 5 were not consistent for the five types of cancer described in this study. Although cancer incidence rates for leukemia, lymphomas, prostate cancer, and urinary bladder cancer were found to be the lowest in District 5, brain cancer ranked third for incidence in this District. The incidence of brain cancer in District 5 was 6.1 percent per 100,000 population as compared with the high of 9.1 percent per 100,000 population in District 2 and the low of 5.4 percent per 100,000 population in District 4. This incidence of brain cancer was within one case per 100,000 population of the incidence reported in three out of the four remaining Districts and within three cases per 100,000 population of the incidence reported in District 2 where brain cancer showed the highest incidence.

Summary

Health Planning Districts 1, 2, and 3 shared similarities in both environmental influences of occupation and geographic characteristics and in cancer incidence. These three Districts had the same primary occupation of agriculture and similar geographic characteristics for topography, wind, and water. The incidence of cancer was similar in these three Districts with the highest incidence of each of the five types of cancer, leukemia, lymphoma, brain, prostate and bladder cancer, having occurred in one of these three Districts. Health Planning District 5 was totally dissimilar to Districts 1, 2, and 3. The primary occupations in District 5 were services and manufacturing. In comparison with Health Planning Districts 1, 2, and 3, District 5 had completely opposite geographic characteristics, such as mountains instead of grasslands, and 40 times the water run-off as was found in Districts 1, 2, and 3. Cancer incidence in District 5 had the lowest incidence of all types of cancer, with the exception of brain cancer in which this District ranked third. Health Planning District 4 shared some similar occupational and geographic characteristics with all four of the other Districts. Cancer incidence reported for District 4 tended to fall in the middle ranges, with the exception of brain cancer which showed the lowest incidence in this District.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This study was conducted to explore and describe occupational and geographic differences between the five Montana Health Planning Districts and to determine their possible influence on the pattern of cancer incidence in this State. The researcher's motivation for conducting this study was to gain information on what occupational and geographic influences may have resulted in a higher incidence of specific types of cancer in certain areas of Montana. Determination of potential occupational and geographic influences on the incidence of cancer in Montana provided further insight into this problem.

The conceptual framework utilized for investigation of potential occupational and geographic influences on cancer incidence in Montana was the Wheel Model of Man and Environmental Interaction (Mausner & Kramer, 1986). The Wheel Model is an epidemiological framework used to study patterns of disease in human population groups. This Model focused on the concepts that the three environments, physical (geographic factors), biological (occupation), and social (occupational safety and State laws), influence the incidence of disease in a population.

Existing data on the five Montana Health Planning Districts was investigated to determine occupational and geographic characteristics and the incidence of five types of cancer in each District for the years 1986-1988. Data obtained were analyzed by

number and percent to determine occupational and geographic patterns which might indicate an influence on the incidence of cancer in a particular District.

Final data from each of the five Montana Health Planning Districts was described in table format. The highest incidence of leukemia, lymphoma, brain cancer, prostate cancer and bladder cancer was found to occur in District 1, 2, and 3. The primary occupational influence in all three of these Districts was agriculture. The geographic influences common to all three of these Districts were primarily flat open terrain, high cross-winds, and minimal water run-off.

The lowest cancer incidence rates for leukemia, lymphoma, prostate cancer and bladder cancer were found in Health Planning District 5. This District showed the third highest incidence of brain cancer of the five Health Planning Districts. The primary occupations in this District were services and manufacturing. These occupational categories included jobs associated with tourism and logging which were the predominant industries in District 5. The geographic characteristics common to this District were in sharp contrast to Districts 1, 2, and 3, with mountainous terrain, low or stagnant wind activity, and high water run-off.

The occupational and geographic characteristics, and the incidence of cancer in Health Planning District 4 showed similarities to all four of the other Districts. The primary occupations in this District included both the tourism industry (services) and agriculture. The geographic characteristics included both mountains and grasslands, high winds, and a water run-off midway between that of Districts 1, 2, and 3, and the water run-off in District 5. The cancer incidence for District 5 also showed falling

between the figures for the other four Districts, with the exception of incidence of brain cancer. District 4 had the lowest incidence of brain cancer for the five Health Planning Districts.

The researcher concluded that the occupational and geographic characteristics found in the five Montana Health Planning Districts showed a pattern which coincided with patterns of cancer incidence for leukemia, lymphoma, brain cancer, prostate cancer and bladder cancer. The finding that the incidence of brain cancer showed some variation from the pattern seen for the other four types of cancer in Districts 4 and 5 is of interest. Determination of why this pattern varied is beyond the scope of this study.

Findings in this study supported the findings of Milham (1971; 1976), Donham, et al. (1980), Burmeister (1981), and Brownson, et al. (1990), who found an increase of leukemia, lymphoma, and cancers of the brain, prostate and bladder in rural states with a primary occupation of agriculture. The study also supported studies by Warren (1967), Kmet & Mahboubi (1972), Hammond (1974), and Warren, et al. (1978), who concluded that geographic characteristics of wind, water, and topography have an influence on the incidence of disease. Finally, this study supported the findings of the Montana Central Tumor Registry (MCTR) report for the years 1979-1981 that showed an elevated incidence of leukemia, lymphoma, cancer of the prostate and cancer of the bladder which were higher in Districts 1, 2, 3, and 4 than in District 5. However, this study differed from the findings of the MCTR for the years 1979-1981 for brain cancer. The MCTR report for the years 1979-1981 showed the incidence of brain

cancer to be lowest in District 5. Incomplete reporting during the MCTR development stages could account for the differences. This study showed an incidence of brain cancer which was third highest in District 5 as compared with the other four Districts.

Implications for Nursing Practice

This study showed similar patterns of occupational and geographic characteristics for three of the five Montana Health Planning Districts. These same three Districts also showed similar patterns of cancer incidence. These findings appear to supported the theory that factors in the environment may influence the incidence of a disease, such as cancer. Identification of environmental characteristics and patterns of cancer incidence in the five Health Planning Districts in Montana was the first step in the epidemiologic process of determining risk factors in cancer incidence for the State.

This first step epidemiological study provided knowledge of the incidence of cancer, and the occupational and geographic characteristics of each of the five Montana Health Planning Districts. Successive studies using the epidemiologic process are needed to determine a cause and effect relationship for cancer in the five Montana Health Planning Districts. Nurses are health professionals who can use the information provided by this study as the foundation for further research on cancer incidence in Montana. Further research will need to follow the epidemiologic process of analysis and testing to determine the causes, characteristics, and development of cancer in the five Districts. Knowledge of the causes, characteristics, and development

of cancer in Montana can then be added to the knowledge of cancer incidence in the State which was provided by this study. Knowledge gained from each step in the epidemiologic process will provide information on which to base the assessment, planning, and implementation of adequate prevention programs and services in the five Health Planning Districts of Montana.

Assessment, planning, and implementation of health education programs and services community health nurses is based on an awareness of the risk factors influencing the incidence of disease in the community. Awareness of the risk factors allows the community health nurse to assist clients and communities to a healthier future. A healthier future for clients and communities would include disease prevention, health promotion and health maintenance. Disease prevention begins with assessment of the community as clients. The communities identified in this study were the five Montana Health Planning Districts.

Using the knowledge of cancer incidence and occupational and geographic characteristics described in this study for a specific District, the community health nurse could assess the potential level of risk for incidence of leukemia, lymphoma, or cancer of the brain, prostate, or bladder within that District. Assessment of the risk to that District would allow for planning of community health education programs to meet deficits in knowledge within the community. Through community education, the nurse could facilitate disease prevention and health promotion and maintenance by promoting awareness of environmental influences on health. Programs could include: (1) occupational risk factors associated with primary occupations in the District, such

as hazards of the use and application of agri-chemicals (2) geographic characteristics of the District and how these affect health risks (3) and methods to minimize the environmental impact of primary occupations in the District, such as proper storage and disposal of used chemical containers.

Prevention and promotion of health through education of communities to environmental influences on health in the rural state of Montana should address the needs of clients at various income levels and in a variety of settings. Community health education in the Health Planning Districts of Montana should include: (1) knowledge of the risk factors endemic to each District which influence the incidence of disease in that District (2) awareness of occupational influences on disease (3) economic advantages of disease prevention versus disease treatment in an agricultural environment, (3) importance of prevention and health promotion in reducing the overall cost of health care, and (4) encouragement of routine health maintenance and assistance to obtain it locally.

Health promotion in a rural community needs to recognize that expenditure of time and distances to education, which may interfere with the operation of a farm or ranch, could prohibit clients from attendance and participation. To encourage rural communities to participate in community health education, teaching must be provided at a time when it does not conflict with farm and ranch operation. Educational programs also need to be at a convenient location, such as the local church or meeting hall (Weinert & Long, 1987). Nurses and community health educators must be

familiar with the culture of the communities they serve if they want to successfully promote health practices.

Knowledge of existing health practices and the existing health care system in a community are also invaluable in determining how to successfully present new information to promote health. Research has shown that most rural populations will seek the advice of an established health care provider in their community over any newcomer offering information (Weinert & Long, 1987). If a community health educator wants to familiarize an agricultural community with health risk factors associated with agriculture, entry to the community through an established health care provider in the community is highly advised.

The community health nurse can promote health in the community locally through community education, regionally through dissemination of research findings at the District or State level, and federally by dissemination of information through senators and representatives. Dissemination of information could result in increased awareness of health risks at all levels, increased funding for health related research and health care, changes in occupational practices, and legislation to protect against environmental pollution. Improvements in occupational safety standards and protection of agricultural workers from occupational risks could also result from dissemination of information. Community education and dissemination of research information at the local, District, State and federal level are appropriate interventions by community health nurses to advance disease prevention, health promotion and maintenance in rural populations like Montana.

This study was the first step in determining potential occupational and geographic environmental risk factor which may influence the incidence of cancer in the five Montana Health Planning Districts. Research which definitively establishes such influences is needed before rural communities can be approached to alter behaviors which may threaten the health of residents.

Recommendations for Further Research

Several recommendations for further research are suggested:

(1) Replication of this study to determine whether findings of cancer incidence in the five Montana Health Planning Districts has changed since 1988.

(2) Further investigation of potential health hazard influences in the agricultural environment of Montana, such as pesticide usage and water purification practices, to determine relationships which could explain influences on cancer incidence in Montana.

(3) Investigation to determine what agri-chemicals are used in the Health Planning Districts of Montana in order to plan and institute safety measures in their application.

(4) Further utilization of the epidemiological Wheel Model to guide the investigation of occupational and geographic influences on cancer incidence in the Montana Health Planning Districts.

(5) Investigation of additional potential health hazard influences in District 5 to determine reasons for the increased incidence of brain cancer in that District.

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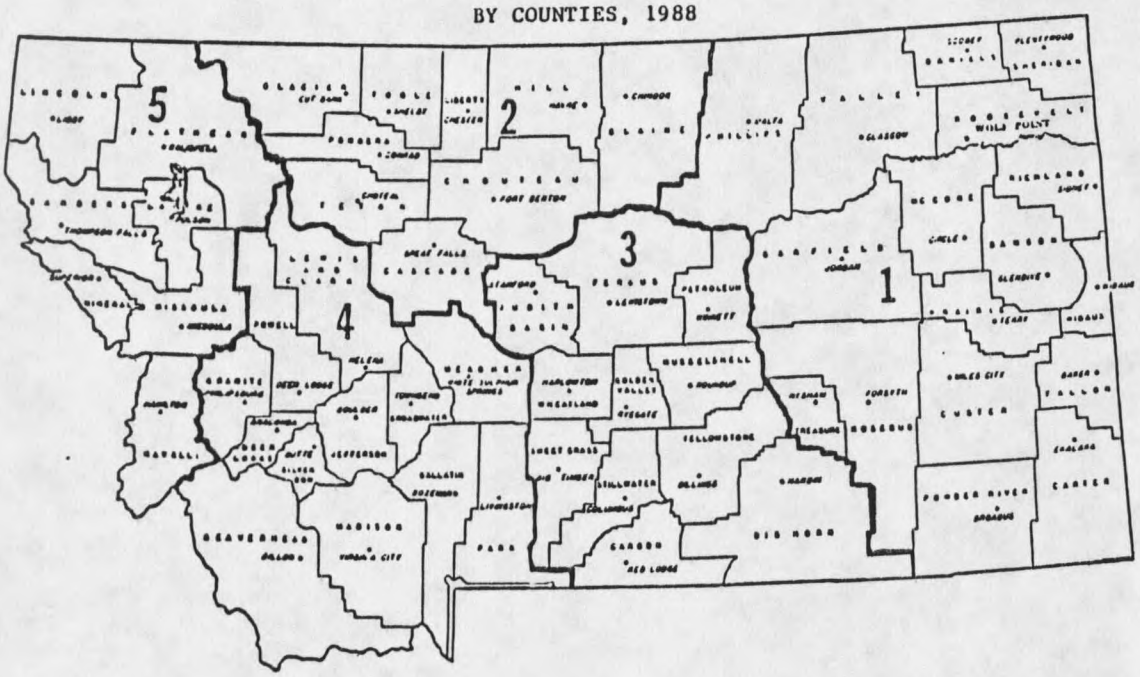
APPENDICES

APPENDIX A
Montana Health Planning Districts

Figure 10

MONTANA HEALTH PLANNING DISTRICTS

BY COUNTIES, 1988



DISTRICT #1
Carter
Custer
Daniels
Dawson
Fallon
Garfield
McCone
Phillips
Powder River
Prairie
Richland
Roosevelt
Rosebud
Sheridan
Treasure
Valley
Wibaux

DISTRICT #2
Blaine
Cascade
Chouteau
Glacier
Hill
Liberty
Pondera
Teton
Toole

DISTRICT #3
Big Horn
Carbon
Fergus
Golden Valley
Judith Basin
Musselshell
Petroleum
Stillwater
Sweet Grass
Wheatland
Yellowstone

DISTRICT #4
Beaverhead
Broadwater
Deer Lodge
Gallatin
Granite
Jefferson
Lewis & Clark
Madison
Meagher
Park
Powell
Silver Bow

DISTRICT #5
Flathead
Lake
Lincoln
Mineral
Missoula
Ravalli
Sanders

Source: Montana Central Tumor Registry, 1988.

APPENDIX B
Letter of Permission

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

STAN STEPHENS, GOVERNOR

COGSWELL BUILDING

STATE OF MONTANA

FAX # (406) 444-2606

HELENA, MONTANA 59620

Montana Central Tumor Registry
Cogswell Building
Helena, MT 59620-0920
January 2, 1991

Kathy Stillson
PO Box 6086
Bozeman, MT 59771

Dear Kathy:

I'm sorry that this response took so long. Sam Sperry apologizes for not routing your letter to the Tumor Registry sooner. In the future, you might just want to address your requests to the Tumor Registry so that they do not have to go through the entire bureau first. I can usually respond to my requests fairly quickly once I receive them.

Briefly, I will explain what I have sent to you. I was unsure how detailed you wanted your information so what I am sending you is pretty undetailed but be sure and let me know if you need more information. The printouts are simply a cross-tab of cancer incidence by year of diagnosis (years 1986 - 1988) and the patient's county of residence. There is a separate printout for each cancer site that you requested. If you are interested more in a case-by-case list, I can do that for you also, without any identifying information, of course. Since there are around 2800 cases that you have requested, a case-by-case list would take a little more printing time, but I sure can do that for you.

According to the Montana State law, you are free to use this data as long as there is no identifying information included. There is no charge for the Tumor Registry to provide this data for you. I am very interested in your final report findings.

By the way, the reason that I chose the 3-year period 1986 through 1988 is because 1989 and 1990 are not completed yet and I feel confident that the Tumor Registry data is complete through 1988.

Please be sure to give me a call if you need any more information. My Direct number is 444-2618. I am in the office from 7:30 to 4:00 pm.

Thank you,

Debbi Hellhake

Debbi Hellhake, RRA
Tumor Registrar

APPENDIX C
Human Subjects Review

Protection of human subjects

The sample for this study consisted of 2,217 cases of cancer incidence recorded on The Montana Central Tumor Registry (MCTR) data base. The study was a secondary analysis of the MCTR data. Individuals were not contacted directly because there was no identifying data supplied by the Tumor Registry for the 2,217 cases reported. Complete anonymity was maintained due to MCTR reporting procedures.

Recruitment and consent: No recruitment and consent of individual cases was required. Data were provided to the MCTR in accordance with Montana State law. Therefore, further contact of individuals by the researcher was not necessary.

Risks: There were no risks of any kind to the sample cases because they were provided without any identifying data to the researcher.

Protection: All data were analyzed by the researcher. The sample cases remained collective and without identifying information.

Benefits/Risk Ratio: As disease statistics are described and explored, the findings become a basis for on-going research on influences and risk factors for that disease. Although it is unlikely that this study directly benefitted the individuals represented by the cancer incidence statistics described and explored in this study, there were benefits to researchers and health care providers who read the study. Benefits included an increased awareness of cancer incidence across the Districts of Montana. In addition, knowledge of the influence of environmental factors on the incidence of cancer in the five Health Planning Districts, will assist health professionals in the planning of community education and preventative health care services.

Risk/Benefits Ratio: There were no risks to the sample. However, the benefits to be gained from this study were significant. These included an increased awareness for both the health professional and the population of Montana.

Human subjects review: The study was prepared for submission to Montana State University Human Subjects Review Committee.

APPENDIX D
Letter of Exemption for Human Subjects

MONTANA STATE UNIVERSITY
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College of Nursing
Sherrick Hall
Bozeman, MT 59717-0005

Telephone 406-994-3783
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March 20, 1991

TO: Kathy Stillson
Graduate Student

FR: Gretchen McNeely
Assistant to the Deans

RE: Research Proposal

Your proposal "Occupational and Geographic Influences on the Pattern of Cancer Incidence in Montana: A Descriptive and Exploratory Study" was forwarded to the Human Subjects Committee for review as an exempt proposal. I hope your research is going well.

AGM/ko

cc: Christa Stern, Chairperson

APPENDIX E
Letter of Data Request

P.O. Box 6086
Bozeman, MT 59771

October 22, 1990

Sam Sperry
Montana Central Tumor Registry
Cogswell Building
Helena, MT 59620

Dear Mr. Sperry:

This letter is to request a read out of tumor registry data for cancer incidence in Montana. I am a Master's candidate in the College of Nursing at Montana State University, in the last two quarters of my program. In the course of my studies I became interested in epidemiology and, more specifically, in environmental influences on cancer incidence. I am currently working on the proposal for my thesis which is a hypothesis generating, descriptive study examining potential environmental influences on cancer incidence in the state of Montana. Having looked at the 1988 Montana Vital Statistics reports, there appears to be some evidence to indicate that environmental influences in the five health planning districts should be considered.

What I am requesting is a read out of your data for the last three years to date (approximately June 1987-June 1990). Data needed would include: date of incidence, county of residence of cancer patient, and type of cancer. The cancer diagnoses reported need to be limited to: lymphoma, leukemia, bladder cancer, prostate cancer, and brain cancer. This information can be in either hard copy or computer disc form. However, if you provide the information on disc, please let me know what program you have used, e.g. WP 5.0, SPSSX, Wordstar, etc., as I may need to convert it to WP 5.0 for my use. I will ultimately be inputting the data on SPSSX.

Please include a code book for the counties, diagnoses, etc. Please also include a statement of permission for use of these materials in my thesis as well as any specific instructions for citation of these materials. If you can provide this information, please let me know what charge there is for this service and what reports of my findings you would like in return. My thesis committee chairperson is Christa Stern, Ph.D., R.N., MSU extended campus, Billings, MT 59101; phone # 657-2912. My phone # is 586-8058. If there are any questions or you need further information from me, please contact me at your earliest convenience. Thank you for all your assistance.

Sincerely,

Kathy E. Stillson, Master's Candidate, B.S.N., R.N.