

University of Montana

## ScholarWorks at University of Montana

---

Graduate Student Theses, Dissertations, &  
Professional Papers

Graduate School

---

1995

### Prenatal care in Montana| A spatial analysis

Mary L. Livermore

*The University of Montana*

Follow this and additional works at: <https://scholarworks.umt.edu/etd>

**Let us know how access to this document benefits you.**

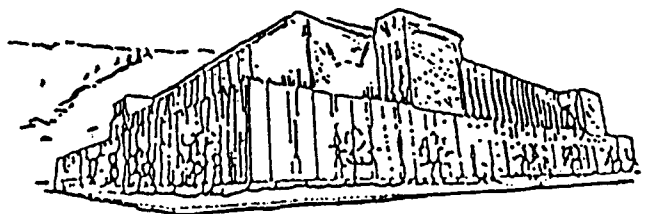
---

#### Recommended Citation

Livermore, Mary L., "Prenatal care in Montana| A spatial analysis" (1995). *Graduate Student Theses, Dissertations, & Professional Papers*. 3288.

<https://scholarworks.umt.edu/etd/3288>

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact [scholarworks@mso.umt.edu](mailto:scholarworks@mso.umt.edu).



Maureen and Mike  
**MANSFIELD LIBRARY**

The University of **MONTANA**

---

Permission is granted by the author to reproduce this material in its entirety, provided that this material is used for scholarly purposes and is properly cited in published works and reports.

*\*\* Please check "Yes" or "No" and provide signature \*\**

Yes, I grant permission  \_\_\_\_\_  
No, I do not grant permission  \_\_\_\_\_

Author's Signature Margaret Swermore

Date 11-9-95

Any copying for commercial purposes or financial gain may be undertaken only with the author's explicit consent.





**PRENATAL CARE IN MONTANA:**

**A SPATIAL ANALYSIS**

by

**Mary L. Livermore**

**B.A. University of Minnesota, 1989**

**presented in partial fulfillment of the requirements**

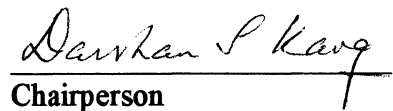
**for the degree of**

**Master of Arts**

**The University of Montana**

**1995**

**Approved by:**

  
Chairperson

  
Dean, Graduate School

November 16, 1995  
Date

The primary data used for this thesis were provided by the Montana Department of Health and Environmental Sciences. The content and conclusions of the research based on these data do not represent an official report of the state nor do they express the opinions of the Montana Department of Health and Environmental Sciences.

UMI Number: EP33853

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent on the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



UMI EP33853

Copyright 2012 by ProQuest LLC.

All rights reserved. This edition of the work is protected against unauthorized copying under Title 17, United States Code.



ProQuest LLC.  
789 East Eisenhower Parkway  
P.O. Box 1346  
Ann Arbor, MI 48106 - 1346

9:42 12-13-95

Livermore, Mary L., M.A., December 1995

Geography

**Prenatal Care in Montana: A Spatial Analysis (105 pp.)**

Director: Darshan Kang, Ph.D. *DK*

Prenatal care involves regular visits by a pregnant woman to a qualified health-care provider during the course of pregnancy to promote good health habits on the part of the woman, identify and treat obstetric problems, and assess and support healthy development of the fetus. Low birth weight, infant mortality, and other negative birth outcomes are often avoided by timely utilization of prenatal care.

Given that prenatal care effectively reduces infant mortality and morbidity; the research problem lies in determining what barriers prevent women from obtaining preventative care during pregnancy. One potential barrier is limited locational access to practitioners who provide prenatal-care services. In Montana, where potential prenatal-care providers are unevenly distributed across the State, there is great potential for limited access to restrict women's use of care.

To determine whether availability of prenatal-care providers affected Montana women's use of services during the period from 1980-1989, regional patterns of utilization were described using thematic maps (with separate maps for Native Americans and whites). The maps illustrate, by county, averages in the timing of the start of prenatal care and total number of prenatal-care visits, percentage of women receiving no prenatal-care, and proportions of women obtaining Adequate, Intermediate, or Inadequate levels of prenatal care. These maps were compared with maps illustrating county availability of practitioners who may provide prenatal care (Obstetrician/Gynecologists, Family Practitioners, and Certified Nurse Midwives). Additionally, average values of prenatal-care utilization were compared at different levels of provider availability within 25, 50, 75, or 100 miles of a woman's generalized location of residence.

It was hypothesized that increased regional availability of providers would improve prenatal-care use. However, the findings did not support this hypothesis. The results did show, however, that Native American women overall have access to fewer providers and have less desirable levels of prenatal-care use in all Montana counties and for all measures of prenatal-care use compared to whites. For both Native Americans and whites, counties with very low levels of prenatal-care utilization were identified.

## ACKNOWLEDGEMENTS

There are many individuals who deserve recognition for assisting me in completing this project. First, and foremost, I want to thank Brian, my husband, for encouraging me to start the degree program and providing continual support along the way. Brian was a great help with the GIS portion of the project. I also want to thank "our little one", who is due in December, for providing me with the impetus and added enthusiasm to finally complete the thesis. Starting prenatal care myself really helped to keep the topic perpetually interesting.

I also want to recognize the members of my committee, Dr. Darshan Kang, Dr. William McBroom, Dr. Christiane von Reichert, and Dr. Paul Wilson for their support, advice, and encouragement throughout the course of the thesis. There were also several persons in the health field who provided invaluable information: Linda Davis, Lake County Family Planning; JoAnn Dodson, The MIAMI Project; and Melanie Reynolds and Suzanne Nybo, State Family Planning Office. Without all of you, this project would not have been possible.

## TABLE OF CONTENTS

ABSTRACT .....	ii
ACKNOWLEDGMENTS .....	iii
LIST OF TABLES .....	v
LIST OF ILLUSTRATIONS .....	vi
<b>Chapter</b>	
1. INTRODUCTION .....	1
Barriers to Prenatal Care: The Research Problem .....	4
Purpose .....	12
2. SPATIAL ORGANIZATION OF SERVICES .....	14
Geographic Theories .....	15
Review of Literature .....	18
3. PRENATAL CARE .....	22
The Measurement of Sufficient Prenatal Care .....	23
Review of Literature .....	25
4. METHODOLOGY .....	37
Primary Data Set .....	38
Physician and Midwife Data .....	39
Preparation of the Primary Data Set for Generation of Maps and Tables .....	40
Preparation of the Physician and Midwife Data for Generation of Maps .....	45
Mapping Conventions Used for Regional Comparisons .....	46
Measuring Locational Access .....	49
5. ANALYSIS AND DISCUSSION .....	54
Analysis and Discussion of Regional Data .....	54
Analysis and Discussion of Locational Access to Providers and Maternal Socio-Demographic Characteristics .....	82
6. CONCLUSIONS .....	93
Limitations of the Data and Methodology .....	95
Recommendations .....	96
APPENDIX .....	98
WORKS CITED .....	99

## LIST OF TABLES

Table	Page
1. Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 25 and 50 Miles of Women	84
2. Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 75 Miles of Women . . . . .	85
3. Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 100 Miles of Women . . . . .	86
4. Average Number of Potential Prenatal-Care Providers Available within 25, 50, 75, and 100 Miles of the Modal Population Center of a County's Native American and White Women . . . . .	87
5. Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Marital Status, Age, Education, and Parity: Montana, 1980-1989 . . . . .	90
6. Percentage of Births in which Mother Received No Prenatal Care by Marital Status, Age, Education, and Parity: Montana 1980-1989 . . . . .	91

## LIST OF ILLUSTRATIONS

Figure	Page
1. Population Density and Percentage of Persons by Race by County, 1990 . . . . .	6
2. Average Number of Potential Prenatal Care Providers per Year by County during the 1980-1989 Period . . . . .	10
3. Average Number of Potential Prenatal Care Providers for Every 1,000 Births, Montana, 1980-1989 . . . . .	11
4. Montana Counties by Name . . . . .	48
5. Average Month of Start of Prenatal Care by Montana Native American Women, 1980-1989 . . . . .	56
6. Average Month of Start of Prenatal Care by Montana White Women, 1980-1989	57
7. Average Timeliness of the Start of Prenatal Care by Montana Native American Women, 1980-1989 . . . . .	58
8. Average Timeliness of the start of Prenatal Care by Montana White Women, 1980-1989 . . . . .	59
9. Average Number of Prenatal Care Visits by Montana Native American Women, 1980-1989 . . . . .	65
10. Average Number of Prenatal Care Visits by Montana White Women, 1980-1989	66
11. Adequacy of the Number of Prenatal Care Visits by Montana Native American Women Delivering at 36 Weeks Gestation or Later, 1980-1989 . . . . .	67
12. Adequacy of the Number of Prenatal Care Visits by Montana White Women Delivering at 36 Weeks Gestation or Later, 1980-1989 . . . . .	68
13. Percentage of Births to All Montana Women who had No Prenatal Care, 1980-1989 . . . . .	74



14. Proportion of Montana Native American Women Receiving Adequate, Intermediate, or Inadequate Prenatal Care, 1980-1989 .....	77
15. Proportion of Montana White Women Receiving Adequate, Intermediate, or Inadequate Prenatal Care, 1980-1989 .....	78

## CHAPTER 1

### INTRODUCTION

Infant mortality, death before age one, is considered a measure of the health of a population. Despite being a highly developed industrial country, the United States ranked twenty-first in infant mortality in 1989 when compared to 28 other countries with populations greater than 2.5 million. The infant mortality rate (the number of infant deaths for every 1,000 live births) for the United States is more than twice as high as that of Japan (Wegman 1991, 1091).

Despite having a presumably low-risk, primarily white population, Montana ranked 22d in infant mortality among the 50 states in 1987 with a rate of 10.0 infant deaths per 1,000 live births. Although almost identical to that of the United States as a whole (10.1), Montana's rate is higher than three of its four neighboring states<sup>1</sup> and appreciably higher than the best-ranked rate of 7.2 for Massachusetts (U.S. Department of Commerce 1991, 16).

One of the primary causes of infant mortality is low birth weight. Low birth weight is defined as birth weight below 2,500 grams (5 pounds, 8 ounces). In 1988, nearly seven percent of the babies born in the U.S. were low birth weight. The same rate

---

<sup>1</sup>North Dakota, South Dakota, and Wyoming had infant mortality rates of 8.7, 9.9, and 9.2 respectively. The rate for Idaho was 10.4.

was recorded for Turkey, Kuwait, and Chile (Children's Defense Fund 1991<sup>2</sup>). For the 1987-1989 time period, nearly six percent of Montana babies were born at weights below 2,500 grams, placing Montana at a rank of 15 among the 50 states, which, although better than most states in the U.S. is still far behind best-ranked North Dakota's rate of 4.9 percent (U.S. Department of Health 1992a, 133).

A substantial amount of research has shown that low birth weight, infant mortality, and other negative birth outcomes can be avoided by timely utilization of prenatal care by pregnant women (Clarke et al. 1993, 117; Cramer 1987, 312; Defo and Partin 1993, 88; Dott and Fort 1975 856; Gould and LeRoy 1988, 899; Greenberg 1983, 801; Haas et al. 1993, 89; Hoff et al. 1985, 780; Institute of Medicine 1973, 1; Institute of Medicine 1985, 150; Korenbrot, Simpson, and Phibbs 1994, 72; Ryan, Sweeny, and Solola 1980, 878; Showstack, Budetti, and Minkler 1984, 1005-6; Wilson et al. 1992, 282-3). Prenatal care involves regular visits by a pregnant woman to a qualified health-care provider during the course of pregnancy to promote good health habits on the part of the woman, identify obstetric problems, and assess and support healthy development of the fetus.

Because it improves birth outcome, prenatal care is an effective means of reducing tax expenditures associated with health-care (American Nurses Association 1987, v;

---

<sup>2</sup>The Children's Defense Fund is the original source of this information. However, its reference was located in a secondary source. Since the original source could not be located, the page number is unknown. Many other parenthetical references within this report which do not provide a page number were found in secondary sources. The list of works cited will provide details in each case.

Additional instances in which page numbers are not provided include references to the United States Bureau of the Census 1992 and references which refer to a work in its entirety. In the case of the Bureau of the Census, these citations were found using CD-ROM technology; hence, a page number is not applicable.

Brown 1989, 73; Montana Department of Health 1990, 4; U.S. Department of Health 1992b, 12; Wilson et al. 1992, 283). Expenses associated with adverse birth outcomes include those related to intensive medical care following delivery as well as long term costs associated with chronic illness (American Nurses Association 1987, v). The average health-care costs associated with low birth weight infants from birth to age 35 in the United States is more than twice that for those born at normal birth weights (Robert Wood Johnson Foundation 1991, 37). In Montana, half of the 1988 Medicaid budget for obstetric and newborn care was spent on a mere four percent of Medicaid births, many of which may have been prevented through adequate use of prenatal care (Montana Department of Health 1990, 4).

Interest in infant mortality, low birth weight, and prenatal care in the United States is evidenced by the reports of the Healthy People 2000 Consortium of the Department of Health and Human Services. One report, *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* states as one of its goals to “increase to at least 90%, the proportion of all pregnant women who receive prenatal care in the first trimester of pregnancy”. As of 1987, the Consortium found that only 76% of all births were to women receiving prenatal care in their first trimester; for American Indians, one of the special target populations, this rate was only 60% (U.S. Department of Health 1992b, 111).

Prenatal care and infant health are also important objectives in Montana. In 1989, the MIAMI Act (Montana's Initiative for the Abatement of Mortality in Infants) was passed by the Montana legislature. Its goals were stated as follows:

“assuring that mothers and children, in particular those with low income or with limited availability of health-care services, receive access to quality maternal and child health services, reducing infant mortality and the number of low birth weight babies, and preventing the incidence of children born with chronic illness, both defects or severe disabilities as a result of inadequate prenatal care” (Montana Department of Health 1990, 1).

Several studies have been written since the passage of the MIAMI Act which examine the utilization of prenatal care in Montana (McBroom and Reed 1992; Reed, McBroom, and Sperry 1991; and Montana Department of Health 1991), providing further evidence of the continued importance of prenatal care in Montana.

### **Barriers to Prenatal Care: The Research Problem**

The effectiveness of prenatal care in preventing infant mortality and morbidity is also rarely disputed (Institute of Medicine 1985, 150). Considering that nearly 25% of all women (40% in the case of American Indian women) in the country reportedly do not start prenatal care in a timely manner and, as a result, do not achieve the recommended number of visits (U.S. Department of Health 1992b, 111), the research problem lies in determining what barriers prevent women from obtaining preventative care during pregnancy.

The studies that focus on prenatal care identify a variety of barriers which can be divided into three basic types: structural, socio-demographic, and psycho-social (Brown 1989, 75; Montana Department of Health 1991, 1; Lia-Hoagberg et al. 1990, 489-90). Structural barriers include insufficient numbers or inequitable distribution of prenatal care providers, long waiting lines, or insufficient funding for clinics. Examples of socio-

demographic barriers are young maternal age, high parity<sup>3</sup>, or lack of mother's education. Psycho-social barriers include women's lack of knowledge of the benefits of prenatal care or feelings of distress about their pregnancy (Brown 1989, 75; 489-90; Lia-Hoagberg et al. 1990, 489-90; Montana Department of Health 1991, 1).

In the United States, efforts to eliminate barriers to health care have focused on the structural barrier of funding. In many instances, eligibility for Medicaid has been increased to meet the goal of providing more health care to people who otherwise cannot afford it. However, little effort has been made toward enacting legislation which reduces non-economic barriers (Aday 1975, 447; Fossett et al. 1991, 405), such as the maldistribution of health-care providers. Due to the nature of Montana's population distribution, the maldistribution of providers is likely to limit the availability of prenatal-care services for many women.

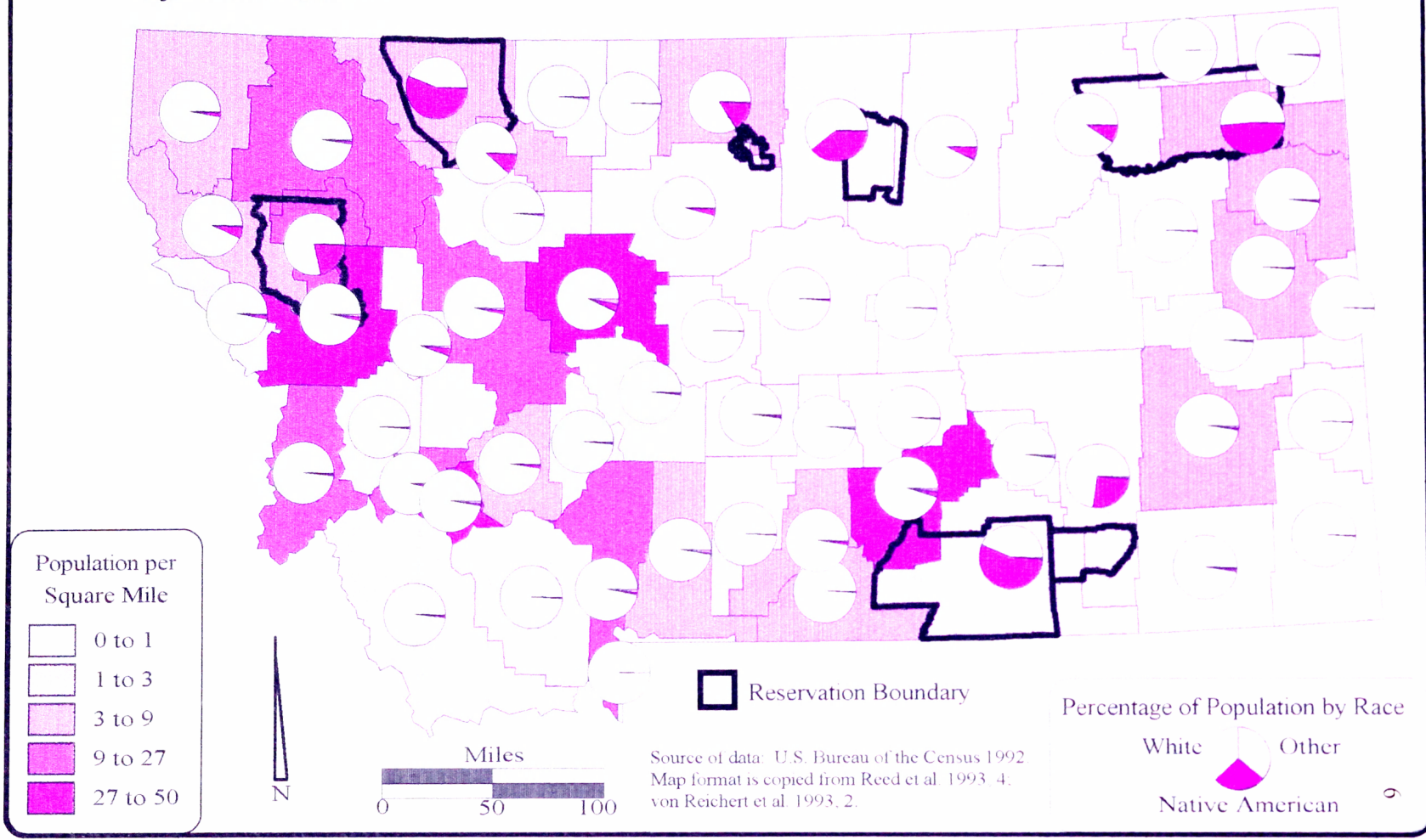
### Demographic Characteristics of Montana

Montana has over 145,000 square miles of territory making it the fourth largest state of the union after Alaska, Texas, and California. In spite of its size, Montana's 1990 population, just under 800,000, places it as one of the least populated states in the union. Within this large State, the relatively small population is distributed unevenly (see fig. 1).

---

<sup>3</sup>*Parity* in this context is defined as the number of previous live births or stillbirths.

Figure 1: Population Density and Percentage of Persons by Race by County, 1990



Population per Square Mile

- 0 to 1
- 1 to 3
- 3 to 9
- 9 to 27
- 27 to 50



Miles

0 50 100

Reservation Boundary

Source of data: U.S. Bureau of the Census 1992  
 Map format is copied from Reed et al. 1993: 4.  
 von Reichert et al. 1993: 2.

Percentage of Population by Race

- White
- Native American
- Other

Sixty percent of the population resides in eight of the State's 56 counties; seven of these eight counties are located in Western Montana<sup>4</sup> (U.S. Bureau of the Census 1992).

Another notable characteristic of Montana's population is its racial composition. Ninety-three percent of the population is white. Native Americans comprise six percent of the State's inhabitants, while other races make up less than one percent of the total population (U.S. Bureau of the Census 1992). Many Native Americans live on one of the State's seven Reservations which accounts for the pockets of concentration of Native American population in many areas of the State (fig. 1). This ethnic minority is often considered separately from whites in studies of health care in Montana due to the different social and economic characteristics often associated with the group. As already mentioned, Native Americans are one of the several target populations designated by the United States Department of Health and Human Services which are given special attention in issues of maternal and infant health (1992b, 111).

Due to the size, spatial distribution, and racial composition of Montana's population, there is considerable potential in the State for disparate locational access<sup>5</sup> to

---

<sup>4</sup>Much of this demographic information was summarized in a similar manner in von Reichert et al. 1993, 1 and Reed et al. 1993, 1.

<sup>5</sup>*Access* and *accessibility*, as they pertain to health care, are nebulous terms. The literature regarding the concepts is somewhat inconsistent. Ricketts, et al. define *access* as "the availability to use a service or thing", with emphasis on physical proximity (1994, 317). Collins and Natapoff define the term as "the ease with which a [person] can enter a health care facility", a definition which, according to the authors, depends on financial status (Collins and Natapoff 1985, 14). Puentes-Markides, however, suggests that the definition of *access* must include not only physical proximity and affordability, but also factors of supply and demand, quality, accommodation, and acceptability (Puentes-Markides 1992, 621-2).

Other authors recognize different types of access. Aday et al. separate *potential*



services. Consistent with this, speculation, a report of the Montana Department of Health and Environmental Services proposed that a primary barrier to adequate prenatal care in Montana is insufficient access to appropriate health-care providers (1990, 4).

### Prenatal-Care Providers

In Montana, appropriate health-care providers for prenatal-care services are comprised of Certified Nurse Midwives, Direct-Entry Midwives, private Obstetrician/Gynecologists, private Family Practice Physicians, and Indian Health Service Physicians (Montana Department of Health 1991, 22). Overwhelmingly, prenatal-care services and deliveries in the State are attended by one of the three types of physicians.

---

*access from realized access. Potential access* encompasses structural features (such as distance or affordability) which determine whether or not people can obtain care. *Realized access* considers whether the care is actually received (Aday et al. 1980, 30-32). Aday's *realized access* is generally equivalent with the term *utilization* which is recognized by other authors (Joseph and Phillips 1984, 9; Meade, Florin, and Gesler 1988, 306).

Joseph and Phillips distinguish between *locational access* and *effective access*. The former refers to physical distance to or location of a health care facility relative to a users residence; the latter is concerned with the hours of a facility and whether it is affordable (Joseph and Phillips 1984, 53). *Locational access* and *effective access*, then, are further distinctions of Aday's *potential access*. *Locational access* sounds much the same as Rickett's definition of *access* and other authors' definition of *availability* (Collins and Natapoff 1985, 14; Meade, Florin, and Gesler 1988, 306). *Effective access* is similar to Collins and Natapoff's definition of *access*.

The present research is concerned with both *locational access* and *realized access*. These two terms will be interchangeable with *availability* and *utilization*, respectively. *Locational access* and *availability* in this context refer to physical proximity, or more specifically, reasonable distance to a health care provider. In this usage, issues such as affordability, quality, and acceptability will not be taken into account since the data are unavailable and since the focus of this report is a geographical approach to prenatal care. *Realized access* and *utilization* refer to whether or not care is actually received.

Certified Nurse Midwives work under the direction of a physician while Direct-Entry Midwives (formerly called Lay Midwives) work independently. The numbers of Certified Nurse Midwives and Direct-Entry Midwives were thin during the period of this study. In the communities where they are available, midwives are a viable alternative to physicians for women who have normal, low-risk pregnancies (Institute of Medicine 1985, 160).

Although there were relatively few midwives during the 1980-1989 period, there were many physicians. However, not all private Obstetrician/Gynecologists, private Family Practice Physicians, and Indian Health Service Physicians provide prenatal care. It is asserted here, however, that even though some of these physicians do not offer prenatal-care services, they are likely to affect utilization of prenatal care by increasing the overall health knowledge of people living in the area and by encouraging women to get prenatal care from a physician who does provide prenatal-care services. Women who live in areas isolated from any health-care resources are less likely to be aware of the prescribed need for prenatal care (Brown 1989, 77).

The distribution of health-care providers in Montana, like that of population, is uneven (figs. 2 and 3). Physicians locate in areas where their profession can be economically supported. They also tend to locate in areas that reflect their lifestyle image and in areas with health-care facilities such as hospitals or clinics. As a result, rural areas are often deficient in physician services as compared to urban or metropolitan areas (Florin 1994, 4; Hicks 1990, 486; Joseph and Phillips 1984, 77, 89; Meade, Florin, and Gesler 1988, 290). Montana had only two "metropolitan" areas as defined by the Census Bureau

Figure 2: Average Number of Potential Prenatal Care Providers per year by County during the 1980-1989 Period

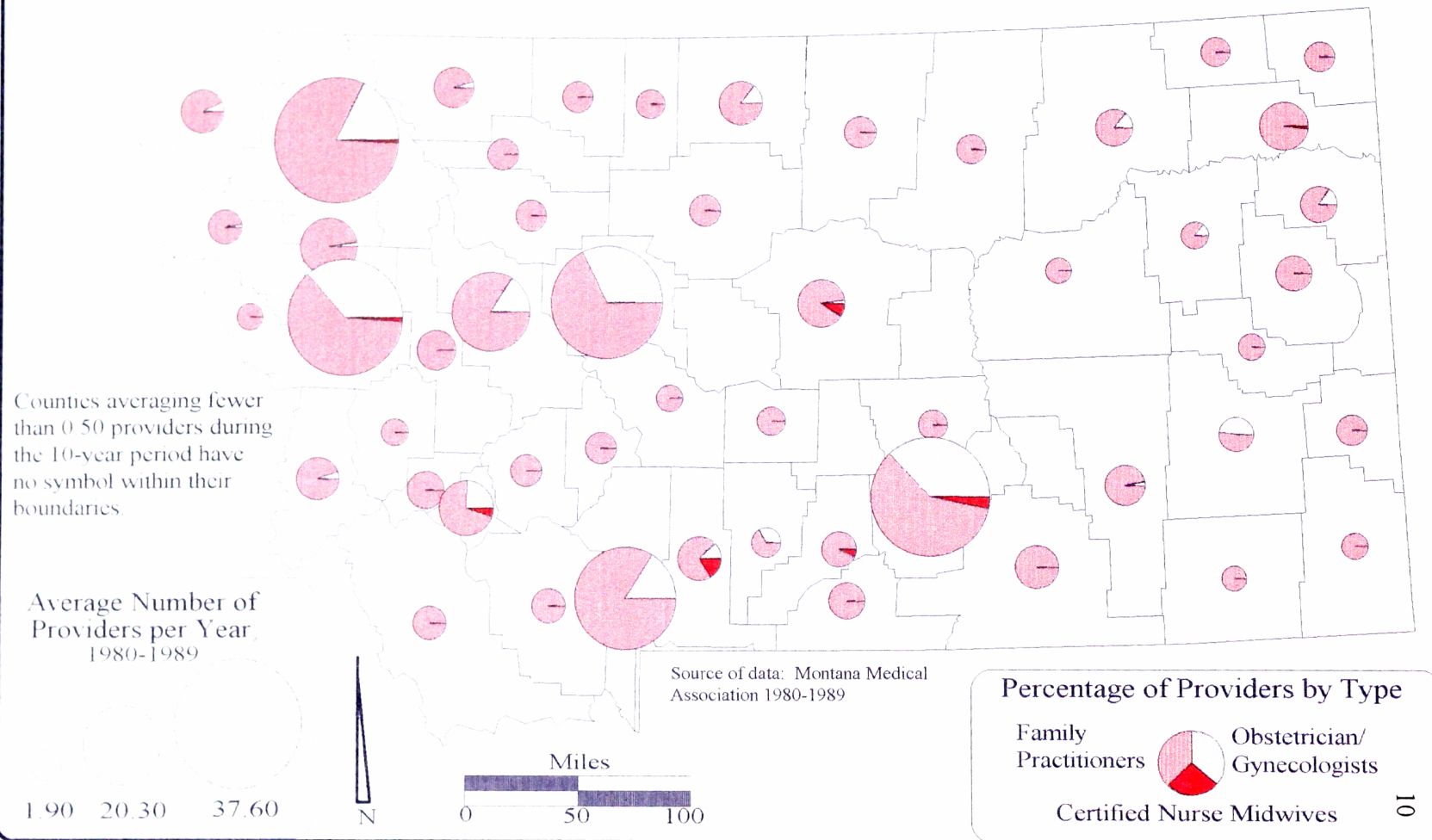
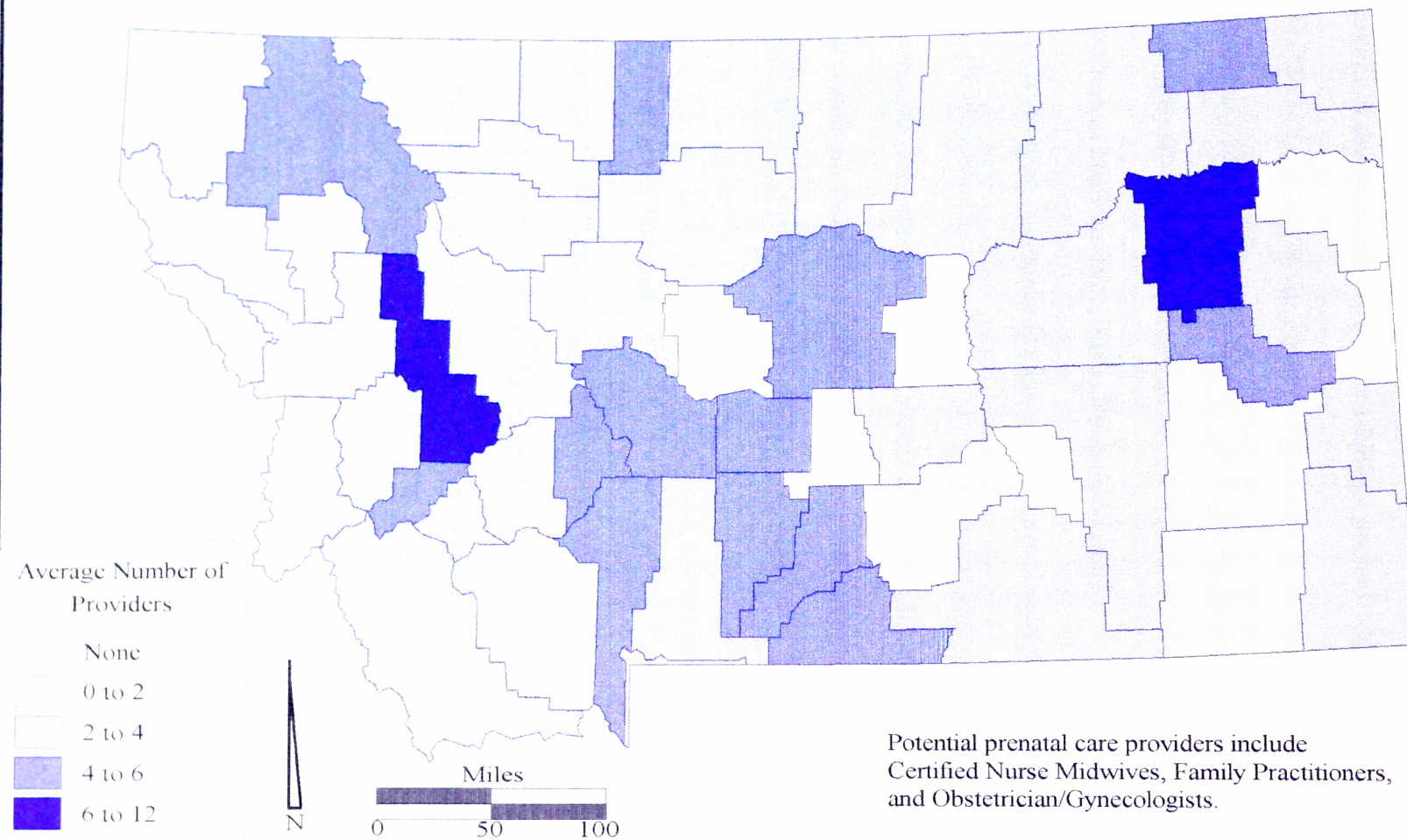


Figure 3: Average Number of Potential Prenatal-Care Providers for Every 1,000 Births, Montana, 1980-1989



during the decade of this study: Great Falls and Billings, each of which had a population less than 100,000 (U.S. Bureau of the Census 1992).

The problem of physician availability is exacerbated for women who depend on Medicaid to cover health-care costs (American Nurses Association 1987, 27; Fossett et al. 1991, 405; Institute of Medicine 1985, 159). Not only do many Obstetrician/Gynecologists and Family Practitioners not provide prenatal care, many of those who do provide prenatal care will not accept Medicaid as payment. This situation is due largely to the low rates of reimbursement provided by Medicaid and also due to the increased malpractice risk taken by physicians accepting Medicaid patients who are often high risk from the beginning (Institute of Medicine 1985, 159).

#### **Barriers to Prenatal Care in Montana**

Considering the maldistribution of both population and prenatal-care providers, there is certainly potential in Montana for the structural barrier of distance to provider to affect women's utilization of prenatal-care services. How this structural barrier compares with other barriers, particularly socio-demographic characteristics of women, will be one focus of the present research.

#### **Purpose**

The purpose of the present research is to describe regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980 to 1989 and to determine whether regional availability of health-care providers had an impact on these

patterns. An additional objective is to determine whether the late initiation of care and less frequent usage of prenatal-care services by Montana's Native American women relative to white women<sup>6</sup> can be attributed to different patterns of locational access to health-care providers.

It is hypothesized that differences in prenatal-care utilization patterns are due to regional variations in availability of health-care providers. Specifically, it is proposed that areas of Montana with limited locational access to appropriate health-care services during the 1980 to 1989 period also had less desirable levels of prenatal-care utilization. It is further hypothesized that when physician and midwife resources in conjunction with individual characteristics of mothers are taken into account, differences in prenatal-care utilization between Montana's Native American and white populations will be lessened.

---

<sup>6</sup>This difference has already been described in literature pertaining to prenatal care in Montana (McBroom and Reed 1992, 1; Montana Department of Health 1991, 14; Reed, McBroom, and Sperry 1991, 95).

## CHAPTER 2

### SPATIAL ORGANIZATION OF SERVICES

The present research will consider how locational access to prenatal-care providers affected regional and individual variations in the utilization of prenatal care in Montana during the 1980s. Geographic techniques will be utilized to identify the spatial variations in prenatal care at the county level and also to determine an index of provider availability to be used as part of a statistical model explaining utilization patterns at the individual level. Since this geographic research pertains to a health-related topic, it is considered part of the study of medical geography.

Medical geography can be defined as “the spatial analysis of most aspects of human health” (Pyle 1979, 9). The focus of this sub-field of geography is explaining spatial variations of phenomena related to health and disease in human populations. The explanation could provide guidance to improve human health. Medical geography draws from other branches of geography and incorporates fundamental geographic theories, such as the Central Place Theory and the Distance Decay Theory.

Although an ancient concept, medical geography is a relatively new sub-field of geography (Meade, Florin, and Gesler 1988, 3). The field has two basic subsets: the study of the distribution and diffusion of diseases and the spatial analysis of health-care

resources (Pacione 1986, i; Shannon and Dever 1974, 4). The present research is concerned with the latter. Specifically, the spatial patterns of utilization of prenatal care in Montana are analyzed to determine if they were related to the location of prenatal-care providers.

The purpose of studying the spatial analysis of health-care resources is to gain understanding of the availability and utilization of care in order to increase knowledge of ways to prevent, reduce, alleviate, or remedy health problems (Barrett 1986, 25). The spatial analysis of health-care facilities includes variables such as locational access to health care, the utilization of health care, disparities in health-care allocation, patient travel patterns, and location of future facilities (Pacione 1986, i; Verhasselt 1993, 121). The present research is primarily concerned with the first two of these topics, and to a lesser extent, with the third.

### **Geographic Theories**

Two primary theories in the study of geography are concerned with the spatial analysis of health-care resources: Central Place Theory and the Distance Decay Theory. Both of these are relevant to the research in this thesis. The Central Place Theory was developed by Walter Christaller in the early 1930s (Christaller 1966). The theory is a basic component of the geography of urban systems as well as economic geography in that it attempts to explain and predict the location, size, nature, and spacing of clusters of economic activity (Berry 1967, 3). Although modifications of the theory have been applied over the years, the classic theory suggests that there are different levels of services



in different settlements based on the size of the settlement and its hinterland. The larger the settlement, the more specialized the goods and services. Where physical barriers are absent, the arrangement of different-sized settlements is quite predictable (Wheeler and Muller 1986, 152-170).

The Distance Decay Theory simply states that interaction decreases with increased distance (Wheeler and Muller 1986, 76). Both theories are relevant in studies of medical geography, and more specifically, to studies of locational access to health-care services.

Central Place Theory predicts the location of health-care services: individual practitioners may be located in clinics or offices in smaller settlements to provide basic health-care services whereas larger cities may contain major medical centers with a whole range of specialized health-care services (Meade, Florin, and Gesler 1988, 287).

Generally, people are willing to travel longer distances for more specialized care than for primary-care services (Ricketts and Savitz 1994, 100).

According to the Distance Decay Theory, living close to a facility or physician may increase the likelihood that these services will be used (Meade, Florin, and Gesler 1988, 306). For a given health-care resource, the majority of its users will be people living closest to it; the number of users will decrease with increasing distance (Phillips 1986, 220). Distance to a health facility may affect utilization in several ways: distance serves as a barrier to reaching a facility, and it can deter people from trying to get care in the first place (Thaddeus and Maine 1994, 1093). Distance to a facility may also affect utilization due to the factor of health knowledge. The closer a person lives to a health-care service,

the more likely they are to be aware of the need for care in general (Eyles and Woods 1983, 116-17; Paul 1991, 48).

The concepts of the Central Place Theory and Distance Decay Theory both explain locational access and realized access to prenatal care. The Central Place Theory provides an explanation of the distribution of prenatal-care providers in Montana. In Montana where the spatial distribution of the population is irregular (Figure 1), there were several counties during the study period which had no prenatal-care providers while other counties, those with large populations, had large numbers of providers (Figure 2). Residents of counties without providers had to travel to another county if they were to obtain care. Since locational access is limited, realized access is likely to be affected.

The Central Place Theory also helps explain why the counties of Montana with a relatively large number of providers were more likely to have the specialized providers, that is, Obstetrician/Gynecologists<sup>1</sup>. As Figure 2 shows, the counties with a high average number of providers usually had Obstetrician/Gynecologists whereas the counties with few providers were more likely to have only Family Practitioners.

The Distance Decay Theory is relevant to locational and realized access in a similar manner. Theoretically, the further a woman has to travel to obtain prenatal care, the less likely she is to obtain it. In a large state like Montana, where it may take an hour or more

---

<sup>1</sup>Since Obstetrician/Gynecologists receive more specialized training than Family Practitioners and because they treat a subset of a given population, that is, adult women, they are more specialized and hence more likely to locate in regions with larger populations.

to reach the nearest prenatal-care provider, the potential impact of distance decay on utilization is great.

The Central Place Theory explains why the distribution of potential prenatal-care providers is uneven in Montana. The Distance Decay Theory provides the basis for showing the effect of distance on a woman's likelihood to obtain sufficient care in Montana.

### **Review of Literature**

There are a number of studies reported in scientific literature which consider locational access to health-care facilities and the associated impact on utilization of services. For the majority of these studies, locational access was determined by considering the distance between patient and provider. Realized access was measured by determining the number, timing, or ratio of persons who have utilized a health-care resource to the total population or by measuring rates of mortality or morbidity (Aday, Fleming, and Anderson 1984, 20; Paul 1991, 43).

The first recorded research of locational access to health care, published in 1851, focused on mental health. Jarvis determined that “the people in the vicinity of lunatic hospitals send more patients to [these hospitals] than those [who live] at a greater distance” (Jarvis 1851). The relationship between distance and admission to mental hospitals was found to be equally strong in subsequent studies. As a result, the above quoted phenomena was labeled Jarvis' Law (Walmsley 1978, 73).

Jarvis' Law also holds for medical hospitals. A study of emergency- room use in metropolitan Toronto found that people living close to hospitals with emergency rooms tended to use the facilities like a clinic whereas people living far away used the services much less frequently and for more serious conditions (Ingram, Clarke, and Murdie 1978, 60-62). A study in rural New South Wales in the same year demonstrated that the closer a person lives to a hospital, the more likely they were to use the facility (Walmsley 1978, 74). In neither of these two studies was consideration given to variables other than distance.

The strength of the distance variable may be affected by the rural or urban nature of the region studied. Jehlik and McNamara reported that rural residents tend to use established health facilities for medical rather than preventative purposes (Jehlik and McNamara 1952). If this pattern still holds, it may be determined that residents of Montana who live in more remote areas may forego preventative prenatal care.

As reported in the above review, distance to health-care facilities has been shown to affect utilization of services. However, by placing a narrow focus on distance, other significant factors affecting utilization may be neglected (Joseph and Phillips 1984, 116-22; Meade, Florin, and Gesler 1988, 308; Shannon and Dever 1974, 5-6). As a result, many studies looking at the effect of distance on health-care utilization simultaneously consider the effects non-spatial factors such as age, income, education, or ethnicity have on utilization (Meade, Florin, and Gesler 1988, 309).

Aday looked at national data for the United States to research how insurance availability, low income, and travel time affect utilization of care (Aday 1975, 447). She

found that the insured non-poor sought all types of care in times of need regardless of travel time to a facility. However, for the uninsured non-poor and insured poor, the closer the people lived to a facility, the more likely they were to seek care. For the uninsured poor, like the insured non-poor, travel time to a facility was not found to be a significant barrier; however, care was usually not sought until it was urgently needed (Aday 1975, 453).

Weiss and Greenlick also looked at the impact of social class and distance on utilization. Their study focused on members of a specific insurance group in metropolitan Portland (Weiss and Greenlick 1970, 457). The results showed that the influence of distance on utilization depended on social class and the type of service used. For the middle class, out-patient visits tended to decrease when distance from a facility exceeded 15 miles. At this distance, telephone contacts increased. For the working class, out-patient visits decreased at the same distance boundary, but emergency room visits rather than telephone contacts increased (Weiss and Greenlick 1970, 457).

Phillips considered distance along with social status, age, place of previous residence, number of children at home, and personal mobility to explain spatial patterns of surgery attendance in West Glamorgan, United Kingdom (Phillips 1979, 169). Phillips found that location of previous residence, mobility, and social status did significantly impact how far persons traveled to have surgery. Persons with a previous residence were likely to return to that area for surgery in spite of distance. Personal mobility and social status linked together to make distance less of a barrier for high income persons than for

low income persons. Age and number of children at home did not affect how far people traveled for surgery (Phillips 1979, 180).

All three of these reports demonstrate that the strength of distance as a barrier to utilization depends on individual characteristics of the people seeking care and the type of care being sought. In general, distance prohibits persons of lower incomes or social stature from seeking non-urgent care more than it prohibits higher income or higher status persons. For critical care needs, distance is less of a barrier no matter what the social status. As will be shown in Chapter 3, many different non-spatial factors affect utilization of care in the case of pregnant women.

The focus of the present research is determining the effect of distance to providers upon utilization of prenatal care. However, it is consistent with the literature to simultaneously consider non-spatial variables as well, since, as the above review suggests, the effect of distance as a barrier to health care may be modified by the attributes of the individual seeking care.

### CHAPTER 3

#### PRENATAL CARE

The report describing the MIAMI Act, first referenced in Chapter 1, maintains that “the most effective tool to decrease the incidence of low birth weight is early, comprehensive, and continuous prenatal care” (Montana Department of Health 1990, 1). By acquiring prenatal-care services, a pregnant woman receives information about habits that affect her health and the health of the developing fetus. Advice is provided concerning such topics as proper nutrition, exercise, and the need to avoid alcohol, tobacco, and other drugs. Additionally, during the course of prenatal-care visits to an appropriate provider, medical risks for both the woman and the fetus can be identified and treated (Cooney 1985, 986).

According to current guidelines, which have remained unchanged during the period of the present study (1980-1989), sufficient prenatal care entails initiation of prenatal visits with a qualified practitioner in the first trimester of pregnancy. The visits should continue on a regular basis every four weeks until the 28th week of gestation, then every two weeks until the 36th week of gestation, and weekly thereafter (American College 1988). A woman carrying to term (38 weeks from estimated date of conception

or 40 weeks from the date of the last normal menses) should have a minimum of 13 visits during the course of pregnancy according to this plan.

As evident from the guidelines, both the timing of the first visit and the total number of visits are considered important in prenatal care. Initiating care in the first trimester is recommended so that potential problems with the pregnancy can be identified early, and plans can be made to establish appropriate treatment or behavioral modification (Institute of Medicine 1973, 6; Thomas, Golding, and Peters 1991, 715). Early care is also important because it sets the stage for good health habits by the mother during the critical development stages of the fetus.

Completing the total recommended number of visits insures continuity of care through which changes in risk factors during the course of pregnancy can be monitored and remedied. Continuity of care also serves to remind women to maintain good health habits throughout the pregnancy.

### **The Measurement of Sufficient Prenatal Care**

There are several different ways in which prenatal-care usage is measured in scientific literature. Although some studies simply consider whether or not prenatal care was used, most consider the timing of the first visit, the total number of visits, both of these factors, or the overall sufficiency of prenatal care as measured by an index combining the two factors.

The Kessner Index (see Appendix) or a modification thereof is the most often used measure which combines timing and number of visits. David Kessner and associates



developed it at the Institute of Medicine in 1973. The outcome of the index specifies whether or not the combination of timing and number of visits for prenatal care was “Adequate”, “Intermediate”, or “Inadequate”<sup>1</sup> (Institute of Medicine 1973, 59).

The Kessner Index is different from measures used prior to 1973 because it takes into account the fact that the number of visits will be affected by length of pregnancy. For example, for a woman who reaches term (40 weeks) to have what is considered an Adequate prenatal-care regimen, she would be expected to have started care in the first trimester of pregnancy and have completed 13 or more visits. However, if a woman delivers at 30 weeks gestation and had been following the recommended number of visits up to the time of delivery, she would not have been pregnant long enough to complete the recommended number of visits for a full-term pregnancy. The Kessner Index accounts for the sufficiency of care in pre-term births as well as term births and bases the adequacy of number of visits on the length of gestation. Hence, a woman delivering at 30 weeks would have had Adequate care if she started care in the first trimester and had six or more visits (Institute of Medicine 1973, 59).

The Kessner Index considers both the timing of prenatal care and the number of prenatal-care visits simultaneously. However, there is evidence to suggest that timing and

---

<sup>1</sup>There are two primary uses of the word *adequate* in this report. The first refers to the general adequacy or sufficiency of prenatal care. The second refers to *Adequate* care as defined by the Kessner Index or similar measure. To distinguish the two in subsequent mention, the general *adequate* or *adequacy* will remain entirely in lower-case letters; it will be interchangeable with forms of the word *sufficient*. *Adequate* or *Adequacy* as they refer to a prenatal-care index will have the first letter capitalized as shown throughout this footnote. Similarly, the terms *Intermediate* and *Inadequate* will follow the same convention when they result from use of a prenatal-care index.

number of visits are affected by different factors individually (McDonald and Coburn 1988, 170). Of particular relevance to this thesis is the finding that women who have longer distances to travel for care may appropriately initiate prenatal visits in the first trimester, but may not continue with the prescribed number of visits (Korenbrot, Simpson, and Phibbs 1994, 73; McDonald and Coburn 1988, 170). Thus, in addition to briefly considering a measure of the overall Adequacy of prenatal care, this thesis will focus on factors, particularly factors pertaining to distance, which influence the timing of initiation of care and the total number of visits separately.

Women who have a very high number of prenatal-care visits during the course of pregnancy may need special consideration in measurements of sufficiency of care. A woman who has an identified risk factor may increase her prenatal-care visits. In cases where a woman has 110% or more of the recommended number of visits, the pregnancy was probably high risk. What looks like an adequate number of visits could actually be inadequate if the provider was encouraging even more visits (Korenbrot, Simpson, and Phibbs 1994, 69-70).

## **Review of Literature**

The value of prenatal care as a safeguard against low birth weight and, in turn, infant mortality is widely recognized in medical as well as social science literature. The specific barriers which prevent women from obtaining sufficient prenatal care, however, are still somewhat unclear. The present research will focus on the effect of locational access to prenatal-care providers on realized access of prenatal care in Montana.

Emphasis will be placed on the distance variable or spatial aspect of utilization of prenatal care. The literature review here will consider previous studies which researched barriers to prenatal care in the United States.

The most effective scientific format for testing factors or barriers that affect utilization of prenatal care would entail random assignment of women into groups with different barriers. For example, for the present research, pregnant women would be assigned into different groups at varying distances from a specified number of prenatal-care providers. However, for obvious ethical reasons this type of research design is not possible (Clarke et al. 1993, 119; Gortmaker 1979, 654). As a result, studies reporting factors affecting prenatal care consider data after the birth of a child.

Previous studies of barriers to prenatal care have used two primary types of data sources: sample data from surveys or hospital records (Kalmuss and Pennelly 1990, 215; Leatherman, Blackburn, and Davidhizar 1990, 258; Lia-Hoagberg et al. 1990, 488; Zambrana, Dunkel-Schetter, and Scrimshaw 1991, 285) and state records of birth certificates (Braverman et al. 1993, 1286). In at least one case, a combination of the two types of data sources was used (McDonald and Coburn 1988, 167). Researchers analyzing data from surveys or hospital records benefit from their ability to obtain detailed information about respondents. In contrast, researchers who use vital statistics are limited in terms of the variables that can be studied. They benefit, however, from having nearly complete counts of the population under consideration. The present research will use the latter type of data.

As previously mentioned, most studies consider the timing of first visit, number of visits, or an index of adequacy of care to represent dependent variables. Independent variables include characteristics of the mother such as her feelings about the pregnancy, age, race, birthplace, marital status, educational attainment, employment status, financial resources, income, method of payment for care, previous live births, number of children at home, medical risks, substance abuse, mother's relationship with baby's father, provider setting, travel time, transportation, and geographic region of residence (Braverman et al. 1993, 1287; Kalmuss and Pennelly 1990, 217; Leatherman, Blackburn, and Davidhizar 1990, 260; Lia-Hoagberg et al. 1990, 489; McDonald and Coburn 1988, 169; Zambrana, Dunkel-Schetter, and Scrimshaw 1991, 286). These variables include all three types of barriers to prenatal care listed in Chapter 1: structural, socio-demographic, and psycho-social.

Despite differences in types of data, methodology, and region of study, the conclusions reached by different research projects often have similarities. Leatherman, Blackburn, and Davidhizar's study in a Midwest county (1990, 260), the research by Braverman et al. of California birth certificates (1993, 1287), as well as Kalmuss and Pennelly's study of Black and Hispanic women in New York City (1990, 218) all determined that not having enough money or lacking health insurance to pay for care was the primary reason women in their studies did not obtain sufficient prenatal care. Leatherman, Blackburn, and Davidhizar's survey included only women who did not receive adequate care as determined by both late timing of first visit and a low number of visits (1990, 258); Kalmuss and Pennelly included only Black and Hispanic women living

in areas with low prenatal-care use and measured care by considering only the timing of first visit; while Braverman et al. included all live births in California for a single year and measured the adequacy of prenatal care by using both the timing and number of visits (1993, 1286). In spite of the major differences in the data as well as geographic region, all three sets of researchers found financial difficulties to be the most significant barrier to prenatal care.

Other noteworthy barriers to care identified by the researchers were dependent upon the variables tested. In Leatherman, Blackburn, and Davidhizar's research, fear of having someone discover the pregnancy and lack of transportation were also found to be important barriers (1990, 260). The latter of these may have been related to financial difficulties for many of the women in the study. Braverman and colleagues demonstrated that lack of a high school education, higher parity, and younger age all tended to increase the likelihood that a woman would receive inadequate care (1993, 1288). Kalmuss and Pennelly showed that a negative attitude toward the pregnancy appeared to delay the initiation of timely care as did substance abuse and being Hispanic (1990, 218).

The conclusions reached by other studies regarding barriers to prenatal care are not always consistent. In contrast to Braverman et al., Leatherman, Blackburn, and Davidhizar, and Kalmuss and Pennelly, Lia-Hoagberg and colleagues (1990, 490) found that inability to pay for services was not a statistically significant barrier to prenatal care among women from a Midwestern city. Instead, it was concluded that lack of availability of child care and insufficient access to transportation were the most significant barriers to Adequate care (1990, 493). However, both lack of child care and insufficient

transportation may be related to lack of sufficient income. Considering that the study done by Lia-Hoagberg et al. included only respondents with low incomes, their results must be interpreted with care. The results may have been different if the entire population of pregnant women in the city were represented, rather than just those of lower incomes.

The barriers to prenatal care found to be significant by Zambrana, Dunkel-Schetter, and Scrimshaw are less related to income than those found by the four above mentioned studies. Zambrana, Dunkel-Schetter, and Scrimshaw (1991, 292) determined that a mother's good relationship with the baby's father was a significant positive factor in the timing of the first prenatal visit, and substance abuse was the most significant negative factor in determining the total number of prenatal visits in their sample of women in Los Angeles. Zambrana, Dunkel-Schetter, and Scrimshaw's study, like that of Lia-Hoagberg et al., Leatherman, Blackburn, and Davidhizar, and Kalmuss and Pennelly used only a subset of the entire population of their study area. The research was concerned only with the prenatal-care use patterns of Blacks, Mexican-Americans, and recent Mexican immigrants who had 12 years of education or less (Zambrana, Dunkel-Schetter, and Scrimshaw 1991, 285). Although it would have been more meaningful to compare the results of these studies had they all used samples representing their entire populations or identical subsets of the populations, their differing conclusions suggest that the type of barrier to prenatal care which most affects a population depends upon the characteristics of the population studied.

McDonald and Coburn (1988, 167), used birth certificates matched with questionnaires from a stratified sample of all mothers delivering during a six-month period

in the state of Maine. These researchers, like Leatherman, Blackburn, and Davidhizar (1990, 260), Braverman et al. (1993, 1287) and Kalmuss and Pennelly (1990, 218), found that the most significant barriers to timely start of prenatal care were related to low income and lack of medical insurance. Other factors which delayed the start of care included unplanned pregnancy and greater distance needed for travel to obtain care. Looking at the ratio of actual visits to prescribed visits, McDonald and Coburn discovered that increased travel time to a prenatal-care provider was the most significant barrier to care. Other barriers significantly limiting the number of visits included lack of medical insurance, high parity, younger age, and unplanned pregnancy. Not only did McDonald and Coburn test the significance of independent variables against timing of care and number of visits, but they also tested them against an overall Adequacy of care. For this dependent variable, being unmarried and having a longer distance to travel to care were found to be the most significant barriers to receiving sufficient prenatal care (McDonald and Coburn 1988, 170).

McDonald and Coburn's research was more comprehensive than that of the other studies reviewed here not only because it used a combination of data sources, but also because it statistically tested all three primary measures of sufficient prenatal care (timing of care, number of visits, and an overall index of prenatal care) against the chosen independent variables. Braverman et al. (1993, 1286) as well as Zambrana, Dunkel-Schetter, and Scrimshaw (1993, 1286) considered both timing of care and number of visits, but not an overall Adequacy of care index. Lia-Hoagberg et al. used an overall Adequacy of care index, but did not consider timing and number of visits separately (1990,

488). Leatherman, Blackburn, and Davidhizar eliminated from their study women who received seven or more visits or started care prior to the third trimester. Their analysis did not consider, then, the statistical impact of timing or number of visits on the independent variables (1990, 258).

The six studies reviewed here each had its individual focus. For several of these studies, factors related to income or availability of payment for care were primary issues: Kalmuss and Pennelly (1990, 215), Lia-Hoagberg et al. (1990, 488), and Zambrana, Dunkel-Schetter, and Scrimshaw (1991, 285) included only low-income women in their research; for Braverman et al. (1993, 1285), the stated objective of the study was to determine whether expansions in Medicaid eligibility increased women's use of prenatal care. The emphasis on financial issues in the literature is consistent with United States' policy which, as mentioned in Chapter 1, attempts to improve prenatal-care use by eliminating financial barriers at the expense of consideration of other preventable barriers (Aday 1975, 447; Fossett et al. 1991, 405), such as limited availability of providers. Although several of the above reviewed studies considered issues of transportation, availability of care, or region as a component of their studies, for none of the researchers were these spatially-related factors a primary focus. The present research, which will be outlined in the succeeding chapters, will attempt to fill this gap by considering geographic factors affecting prenatal-care utilization.



### **Studies of Prenatal Care in Montana**

Each of the six above reviewed studies focused on data from various regions of the United States. Although there are certainly several similarities, the differing results suggest that the impact of certain variables may depend upon location as well as other characteristics of the study group. This statement is consistent with a recommendation from a Michigan report suggesting barriers to prenatal care differ from state to state (Mayer et al. 1987). To determine what factors are most important in Montana will require examination of data from Montana. This task has already been completed to some extent as will be shown here.

Patterns of prenatal-care utilization focusing regionally on Montana have been studied recently by McBroom and Reed of the Center for Population Research at the University of Montana (1992), Reed and McBroom with Sperry (1991), and Hale of the Montana Department of Health and Environmental Services (1991). The research of McBroom and Reed utilized the State's birth files from 1980 to 1989, the same data set used for the present research (McBroom and Reed 1992, 4). The report written by Reed, McBroom, and Sperry used a subset of the data from McBroom and Reed's 1992 report: the birth records for the period of 1980 to 1985 (Reed, McBroom, and Sperry 1991, 93). The research by the Montana Department of Health and Environmental Services was based on the results of a questionnaire distributed to women who gave birth in Montana in August of 1990 (Montana Department of Health 1991, 2).

McBroom and Reed's research of 1992 was concerned with all risk factors and negative pregnancy-outcomes in Montana from 1980-89 including teenage pregnancy,

travel for birthing, length of gestation, infant mortality, and other factors. Of relevance to this thesis was their inclusion of data regarding the timing of entry into prenatal care and the number of prenatal-care visits (McBroom and Reed 1992, i). McBroom and Reed's report was primarily descriptive in nature. Average values for month entered into prenatal care and number of visits were displayed using bar graphs for each county (McBroom and Reed 1992, I-5).

The report of Reed, McBroom, and Sperry (1991) focused on travel for birthing and for prenatal care. Here, an explanatory linear regression model was employed to predict prenatal-care usage by Montana women. Appropriate health-care service availability was measured by considering the type of delivery service in a mother's county of residence (Reed, McBroom, and Sperry 1991, 93-95). There were three types of independent variables in the analysis: characteristics of the mother (age, education and marital status), natality factors (number of previous terminations, number of living children ever born, and length of pregnancy), and availability of obstetric service in the county of mother's residence. The dependent variables of month care began and number of prenatal visits were grouped by race (white and Native American) and by the factor of whether or not the mother left her county of residence to give birth (Reed, McBroom, and Sperry 1991, 95). The results of the analysis showed that Native American women initiate care an average of about one month later than white women and average two fewer total visits than white women. Additionally, the results showed that prediction of the number of visits was better for Native Americans than for whites primarily due to the different effects

of number of children ever born and marital status (Reed, McBroom, and Sperry 1991, 94).

Hale's report for the Montana Department of Health and Environmental Services examined many types of barriers to prenatal care in Montana. The research considered financial and structural barriers as well as individual characteristics of mothers for the whole State. Special consideration was given to different barriers by race, specifically, Native Americans versus whites (Montana Department of Health 1991, 1). Since there was missing information regarding the number of prenatal visits from many of the respondents, timing of first visit was used as an indicator of adequate prenatal care (1991, 11 & 16). Independent variables utilized in comparing maternal characteristics with timeliness of care included age, marital status, race, education, health insurance, receipt of Aid to Families with Dependent Children or food stamps, and annual per capita income (1991, 19). Additionally, variables concerning how the women in the sample perceived their health status and care they received and how they felt about the pregnancy were considered (1991, 20). Chi-square tables were used to examine the relationships of the independent variables with timing of care. Results showed that women in the sample who were unmarried, less educated, using Medicaid, and having low income were more likely to initiate prenatal care in the third trimester (1991, 16). The results concurred with those of Reed, McBroom, and Sperry in showing that Native American women on average have fewer prenatal visits and later initiation of first visit (Montana Department of Health 1991, 14).

Additionally, according to the results of the Montana Department of Health and Environmental Services study, over one-third of the women in the survey reported problems getting the care they wanted. The most common barriers reported were long waits at the doctor's office, lack of health insurance, insufficient funds to pay for care, and transportation problems. For Native Americans, transportation was cited as the number one barrier to getting care compared to fourth for whites (Montana Department of Health 1991, 25). Although many women reported problems with transportation, Hale found no difference in timing of initiation of care and categories of distance travelled (0-5 miles, 6-25 miles, greater than 25 miles). However, as Hale admits, this finding was not compared region by region (1991, 18). Additionally, Hale did not consider how increasing distances beyond 25 miles may impact care utilization. The present research will consider distance categories starting at 25 miles.

All three reports provide useful information regarding the utilization of prenatal care by women in Montana. Each of the reports had a different focus or purpose. To complement information on prenatal-care issues in Montana, the current research will provide a geographic focus. For example, the bar graphs utilized by McBroom and Reed (1992, I-5) will benefit from a cartographic illustration. The linear regression model used by Reed, McBroom, and Sperry (1991, 95) will be supplemented by considering access to physicians and midwives. As Hale suggests, regional comparisons of the various factors considered in her report will be addressed (Montana Department of Health 1991, 39).

Prenatal care is undeniably a successful means of limiting infant morbidity and mortality. Both the timing of the first prenatal visit and the total number of visits during

the course of pregnancy are important. Many of the previous studies regarding factors which prevent women from obtaining adequate prenatal care in the United States have focussed on financial issues. Few have considered issues related to locational access to prenatal-care providers; those which have, did so only on a limited basis. Studies of prenatal care in Montana have also considered availability of providers on a limited basis. The analysis that follows will examine many of the spatial aspects of prenatal care in Montana, with the inclusion of factors related to locational access to providers.

## CHAPTER 4

### METHODOLOGY

In order to describe regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980-1989, several maps were generated showing county differences for several different indicators of prenatal-care use. To determine whether regional availability of health-care providers had an impact on these patterns, maps illustrating availability of providers were also generated at the county-level for comparison with the prenatal-care utilization maps. To ascertain if the late initiation of care and less frequent usage of prenatal-care services by Montana's Native American women relative to white women could be attributed to different patterns of locational access to health-care providers, locational access was measured, and average values of prenatal-care utilization were compared at different levels of locational access.

The present chapter describes the data, methods, and conventions used to achieve the above stated tasks. In the following chapter, the outcome of the methodology will be presented, analyzed, and discussed.

### **Primary Data Set**

The primary source of data for this project consisted of selected vital records provided by the Montana Department of Health and Environmental Sciences to The Center for Population Research at the University of Montana<sup>1</sup>. These data were made available to the present author only for the purposes described here. The content and conclusions of the research based on these data do not represent an official report of the State nor do they express the opinions of the Montana Department of Health and Environmental Sciences.

The data set, which originated from all recorded certificates of birth in the State of Montana, contains the complete, de-identified records of all live births to Montana women for each of the years 1980 through 1989, regardless of site of birth. Births to women who were not Montana residents at the time of the birth were not included in the data set. A total of 133,062 records were registered. The data included details regarding individual characteristics of women who gave birth (such as county of residence, age, race, educational attainment, marital status, and number of children ever born). Additionally, the data contain information regarding details of the pregnancy (such as timing of first prenatal visit, total number of prenatal visits, and complications of pregnancy) and details regarding the baby and the delivery (such as birth weight, type of delivery, and location of delivery). The data were available to the present author in digital format from The Center for Population Research at The University of Montana.

---

<sup>1</sup>In future mentions, this data set will be referred to as the “primary data set” rather than the “data set from the Montana Department of Health and Environmental Sciences.”

### **Physician and Midwife Data**

Appropriate health care providers or resources for prenatal-care services in Montana include private Obstetrician/Gynecologists, private Family Practitioners, Indian Health Service Physicians (federal), Certified Nurse Midwives, and Direct-Entry Midwives (Montana Department of Health 1991, 22). The number and location by town of Obstetrician/Gynecologists and Family Practitioners for the study years 1980 to 1989 were obtained from the Montana Medical Association's Directories of Physicians. This information is recorded annually by the Montana Medical Association, Helena, Montana, based upon the medical licensure of physicians. The data are collected by the Association in the first few months of every year and recorded in June of each year. The data do not specify whether physicians are Indian Health Service Physicians or private physicians. All physicians, whether federal or private, are licensed in the same way.

The number and location by town of Certified Nurse Midwives for each of the study years were obtained from Joan Bowers of the Montana State Board of Nursing, Helena, Montana. This information was based on all records of licenses for Certified Nurse Midwives in the State. Certified Nurse Midwives renew their licenses at the beginning of every year.

According to Michelle Neal of the Montana Midwifery Association, Missoula, Montana, data regarding the location and number of Direct-Entry Midwives are unavailable for years of the present study. Prior to 1991, Direct-Entry Midwives were not licensed in the State of Montana, and as a result, their practice was considered unlawful.



To protect the identity of the Direct-Entry Midwives who were practicing prior to 1991, data on their location were purposely never compiled.

The data available for the present research on potential prenatal-care providers included Obstetrician/Gynecologists, Family Practitioners, and Certified Nurse Midwives. Unfortunately, data on Direct-Entry Midwives were unavailable for the period of this research. Data were also unavailable which could distinguish Indian Health Service Physicians from private physicians.

#### **Preparation of the Primary Data Set for Generation of Maps and Tables**

Queries were made on data from the primary data set using a statistical program called SPSS (SPSS, Inc., Chicago, Ill.). The data were examined in order to obtain information about average or percentage values for four different indicators of prenatal-care use: month of start of prenatal care<sup>2</sup>, the number of visits, rates of women obtaining no prenatal care, and the overall Adequacy of prenatal care.

Different data conventions were used in preparing the data depending upon the intended use. Data exclusions unique to each indicator of prenatal-care use are outlined in the next four sections. For all four indicators of prenatal care, system “missing” values (represented as “.” in the primary data set) were excluded from analyses. Additionally, for

---

<sup>2</sup>Throughout this work, the phrases such as “month of start of prenatal care”, “month prenatal care began”, and “timing of initial visit” are considered synonymous.

all analyses using the primary data set in the present research, only singleton<sup>3</sup> births were included; multiple births were excluded<sup>4</sup>.

#### Review of Data on Month of Start of Prenatal Care

Initially, the data for timing of first visit were examined in SPSS using frequency tables to determine if there were any outlying or inappropriate values. The month in which women started prenatal care was represented by a number ranging from 0 to 9, where 0 indicated that a woman received no prenatal care, and numbers 1 through 9 indicated the month of pregnancy in which care was initiated. A record showing a value of 2 in this field, for example, would refer to a woman who started care in the second month of pregnancy.

---

<sup>3</sup>“Singleton” refers to the birth of one, and only one, child for a given pregnancy.

<sup>4</sup>The primary data set contains all recorded live births including singleton, twin, and triplet births. From 1980-1989 there were 2,368 white infants (2.0% of all white births) and 280 Native American infants (2.2% of all Native American births) who were born as members of a multiple birth. Each member of a multiple birth is registered as a separate record in the primary data set. However, since the data are de-identified, there is no fool-proof way to link records of the members of multiple births. By including multiple births in the analysis, many mothers would be counted two or three times for a single pregnancy. Given that the focus of this thesis is women's use of prenatal care, and not the outcome of babies who benefited from prenatal care, twin and triplet births were excluded from all spatial and numerical analyses in this thesis.

An additional reason twin and triplet births were not included is that multiple births are considered high risk, and women carrying more than one fetus are generally advised to have more than the usual recommended number of prenatal-care visits. Moreover, the exclusion of multiple births in studies of prenatal care is consistent with other literature in cases where state records of births are used rather than data from surveys (Braverman et al. 1993, 1286).

Since there were no values less than 0 or greater than 9 in the primary data set for the field, all values were included in analyses of month of first visit excepting 0 which indicated no care. In determining the average month of start of care for a given county, values provided for all women of a given characteristic (such as white or Native American) *who had received prenatal care* were averaged. A county with an average month of start of care of 3.00 or greater illustrates a county in which women on average, started care after the first trimester.

#### Review of Data on Number of Prenatal Visits

The data on number of visits for singleton births were also examined using frequency tables. Number of visits ranged from 0 to 81 with 0 referring to women receiving no prenatal care, and numbers 1 through 81 indicating the actual number of prenatal care visits. As presented in Chapter 3, the prescribed number of visits for a woman carrying to term is 13. It is not uncommon for a pregnancy to last a few weeks past 40. However, it is unlikely that a normal pregnancy would result in 20 or more prenatal-care visits. It was presumed here that records reporting 20 or more visits were either mis-coded or were very high-risk pregnancies. Since high outlying values could easily change the average values for a given county, particularly small-population counties, records showing 20 or more visits were excluded from consideration in maps and tables illustrating average number of prenatal visits. Additionally, as was the case with analyses of timing of first visit, records indicating the number of visits as 0 for “no care” were excluded from analyses.

For values illustrating the average number of prenatal-care visits, the resulting value refers to the average number of visits for records of women which report more than 0 or less than 21 visits. An average value of 8.70 for a given age category, for example, would indicate that on average, women *who received care* in that age category had 8.70 prenatal-care visits.

In investigations of the *adequacy* of the number of prenatal visits, sufficiency of the number of visits could not be appropriately determined without consideration of the length of the pregnancy. To arrive at the needed figures, two weeks were added to the “length of pregnancy” variables in the original data set. In the Kessner Index, “gestation” refers to the number of weeks from the date of the last normal menses to the time of delivery. However, the primary data set registered “length of pregnancy” which refers to the estimated total number of weeks a woman is pregnant (calculated from the estimated date of conception).

Following adjustment of the “length of pregnancy” variable, records in which the recorded length of gestation was greater than 44 weeks were removed from consideration. These records were excluded since it is highly unlikely that a pregnancy would last longer than one month beyond normal, full-term gestation.

Pregnancies delivering between 35 and 45 weeks gestation were considered in determining sufficiency of the number of prenatal visits since the Kessner Index (Appendix) considers prenatal care to be Adequate for all pregnancies which have nine or more visits at 36 weeks gestation or later.

### **Review of Data on Women Receiving No Prenatal Care**

In reviewing the data pertaining to women who received no prenatal care, it was noted that some records were coded as 0 for “no care” in the category of “number of prenatal visits” but not in the category of “month prenatal care began”. The reverse situation was also found. For consistency, percentages referring to women who had no prenatal-care visits included only records which were coded as 0 in both the “number of prenatal visits” and “month prenatal care began” categories.

### **Review of Data on Overall Adequacy of Prenatal Care**

Categories of Adequacy (Adequate, Intermediate, or Inadequate levels of prenatal care) were determined based upon a slightly modified version of the Kessner Index sometimes used in the literature (McDonald and Coburn 1988, 172; Showstack, Budetti, and Minkler 1984, 1008). The primary difference between the original Kessner Index shown in the Appendix and the modification is that the modification excludes from consideration records which do not contain all of the data needed for calculation. By the standards of the original Kessner Index, records in which there are insufficient data are designated “Insufficient” care. Using the modification, these records were simply excluded from analyses. Also excluded were pregnancies which had gestations of less than 13 weeks.

An additional portion of the original Kessner Index which is no longer used in studies of prenatal care (and will not be used in the present research) is the consideration of location of delivery. The original Kessner Index specifies that the delivery had to take

place “on a private obstetrical service” in order for the prenatal-care regimen to be considered Adequate. None of several studies reviewed, which used a modification of the Kessner Index, considered the location of delivery as a criterion in determining the Adequacy of prenatal care (Gortmaker 1979, 658; McDonald and Coburn 1988, 172; Peoples and Siegel 1983, 607; Showstack, Budetti, and Minkler 1984, 1008).

As was the case for determination of average values for number of visits, in determining percentages of women receiving Adequate, Intermediate, or Inadequate levels of prenatal care for a particular county or race, cases were excluded in which the number of reported visits was greater than 20. However, unlike determination of average values for timing of first visit or total number of visits, records indicating “no care” were included in consideration of the overall Adequacy of care. Women who reportedly had no prenatal visits were designated as having an Inadequate level of prenatal care.

### **Preparation of the Physician and Midwife Data for Generation of Maps**

The available data on Obstetrician/Gynecologists, Family Practitioners, and Certified Nurse Midwives were entered into a spreadsheet program called Excel (Microsoft Corp., Redmond, Wash.). Initially, the data were arranged in a spreadsheet with towns listed vertically and type of provider by year (1980-1989) listed horizontally. For generation of the map showing average number of potential prenatal-care providers per year by county for the ten-year period of the study (fig. 2), the numbers of providers per town were conglomerated to number of providers per county. Next, the number of

providers by type in each year were totaled by county and then divided by 10 to arrive at the average number of providers per year during the study period.

Since the availability of potential prenatal-care providers may be dependent upon the proportion of providers to the population needing care, a second map (fig.3) was produced to illustrate the availability of providers. Fig. 3 shows the average number of potential prenatal-care providers per year per county divided by the number of singleton births per county over the ten-year period (multiplied by 1,000 to make the values more manageable). The intent was to illustrate the number of potential providers per 1,000 women needing their care. In fig. 2 a county may have a great number of providers, but having a very large number of women requiring their services may mask an actual deficit in provider availability. In contrast, a small-population county may have had only one doctor, but since the population needing care was so small, all needs could be met. Fig. 3 was designed to unmask situations like these which would not be apparent in fig. 2.

To prepare for quantification of locational access, which will be discussed in more detail later in this chapter, the location data were not conglomerated into counties. However, all providers were combined into one category for each separate year.

### **Mapping Conventions Used for Regional Comparisons**

The initial purpose of the present research is to describe regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980 to 1989. To describe these patterns, thematic maps were generated using the MapViewer program (Golden Software, Golden, Colo.) following preparation of the primary data in

SPSS. These maps, which will be presented in the next chapter, illustrate by county the average month in which women started prenatal care, their average number of visits, percentage of women receiving no care, and the proportion of women receiving overall Adequate, Intermediate, or Inadequate prenatal care for the time period of the study. When possible, one map each was produced for the two major racial groups in the State: Native Americans and whites.

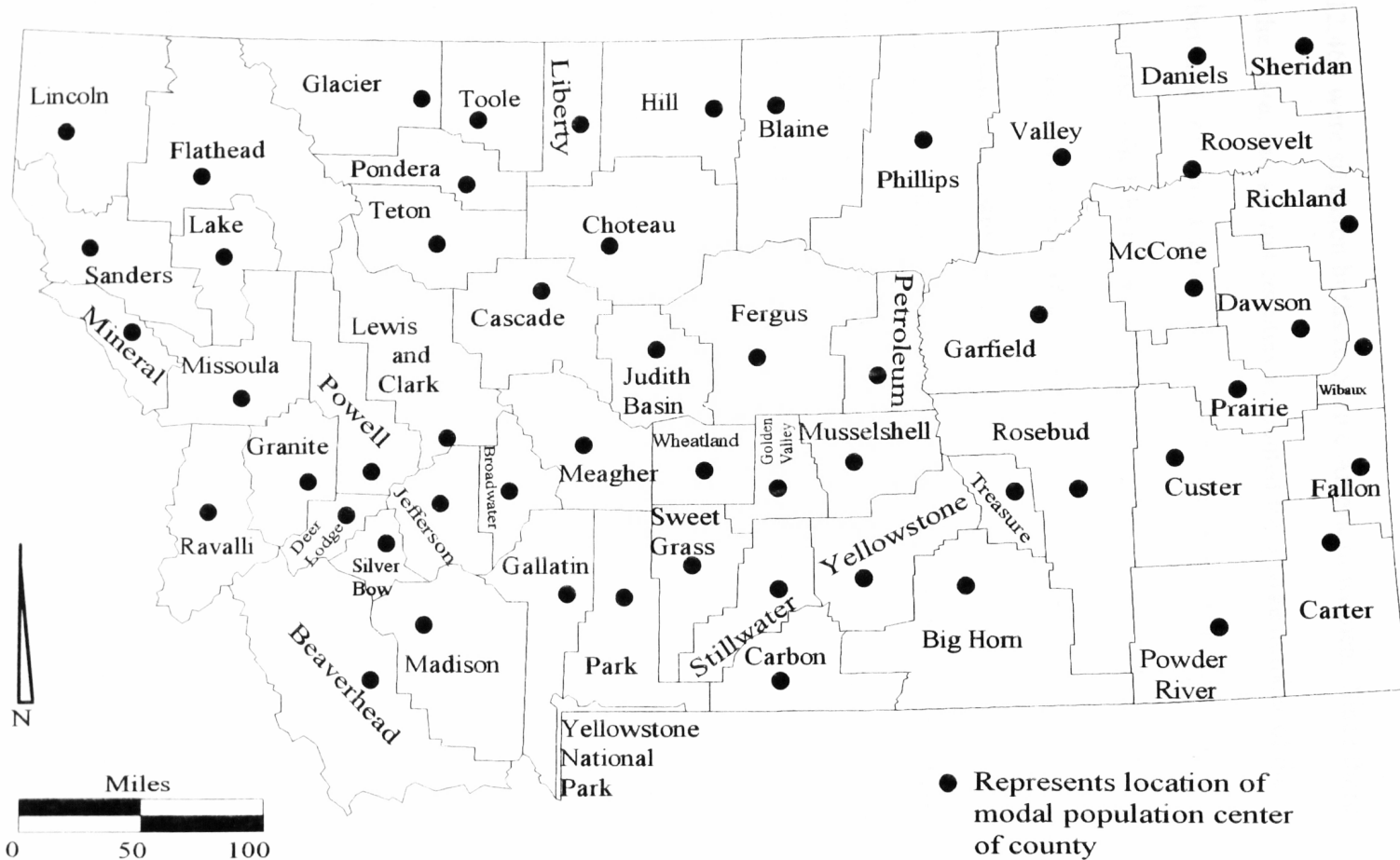
Several conventions were used in the creation of the thematic maps due to the nature of the data set. The primary data set specified the county of residence of the mother as well as the county of delivery. Since the present research is concerned with locational access to prenatal care, only the mother's county of residence was considered. All illustrations showing themes by county were, therefore, based on mother's county of residence, regardless of the site of delivery.

All births to residents of the Yellowstone National Park area were recorded as being residents of neighboring Park County by the Montana Department of Health and Environmental Sciences. To illustrate themes and patterns for the Yellowstone Park area and Park County, the two were treated as a single area. Hence, in all of the choropleth maps, Yellowstone National Park and Park County were shaded identically even though no births were recorded to residents of Yellowstone National Park. To assist with the location of these and other counties by name, a map showing the names of the counties was provided (fig. 4).

An additional convention was utilized for maps showing characteristics of the Native American utilization of prenatal care. Of the 133,062 births recorded in the



Figure 4: Montana Counties by Name



primary data set, 12,469 were singleton births to Native American women. Since there are 56 counties in the State, and several counties accounted for a large number of the Native American births, there were a great many counties which had very few Native American births. Counties which had 10 or fewer births to Native American women for a given category during the study period were not shaded in thematic maps.

Generally, in choropleth mapping, darker shades on a map are used to illustrate higher values. However, for the thematic maps used in this thesis, higher values do not convey the same message. For example, a high average for the month of start of prenatal care would be a negative indicator of prenatal-care use (higher refers to later start); in contrast, a higher value for the number of visits would be a positive indicator of prenatal-care use (higher refers to more visits). To facilitate interpretation of the maps, different color grades were used. For consistency, positive indicators (such as low average values for the month of start of prenatal care and high average values for number of visits) were shaded blue; negative indicators were shaded red. Moderately positive indicators were shaded green, moderately negative indicators were shaded orange, and moderate indicators were shaded yellow.

### **Measuring Locational Access**

An additional objective of the present research is to determine whether the late initiation of care and less frequent usage of prenatal-care services by Montana's Native American women relative to white women can be attributed to different patterns of locational access to potential prenatal-care providers. As mentioned in Chapter 1, it is

hypothesized that when provider availability, in conjunction with socio-demographic characteristics of women, are taken into account, differences in utilization between the two races will be lessened or explained. Initially, to accomplish the task of proving the hypothesis, locational access was measured.

Ideally, to measure a woman's locational access to prenatal-care providers, road or travel-time distance between mother and provider would be measured. The number of providers within a certain distance of each mother could then be determined. The average number of visits or average timing of first visit for women living 0 to 25 miles from one or more providers would be compared with women living further from providers or women living within 0 to 25 miles from a fewer number of providers. If the hypothesis (that areas of Montana with limited locational access to appropriate health-care services during the 1980 to 1989 period also had less desirable levels of prenatal-care utilization) is correct, the more providers available within a specified distance, the higher the average number of visits and earlier the timing of the first visit.

In light of the nature of the data set, however, quantification of locational access was not particularly intuitive. The geographic location of mothers in the primary data set was represented by county, not town or address, while the location of providers was represented by town. Hence, exact road or time distances from mother to provider could not be determined. In order to represent the distance from mother to provider, some estimation was required; specifically, a given point or town within each county had to be chosen to represent the location of all mothers in that county.

For the purpose of determining distance from mother to provider, it was assumed that all mothers in a given county resided at the modal population center of the county (fig. 4). Here, modal center refers to the town of a given county with the largest population. In all cases except Madison County, the modal population center of the county coincided with the county seat. The modal population center of each county was used because it provides a reasonable and consistent estimate of where most women in a county reside. An areal mean center would only show the center in area of a given county and may not accurately reflect the location of the population.

To quantify the availability of providers, a geographic information system, ARC/INFO (Environmental Systems Research Institute, Redlands, Calif.) was used to determine the number of providers within four distance ranges of the proxy for mother's residence (county modal population center). To accomplish this task, all 96 towns which had at least one Certified Nurse Midwife, Obstetrician/Gynecologist, or Family Practice Physician at any time during the ten-year period of the study were plotted on a map of Montana. Next, the total number of providers for each of the ten years were assigned to each point as attribute data. One at a time, four zones (circles) were placed around each of the 56 modal population centers for each of the ten years. The zones of 25, 50, 75, and 100 mile-radii were placed around each county's modal center. Using ARC/INFO, the number of providers within each zone were counted for each year of the study by considering all towns, not just modal centers, which had providers.

For example, in 1980, Polson City (the modal population center of Lake County) had 8 total providers within 25 miles of Polson. This figure includes providers in the

towns of Condon, Lakeside, Polson, and Ronan--all of which are within 25 miles of Polson. Similarly, within 50 miles of Polson for the same year, there were 43 providers; within 75 miles, 81 providers; and finally, within 100 miles of the town, there were 99 providers. Number of providers at each distance zone was determined for *each* of the ten years of the study for *each* of the 56 counties in the State.

The radii of the zones were chosen somewhat arbitrarily, but are based generally upon travel time. In most areas of the State (if following the speed limit), it takes on average about half an hour to travel 25 miles, one hour to travel 50 miles, an hour and a half to travel 75 miles, and about two hours to travel 100 miles. Twenty-five miles is not an unreasonable distance to travel for groceries for many Montanans. An hour's drive is not unusual for a dinner; an hour and a half of travel time is certainly not unique for a trip to a mall; and a two hour drive for a hunting or fishing trip is a matter of course. Shorter distance zones were not used since they have already been considered by the Montana Department of Health and Environmental Sciences (1991, 18). Also, shorter distances would not be appropriate considering that the locations of the mothers had to be generalized.

The result of the analysis in ARC/INFO was a listing of values for each county showing the number of providers within 25, 50, 75, and 100 miles of each modal population center for each of the years from 1980-1989. These figures were coded into the primary data set into four separate fields (one field for each distance variable) using SPSS. The number of providers available within each distance range was assigned to each record. For example, for the "25-mile-zone" variable, every record of a resident of Lake

County who delivered in 1980 was assigned the value 8 (there were 8 potential prenatal-care providers within 25 miles of Lake County's modal population center). All other records were assigned values in the same way requiring 560 "if/then" statements for each of the four distance zones: for example, *if* the mother's county of residence is Lake County and the year of birth is 1980, *then* the number of potential prenatal-care providers within 25 miles of the modal population center of Lake County is 8.

Following these analyses, tables were created to list the average number of prenatal-care visits and average month of start of prenatal care by availability of providers within each of the four distance zones. An additional table was generated to show the average number of providers available at each distance zone for the two different races. In the following chapter, these tables, as well as the thematic maps, will be presented, analyzed, and discussed.

## CHAPTER 5

### ANALYSIS AND DISCUSSION

In the previous chapter, the methods for preparing the data, conventions used in mapping, and methods for measuring locational access were described. In the present chapter, maps and tables are presented, and analysis and discussion of the work's outcome are provided.

#### **Analysis and Discussion of Regional Data**

The purpose of the present research is to describe regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980 to 1989 and to determine whether regional availability of health-care providers had an impact on these patterns. Figures illustrating regional patterns of timing of first visit, total number of visits, women receiving no care, and overall Adequacy of prenatal care were generated to achieve this goal.

#### **Maps Illustrating Regional Patterns of Month of Start of Prenatal Care**

Two different thematic maps for each racial group were created to illustrate regional patterns of the timing of the first prenatal-care visit. The first two maps,

illustrating the timing of first prenatal-care visit, were designed to show how the different *counties* compared in terms of the average timing of first prenatal visit for a given race.

Fig. 5 shows average month of start of prenatal care by Montana Native American women and fig. 6 shows the same information for white women. The two maps are generally not comparable between races since different data divisions were used in each. For the 11,985 Native American births considered in fig. 5, the overall State average for the month of start of prenatal care was 3.62, that is, shortly after the end of the first trimester. For whites (fig. 6) this average was 2.70 (N=115,317), or shortly before the end of the first trimester.

For the purpose of comparing the patterns between the two different *rac*es, two maps illustrating timeliness of care (figs. 7 and 8) were generated using the same data used for the previous two maps (figs. 5 and 6). These timeliness of care maps (figs. 7 and 8) show whether or not the women in each county, on average, started prenatal care in a timely manner. Here, “timely” refers to start of care in the first trimester (before the end of the third month of pregnancy). For all four maps illustrating month of start of care, (figs. 5-8), as per the conventions listed in the previous chapter, only the records of singleton births were considered, and then only if the timing of the first visit ranged from one to nine. Records which indicated no prenatal care or no data for the field were not included.



Figure 5: Average Month of Start of Prenatal Care by Montana Native American Women, 1980-1989

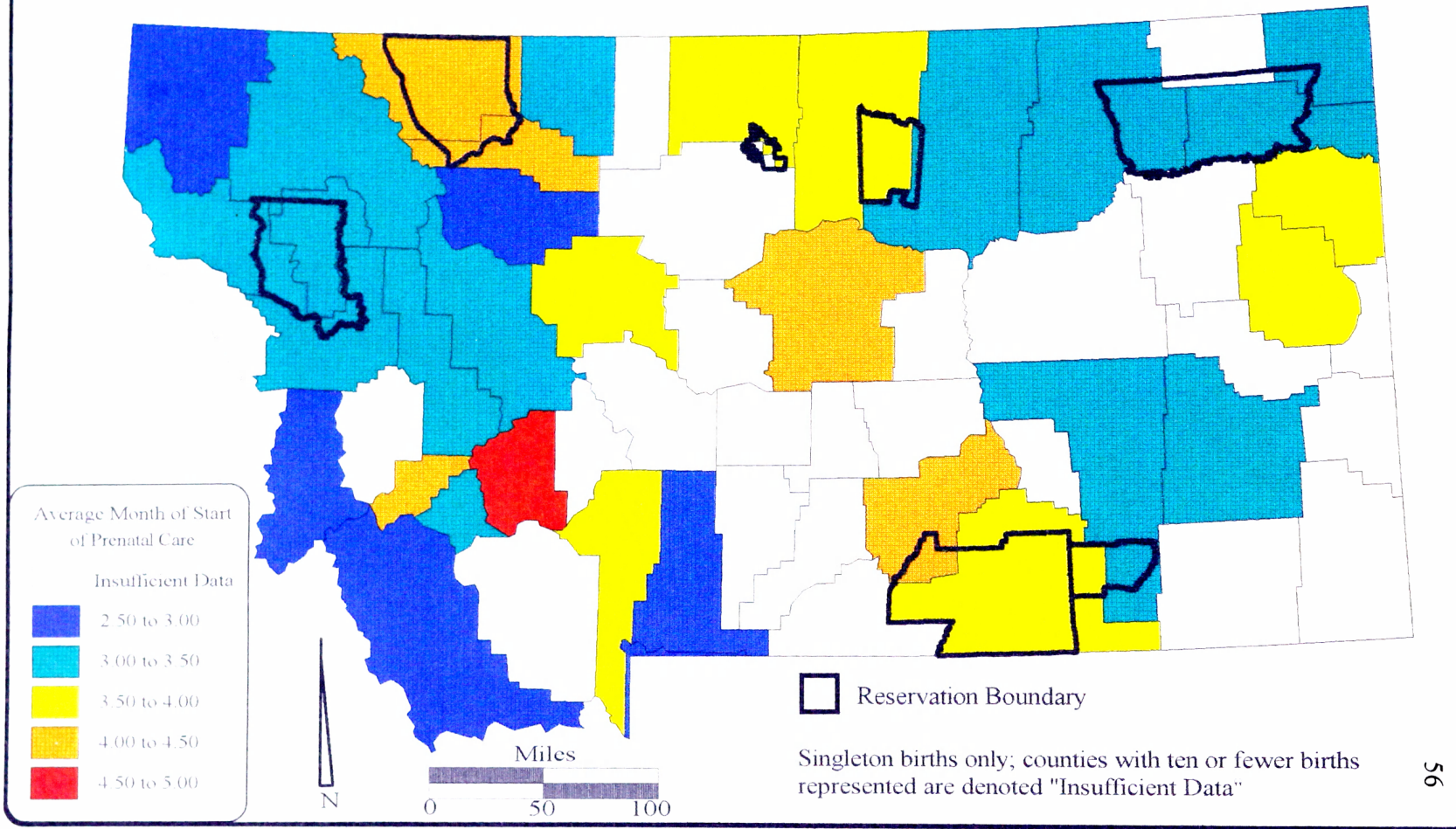


Figure 6: Average Month of Start of Prenatal Care by Montana White Women, 1980-1989

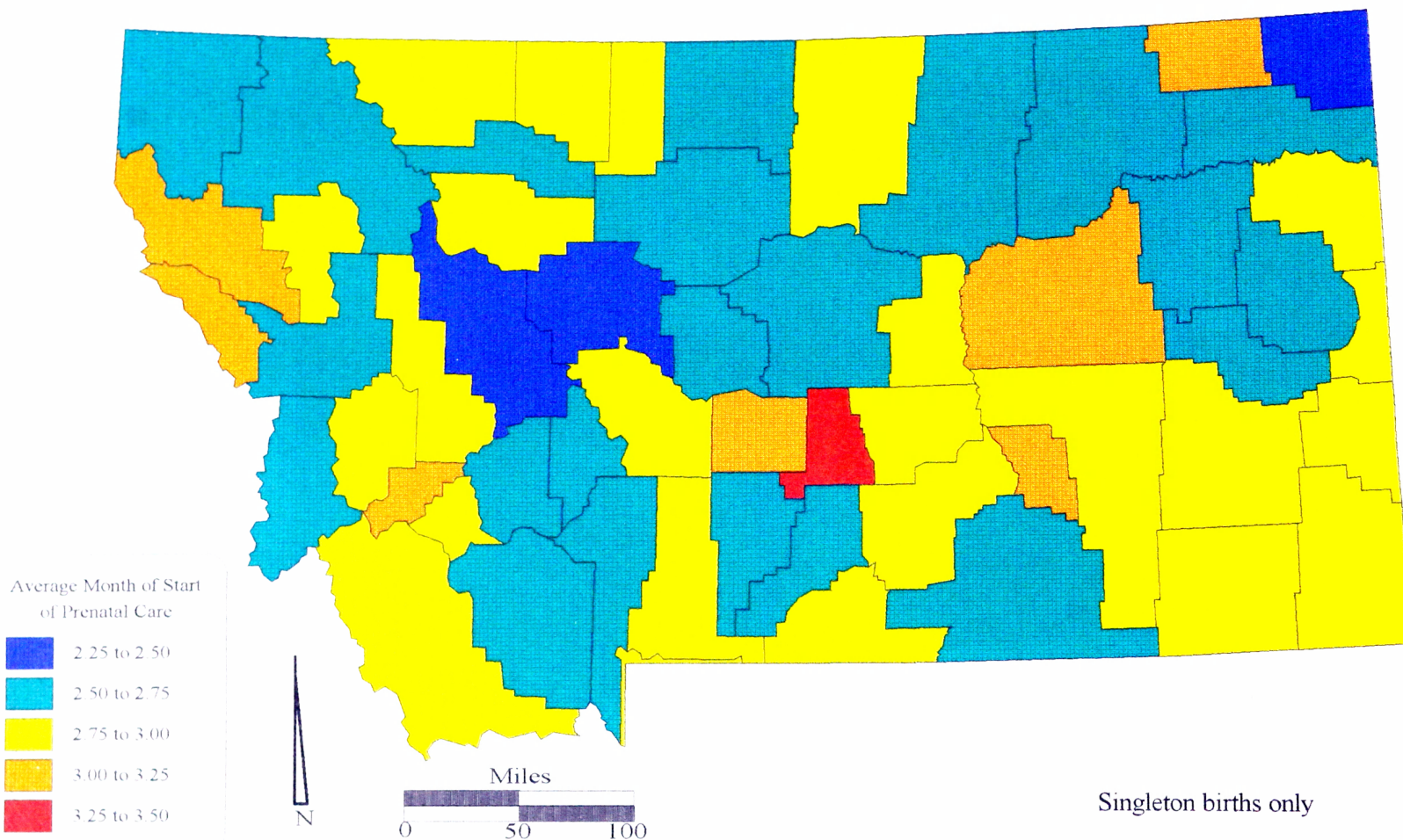




Figure 7: Average Timeliness of the Start of Prenatal Care by Montana Native American Women, 1980-1989

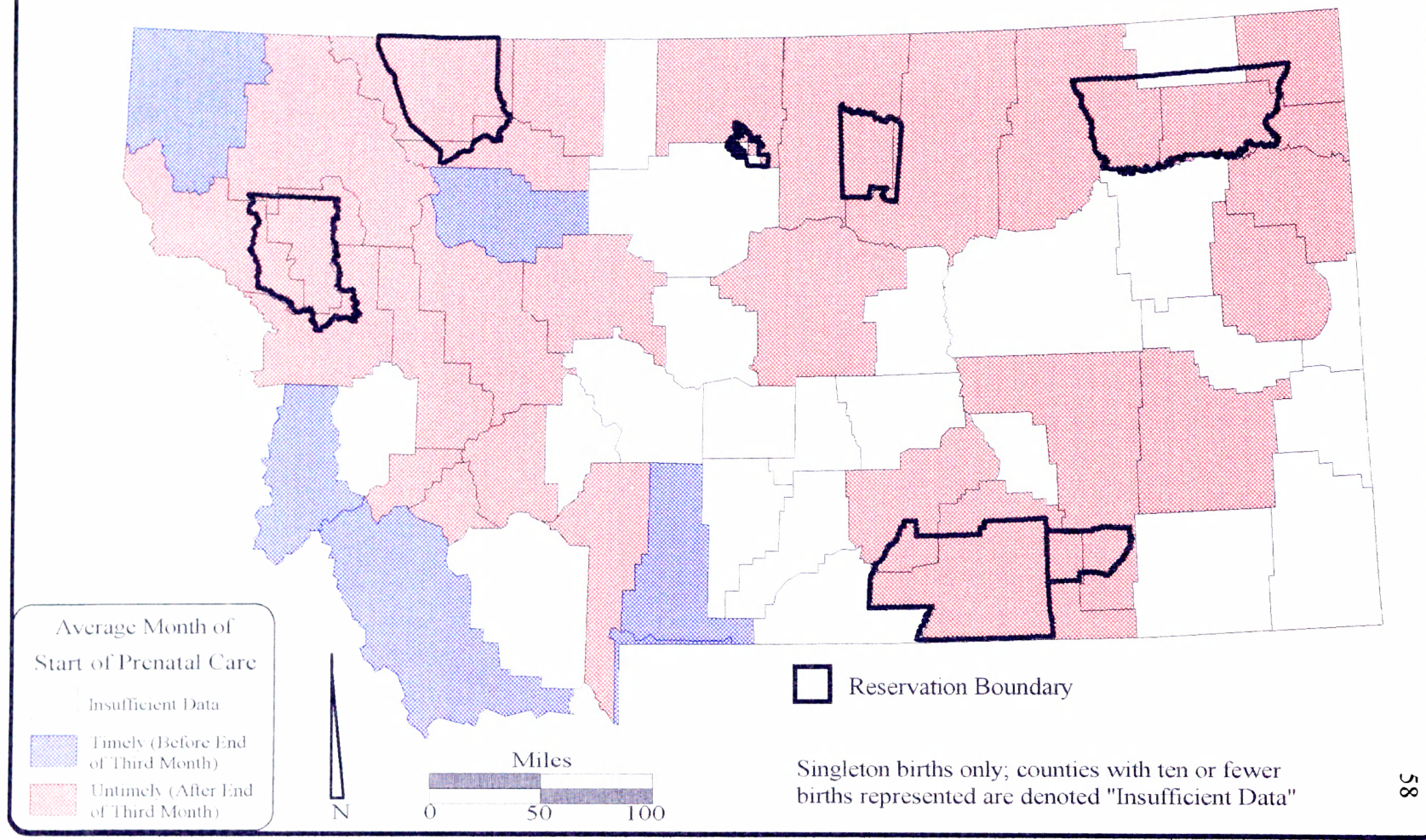
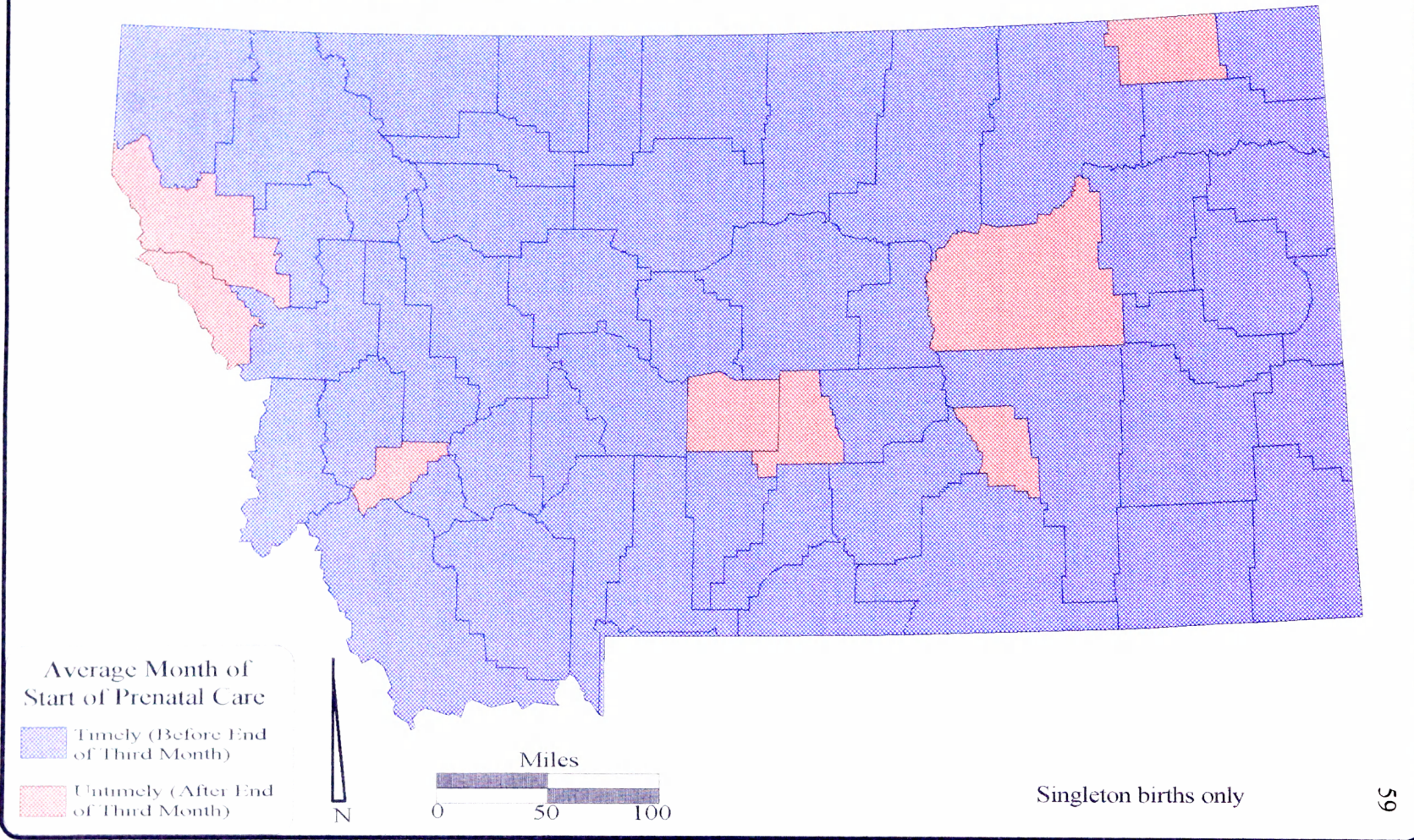




Figure 8: Average Timeliness of the Start of Prenatal Care by Montana White Women, 1980-1989



### **Analysis and Discussion of Regional Patterns of Month of Start of Prenatal Care**

**Fig. 5 shows the average month of start of prenatal care by Native American women. The counties averaging the earliest start of prenatal care (blue) among Native Americans were all located in western part of the State. These were the only counties in which the average start-time for care was in the recommended first trimester of pregnancy. None of the counties illustrating a timely start in care had a reservation within their boundary.**

**Counties averaging close to a timely start in care (green) were located primarily in the northwest portion of the State as well as the east. Jefferson County in the southwest stands out as having had very late average starting time for prenatal care (red). Several counties in the west-central and central regions of the State also averaged rather late starting times (orange).**

**Comparing the patterns of the average month of start of prenatal care by Native American women (fig. 5) with the availability of providers (fig. 2), it is noted that there was little direct visible connection between number of providers within a county and the timing of first visit. Fig. 2 shows that Cascade, Flathead, Gallatin, Lewis and Clark, Missoula, and Yellowstone Counties had the highest average number of providers during the ten year period. However, none of these counties averaged timely start of care during the first trimester for Native Americans. In fact, Yellowstone County was in the second latest category (orange) for start of care. The counties which did average start of care in the first trimester (Beaverhead, Lincoln, Park/Yellowstone Park, Ravalli, and Teton) were counties which averaged 2.9 to 8.2 providers per year over the ten-year period (the mean**

number of providers was 6.7). The counties which averaged 0 to 0.5 providers during the study period were counties which had insufficient Native American births and could not be included in the analysis.

Comparing the timing of care (fig. 5) with the ratio of availability of providers for every 1,000 births within a county (fig. 3) there is still little direct evidence that provider availability affected timing of first visit for Native Americans. One county in the west (Powell) had a high average number of potential providers per births and had a moderately early average start of prenatal care by its residents. However, other counties with moderately early start in prenatal care had a low or medium ratio of providers to women (such as Custer, Flathead, Lake, Lewis and Clark, Missoula, Phillips, Roosevelt, Rosebud, Sanders, Sheridan, Silver Bow, and Valley ). Another county (Jefferson), with a strikingly late average start in prenatal care, also had a medium ratio of providers to women. Except, perhaps, in the case of Yellowstone County, the connection between a large ratio of providers to births and an early average start in care was inconsistent with the expectations of the hypothesis.

Fig. 6 shows the average month of start of prenatal care for white women in the State. This map is not directly comparable with fig. 5, which illustrates the average month of start of care for Native American women, since the data divisions are different. White women residing in Lewis and Clark, Cascade, and Sheridan counties averaged the earliest starting time for prenatal care in the State during the period of the study. Counties which averaged late starting times were scattered across the State with no discernible regional pattern. Golden Valley County, near the geographic center of the State, perhaps due to its

relative isolation from services, averaged the latest starting time (red) for whites. The pattern for starting time of care for whites (fig. 6) differed from that of Native Americans (fig. 5) in that the western portion of the State did not stand out as having earlier average starting time for prenatal care.

The positive relationship between the average start-time of care for whites (fig. 6) and the number of potential providers by county (fig. 2), was slightly more apparent than was the case for Native Americans. However, the association was still quite tenuous. The two counties (Cascade and Lewis and Clark) with the earliest average starting time for care among whites were also counties with a high number of potential providers during the ten-year study period. Three other counties in the west (Gallatin, Flathead, and Missoula) also had a large number of providers and ranked well in terms of timing of first visit. Yellowstone County, the sixth county with a noticeably high number of providers, averaged timely start of prenatal care but not as early as was the case for other counties with a large number of providers.

The county demonstrating the latest average start in prenatal care for white women (Golden Valley), had no providers during the ten-year study period. Other counties with no providers (Judith Basin, Petroleum, and Wibaux), however, still averaged initiation of care in the first trimester. A second county (Treasure), like Golden Valley County, had no potential providers and a late average initiation of care (orange).

By comparing average number of visits for whites (fig. 6) with the ratio of providers to every 1,000 births (fig. 3), the relationship was again very weak. Golden Valley County with very late average starting time had no providers which would support

the hypothesis. However, three of the other counties with no providers (Judith Basin, Petroleum, and Wibaux) had moderate to moderately early average starting times. Three counties with early average start times (Cascade, Lewis and Clark, and Sheridan) all had a medium ratio of providers to births. Although there were a few counties which appeared to conform to the hypothesis that increased access to prenatal-care providers would positively affect timing of first visit, these counties appear to be the exception rather than the rule.

Figs. 7 and 8 use the identical data used for figs. 5 and 6. The data divisions were altered to better illustrate which counties averaged timely care and to compare the patterns between Native Americans and whites. These two maps, illustrating timeliness of care (figs. 7 and 8), demonstrate the phenomenon of later start of prenatal care for Native Americans. Native Americans, on average, started care nearly a month later than their white counterparts: the average month of start of care for Native Americans was 3.62; for whites it was 2.70. The map showing timeliness of care for Native American women (fig. 7) shows that in the majority of counties, the average start of care was untimely for Native Americans; the opposite was true for whites (fig. 8).

None of the counties in the eastern half of the State averaged timely care for Native Americans (fig. 7). Additionally, none of the counties with reservations averaged timely care for Native Americans suggesting that the reservations, whether or not they contain an Indian Health Service birthing facility, do not exert much influence in encouraging women to start prenatal care in a timely manner.



Fig. 8, illustrating timeliness of care for whites, shows that untimely care was found in pockets across the State. The two counties averaging untimely care for whites (Deer Lodge and Sanders) which can be compared with averages for Native Americans (the others did not have sufficient data) also had untimely care for Native Americans.

Since figs. 7 and 8 utilize the identical data used for figs. 5 and 6, the discussion regarding timeliness of care versus availability of providers is not repeated here.

#### Maps Illustrating Regional Patterns of Number of Prenatal Visits

Similar to the maps illustrating average timing of first prenatal visit, two different maps for each racial group were created to illustrate regional patterns in the average number of prenatal-care visits. Figs. 9 and 10 show the average number of prenatal-care visits for each race by county, without consideration for the length of gestation. These maps were not intended to illustrate the different patterns by race, but rather were intended for comparison between counties for a given race. Again, as was the case for the illustrations showing average month of start of care (figs. 5 and 6), different data divisions were used for each of the two maps.

Overall, the average number of prenatal-care visits by Native American women delivering singleton babies from 1980-1989 was 8.19 (N=11,932) or slightly more than eight total visits. For whites, this figure was considerably higher at 10.76 (N=114,671) or nearly eleven total prenatal-care visits.

Figs. 11 and 12 show adequacy of the number of prenatal-care visits for Native Americans and whites. The data differ slightly from that of figs. 9 and 10 in that only

Figure 9. Average Number of Prenatal-Care Visits by Montana Native American Women, 1980-1989

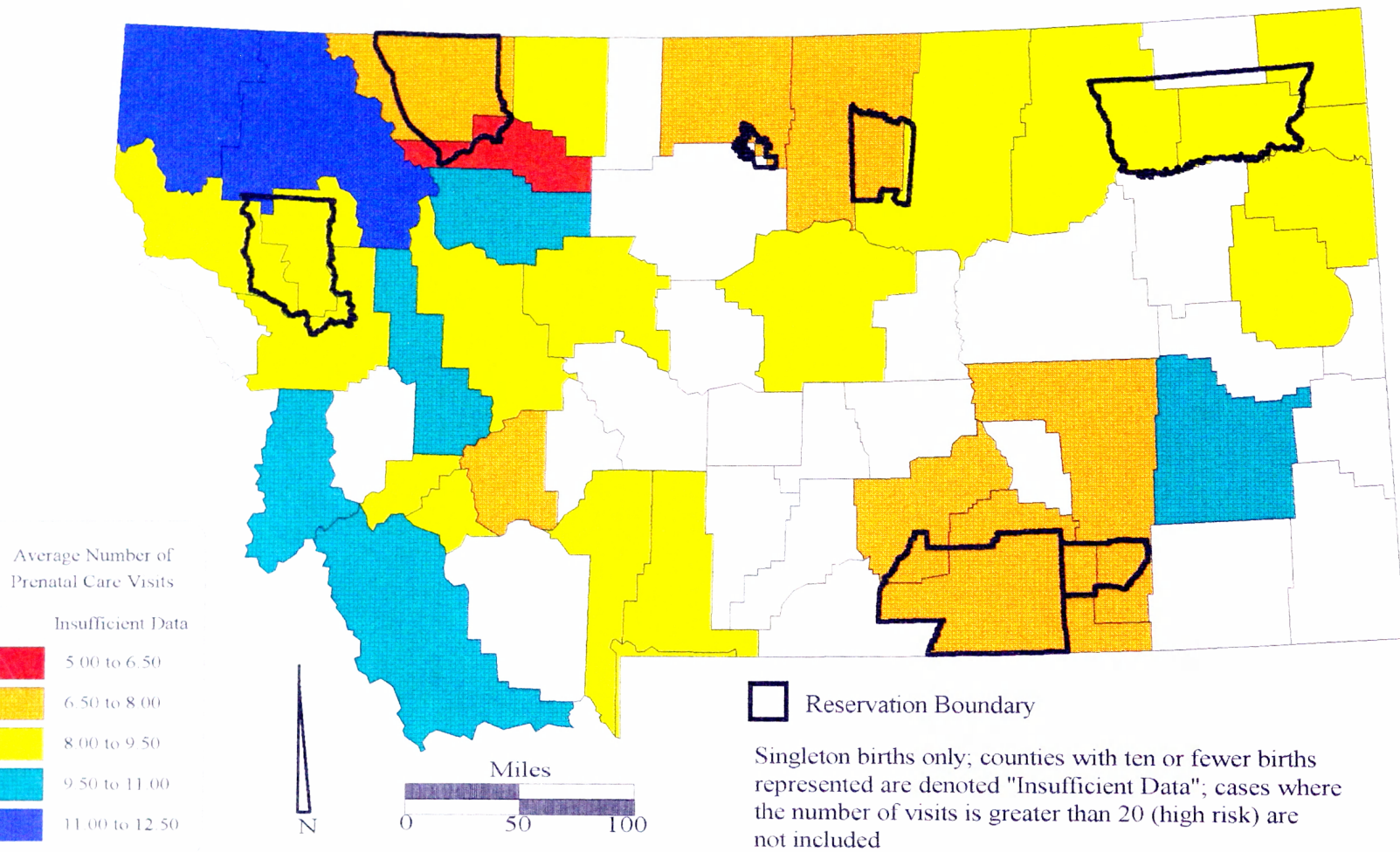


Figure 10: Average Number of Prenatal-Care Visits by Montana White Women, 1980-1989

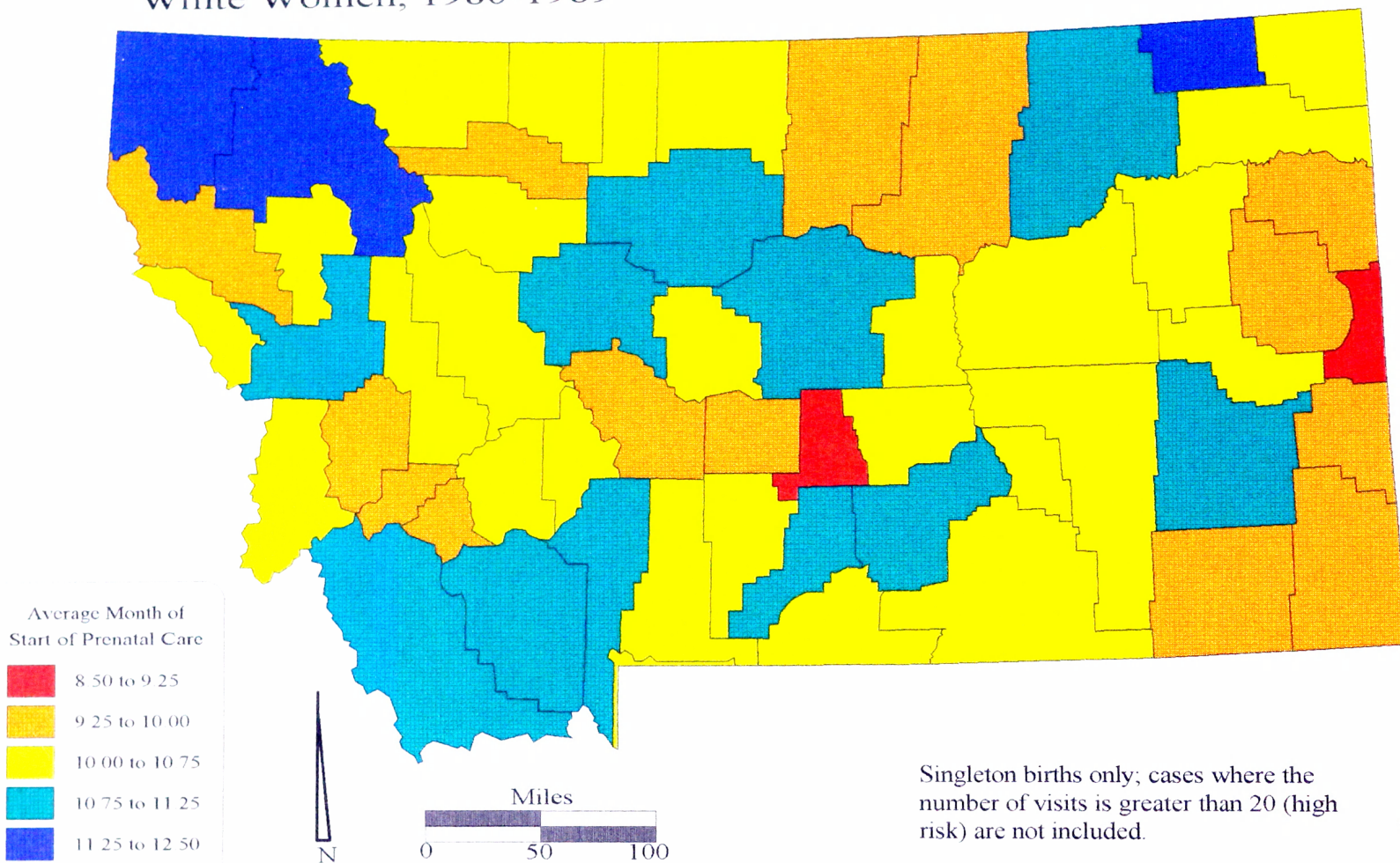




Figure 11: Adequacy of the Number of Prenatal-Care Visits by Montana Native American Women Delivering at 36 Weeks Gestation or Later, 1980-1989

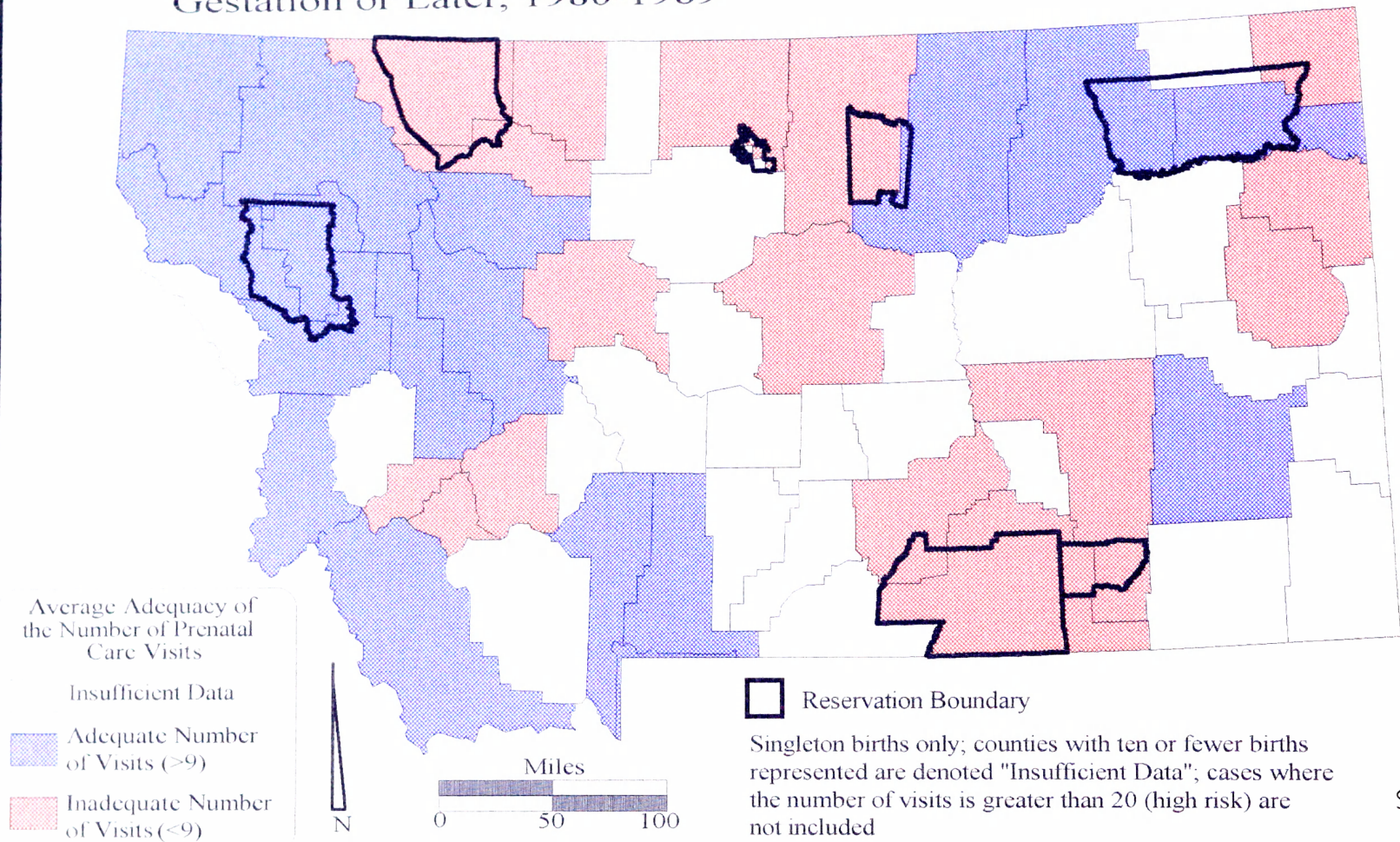
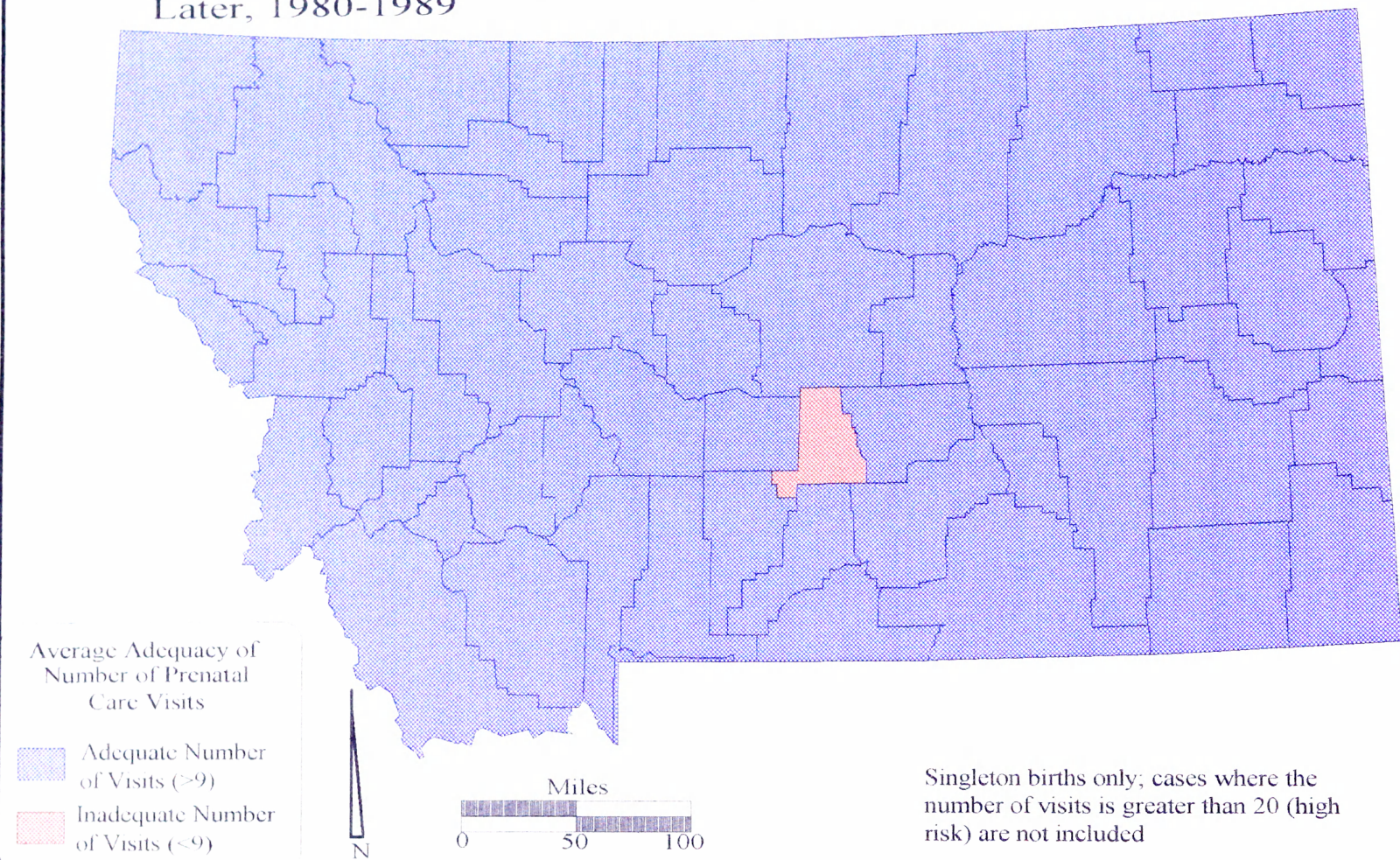




Figure 12. Adequacy of the Number of Prenatal-Care Visits by Montana White Women Delivering at 36 Weeks Gestation or Later, 1980-1989



records of women delivering at or beyond 36 weeks gestation were included. By considering only women delivering past this gestation, the adequacy of number of visits is illustrated. According to the Kessner Index, an average of nine or more visits at or beyond 36 weeks gestation is considered adequate. Since the maps showing adequacy of number of visits (figs. 11 and 12) have identical data divisions, they can be used to compare sufficiency in the number of visits between the two races.

For singleton Native American births delivering between 35 and 45 weeks, the average number of visits was 8.30 (N=10,830); for whites this figure was 10.87 (N=106,865).

#### Analysis and Discussion of Regional Patterns of Number of Prenatal Visits

Fig. 9 shows average number of visits for Native American women who delivered at all lengths of gestation. Two counties in the northwest corner of the State (Lincoln and Flathead) (blue) had the highest average number of visits. Counties with moderately high average number of visits for Native Americans were all located in the western part of the State with the exception of Custer County in the east. Pondera County, also in the northwest, had the lowest average number of prenatal-care visits (red) during the period of the study and contrasts sharply with nearby Lincoln and Flathead Counties. Counties with reservations within their borders fared worse in terms of average number of visits than they did for average month of start of prenatal care. All seven reservation areas rated from moderate to moderately low in total number of visits, whereas several had nearly timely care (fig. 5).

Fig. 10 shows average number of prenatal-care visits for white women who delivered at all lengths of gestation. Here, as was the case for Native Americans, two northwestern counties (Lincoln and Flathead) averaged a high number of prenatal-care visits (blue). For whites, Daniels County in the northeast also had a high average which is remarkable considering that Daniels was one of the counties averaging untimely start of prenatal care (figs. 6 and 8). As was the case for Native American women, there was no distinct regional pattern of the average number of prenatal-care visits for white women. One noteworthy exception is the pocket of comparably low average number of visits along the southeastern border of the State.

The relationship between number of potential providers per county (fig. 2) and average total number of visits for Native Americans (fig. 9) (like that of average start of prenatal care) was weak. Although Flathead County had a high average number of visits and a large number of potential providers, neighboring Lincoln County also had a high average number of visits, but a moderate number of providers. Certainly, residents of Lincoln County could have benefited from the providers in nearby Flathead County, but this would not explain the lack of association between the two variables in other counties in the State. For example, five counties (Beaverhead, Custer, Powell, Ravalli, and Teton) all had a relatively high average number of visits but low to moderate numbers of providers. Gallatin and Yellowstone Counties had a large number of providers, but did not average particularly high number of visits.

For whites (fig. 11), the average number of visits appears to associate more closely with number of providers than for Native Americans (fig. 10). The same was evident in

the case of timing of first visit. Again, however, the relationship is not particularly strong. The counties with the most providers (Cascade, Flathead, Gallatin, Lewis and Clark, Missoula, and Yellowstone) all averaged a high number of visits (shown as green or blue on fig. 10). However, several other counties with a high average number of visits did not have a large number of providers. The two counties with the lowest average number of visits for whites had no providers within their counties for the period of the study. However, three other counties with no providers still averaged a mid-level number of visits.

In comparing the patterns of the number of prenatal-care visits for Native Americans with the ratio of number of potential providers to every 1,000 births (fig. 3), there was again little direct association. For example, in the northwest corner of the State, where the variation in average number of visits is great between counties, the average ratio of providers to births was fairly constant. In the northeast corner of the State where average number of visits for Native Americans was moderate, ratio of providers to women was also moderate. However, in the southeast corner of the State, Custer County had a high average number of visits, but a low ratio of providers to women.

As with Native Americans, there was little association between number of visits and ratio of providers to every 1,000 live births for whites. Two counties (McCone and Powell) with a very high ratio of providers had only a moderate number of visits among white women. The same was true for three other counties (Judith Basin, Petroleum, and Treasure), all of which had no providers at all during the ten-year study period.



Native American women (fig. 11) residing in the western part of the State tended to obtain an adequate number of visits as did women in some areas of the eastern part of the State. However, in other parts of the State, the number of visits was, on average, inadequate. Having a reservation in a county did not appear to impact one way or another whether the number of visits was adequate.

Among white women only those residing in one county (Golden Valley) averaged an inadequate number of visits (fig. 12). In examining the illustrations of the adequacy of number of prenatal-care visits (figs. 11 and 12), it is apparent that in addition to averaging a later start in prenatal care, Native American women also averaged fewer prenatal-care visits than white women.

Comparing the adequacy of the number visits for women delivering after 35 weeks gestation with the number of potential providers, the relationship was again weak. For Native Americans (fig. 11), four of the six counties with a high number of providers averaged nine or more prenatal visits. However, the two remaining counties with a large number of providers (Cascade and Yellowstone) averaged an inadequate number of visits. Counties in the west appeared to do better than those in much of the rest of the State regardless of whether there was a large number of providers or not. In the northeast, even though there were relatively small numbers of providers, several counties averaged an adequate number of visits.

For whites (fig. 12), Golden Valley was the only county averaging an inadequate number of visits. It was also a county with no providers during the ten-year period (figs. 2

and 3). However, the other counties with no providers (Judith Basin, Petroleum, Treasure, and Wibaux) did average an adequate number of visits.

Comparing the ratio of potential providers to births (fig. 3) with adequacy of number of visits for either Native Americans or whites (figs. 11 and 12), the hypothesis is not supported. In very few cases did a high ratio of providers correspond to adequate number of visits. At the regional level, availability of providers did not appear to impact the number of prenatal visits a woman obtains for either Native Americans or whites.

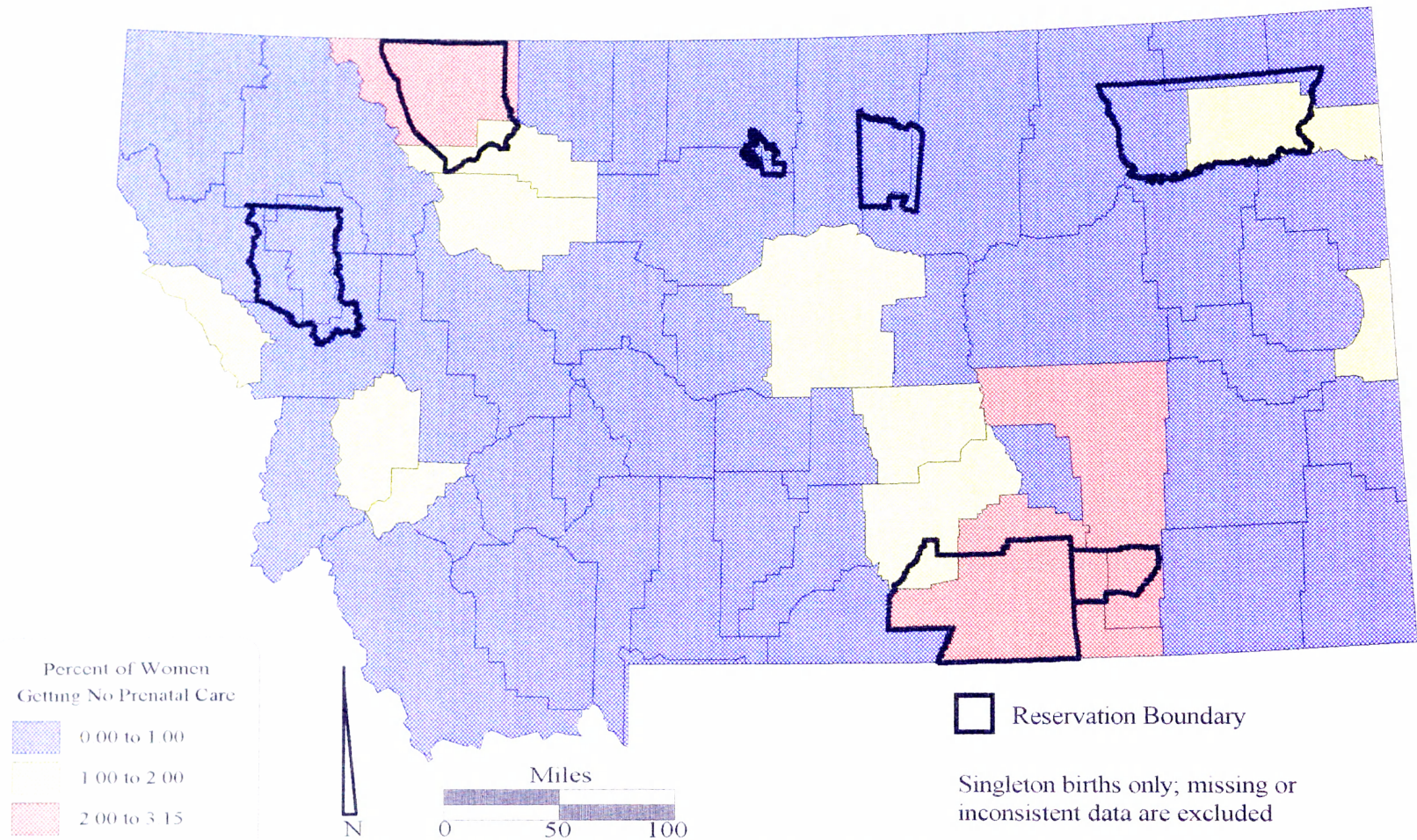
#### Maps Illustrating Regional Patterns of Women Receiving No Prenatal Care

For the figures illustrating timing and number of prenatal-care visits for Montana women (figs. 5-12), the data included only women who had reportedly received at least one prenatal-care visit. Women who received no prenatal care were not included in these maps. Overall, 1,068 singleton births from 1980-1989 in Montana were to women who received no prenatal care. Of these births, 394 were to Native American women (3.16% of all Native American singleton births), 659 to white women (0.90% of all white singleton births), and 15 to women of other races (1.22% of all singleton births to women of other races). Since the numbers by county of women receiving no prenatal care were quite small in most cases, maps showing the percentage of women in each county receiving no prenatal care by *race* were not created. Instead the map generated includes singleton births to women of *all* races<sup>1</sup> who received no prenatal care (fig. 13).

---

<sup>1</sup>There were no maps generated to illustrate regional patterns of prenatal-care utilization for month of start of care, number of visits, and overall Adequacy of care for *all* races. Maps of this nature were not created since, due to the very large number of births

Figure 13: Percentage of Births to All Montana Women who had No Prenatal Care, 1980-1989



### Analysis and Discussion of Regional Patterns of Women Receiving No Prenatal Care

In fig. 13, three counties (Glacier, Bighorn, and Rosebud) stand out as having the highest percentage (2.00 to 3.15 percent) of women receiving no prenatal care. All three of these counties have a reservation within their boundaries; two (Glacier and Bighorn Counties) are the only two counties in the State having an Indian Health Service birthing facility during the period of the study. Counties having 1.00 to 2.00 percent of their resident women receiving no prenatal care were scattered throughout the State with several nearby to the three counties faring the worst.

The association between availability of providers and percentage of women receiving no care was again virtually nonexistent. Five of the six counties with a very high number of providers (Cascade, Flathead, Gallatin, Lewis and Clark, and Missoula) had very low rates of no prenatal care. Yellowstone County was the exception with more than 1.00 percent of its resident women receiving no care. The five counties with no providers (Golden Valley, Judith Basin, Petroleum, Treasure, and Wibaux) were *not* among the counties with the highest percentage of women receiving no care as would have been expected if decreased availability of providers prevented women from obtaining care.

The ratio of providers to number of births (fig. 3) also does not appear to affect percentage of women receiving no care. The three counties with the highest percentage of no-care births (Bighorn, Glacier, and Rosebud) all had a medium-level ratio of providers to births. Although the two counties (McCone and Powell) with the highest ratio of

---

to white women in comparison to births to women of other races, such maps would be nearly identical to associated maps illustrating the phenomena for white births only.

providers to births were among the counties with the lowest percentage of births to women receiving no care, four other counties (Golden Valley, Judith Basin, Petroleum, and Treasure), which had no providers, also were among the counties with the lowest percentage of births to women receiving no care.

#### **Maps Illustrating Regional Patterns of Overall Adequacy of Prenatal Care**

Figs. 14 and 15 illustrate the overall Adequacy of prenatal care by county for Native Americans and whites respectively. The proportional circles show the percentage of women who received Adequate, Intermediate, or Inadequate prenatal care based on consideration of the timing of first visit, the total number of visits, and length of gestation. More specifically, the categories were derived from a modified version of the Kessner Index which is described in Chapter 4.

#### **Analysis and Discussion of Regional Patterns of Overall Adequacy of Prenatal Care**

Since the category divisions for the two maps were based on proportions, it is appropriate to compare the two figures between races as well as between counties. Comparing figs. 14 and 15 it is immediately apparent that more whites obtained Adequate prenatal care during the study period than Native Americans. Indeed, for Native Americans in the State, less than half (47.81%) of the women received Adequate prenatal care; 32.78% received an Intermediate level of care; and nearly 20 percent had Inadequate prenatal care. For whites, more than 80% had Adequate care; 16.15% received care rated as Intermediate; and only 3.24% had Inadequate prenatal care. These figures were not



Figure 14: Proportion of Montana Native American Women Receiving Adequate, Intermediate, or Inadequate Prenatal Care, 1980-1989

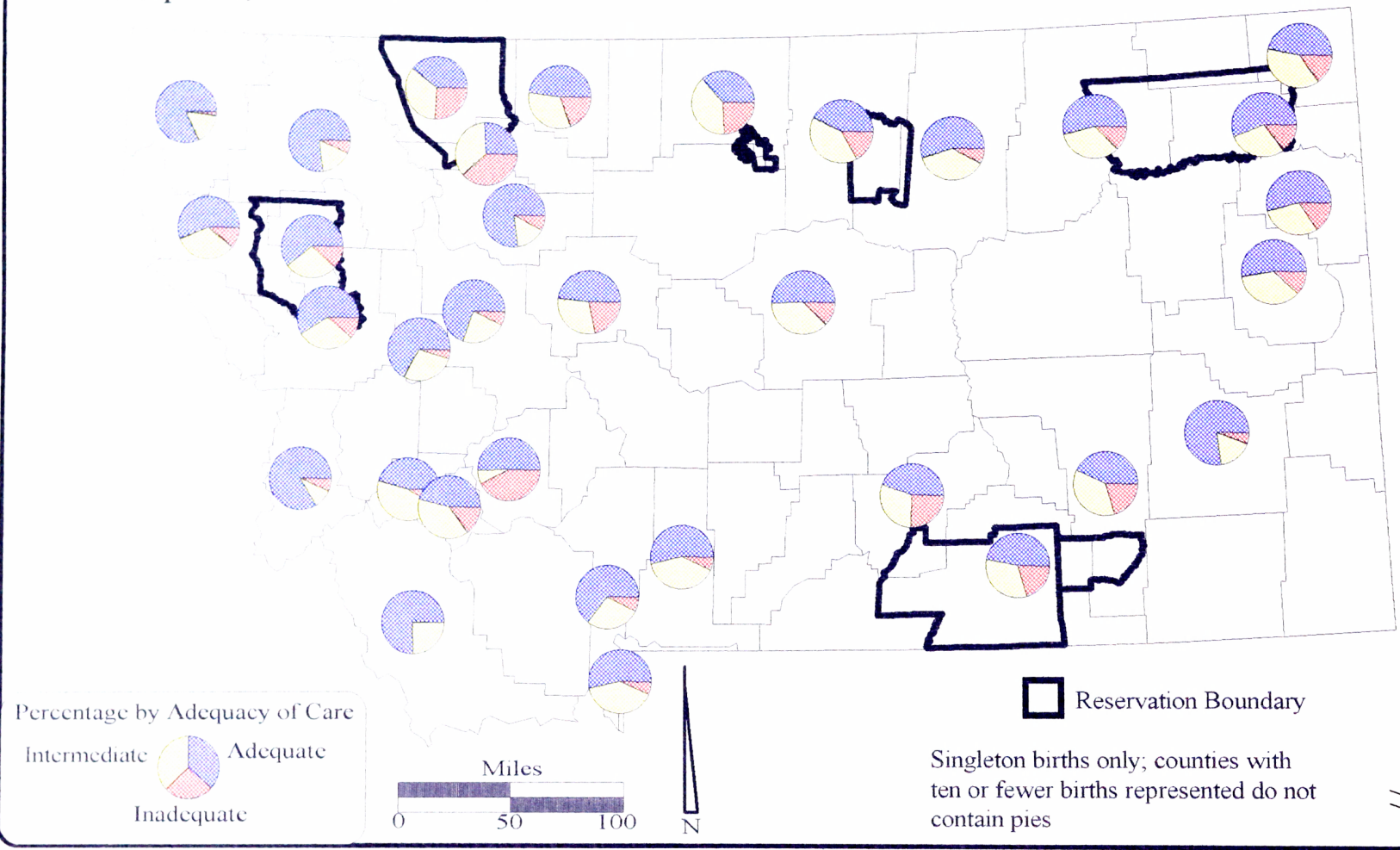


Figure 15: Proportion of Montana White Women Receiving Adequate, Intermediate, or Inadequate Prenatal Care, 1980-1989



surprising considering that whites averaged earlier and more frequent prenatal visits than Native Americans. However, the high rates of Inadequate prenatal care for Native Americans are alarming.

For Native Americans (fig. 14), six counties (Beaverhead, Custer, Flathead, Lincoln, Ravalli, and Teton) fared well in terms of a comparably high percentage of women obtaining Adequate prenatal care (more than 70%). There were three counties (Glacier, Hill, and Pondera) with comparably low levels (less than 40%) of women obtaining Adequate care. Two of these (Glacier and Pondera Counties) averaged very high levels of Inadequate prenatal care (more than 25%) in addition to Yellowstone County. Since all of the counties with low levels of Adequate care and high levels of Inadequate care have relatively large numbers of Native American births, these patterns are particularly noteworthy.

For whites (fig. 15), five counties (Cascade, Choteau, Daniels, Flathead, and Lewis and Clark) averaged very high levels of Adequate prenatal care (more than 85%). Unfortunately, two counties (Golden Valley and Wheatland) had high percentages of women receiving Inadequate care (more than 10%) or low percentages of women receiving Adequate care (less than 60%).

As expected, considering the low association between availability of providers and timing of first visit and number of visits, there was only a very weak relationship between Adequacy of care and provider availability as measured by visual comparison. For Native Americans (fig. 14), the counties with the highest percentage of women receiving Adequate care (Beaverhead, Custer, Flathead, Lincoln, Ravalli, and Teton) were counties



with a wide range of indicators of provider availability. In terms of the number of providers, five of these counties (Beaverhead, Custer, Lincoln, Ravalli, and Teton) had an average availability of providers. Only one (Flathead County) had a large number of providers. The same was true regarding the ratio of providers to births: of the six counties with high levels of women receiving Adequate care, only one (Flathead) had a relatively high ratio of providers to births. Glacier, Hill, and Pondera Counties in the north and Yellowstone County in the south all exhibited high levels of Inadequate care among Native Americans. Although Glacier, Hill, and Pondera Counties had both a small to medium number of providers and a moderate ratio of providers to births, Yellowstone County had a high number of providers and a low ratio of providers to births. For Yellowstone County's Native Americans, the low number of providers available for births during the decade of the study may have negatively affected the overall Adequacy of prenatal care.

White patterns of Adequate and Inadequate care also bore little resemblance to availability of providers. In five counties (Cascade, Choteau, Daniels, Flathead, and Lewis and Clark), white women had very high levels of Adequate care (fig. 15). In terms of the number of providers (fig. 2), three of these (Cascade, Flathead, and Lewis and Clark Counties) had a high number of providers which seems to agree with the hypothesis. However, the remaining two (Choteau and Daniels Counties), which also had high levels of Adequate care, had only a small number of providers in each county. For the counties with high percentage of Inadequate prenatal-care use among white women (Golden Valley

and Wheatland), Golden Valley had no providers while Wheatland County had a low number of providers and a moderately high ratio of providers to births (fig. 3).

#### **Regional Data: Concluding Remarks**

It was hypothesized that differences in prenatal-care utilization patterns were due to regional variations in availability of health-care providers in Montana during the 1980-1989 period. Specifically, it was proposed that areas of Montana with limited locational access to appropriate health-care services also had less desirable levels of prenatal-care utilization.

Although utilization of prenatal care was examined by considering regional variations in averages by county of timing of first visit, total number of visits, percentage of women receiving no care, and overall Adequacy of care, in none of these cases was there a strong or even moderate association between prenatal-care use and availability of providers as measured by both number and by ratio of providers to the number of births. The hypothesis that differences in prenatal-care utilization patterns were due to variations in availability of health-care providers, based on the data used in the present research, is not supported.

The maps generated, although not showing a relationship between prenatal-care utilization and availability of providers, do exhibit areas of the State which are in need of critical attention in terms of prenatal-care use. For Native Americans, proximity to a reservation did not appear to positively influence appropriate prenatal-care utilization.

Although reservations may provide cultural and other resources for their members, prenatal-care support, if it exists, did not appear to influence prenatal-care use.

Among Native American women, those residing in Big Horn, Blaine, Deer Lodge, Fergus, Glacier, Hill, Jefferson, Pondera, Rosebud, and Yellowstone may be in need of programs which support appropriate prenatal-care utilization. In each of these counties, the majority of Native American women had a deficiency in prenatal-care use. Among white women, those residing in the counties of Daniels, Deer Lodge, Garfield, Golden Valley, Mineral, Sanders, Treasure, Wheatland, and Wibaux are in need of special support for prenatal-care use.

#### **Analysis and Discussion of Locational Access to Providers and Maternal Socio-Demographic Characteristics**

Regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980 to 1989 were described using figs. 5 through 15. Regional comparisons between utilization and availability of providers were made possible by visual comparisons of the utilization maps (figs. 5 through 15) and provider availability maps (figs. 2 and 3). These comparisons were based on county-level data and did not directly consider the individual.

A second objective of the present research is to determine whether differences in prenatal-care utilization between Montana's Native American and white populations were due to differences in availability of potential prenatal-care providers in conjunction with

individual characteristics of the mothers. Availability of providers was determined using methods described in the previous chapter for measuring locational access.

#### **Tables Illustrating Patterns of Locational Access to Providers**

After the computations were completed in SPSS, comparisons were made between the availability of providers and the average values for timing of first visit and total number of visits. Tables 1, 2, and 3 show the results of these comparisons for each distance category (25, 50, 75, and 100 miles) by race by grouping of the number of providers available. Table 1 shows the average number of visits and average month of start of care for each of the two races by number of potential providers within 25 and 50 miles of each modal population center. Number of potential providers were grouped by five's for convenience. The number of providers available within 25 miles of each county modal population center ranged from 0 to 46; within 50 miles, the range was 0 to 60. Similarly, Tables 2 and 3 show the average number of visits and average month of start of care for each of the two races by number of potential providers within 75 and 100 miles of each modal population center. For these two tables, number of providers were grouped by tens since there were more providers within the larger distance ranges. Number of providers available within the 75-mile zone ranged from 5 to 106; within the 100-mile zone, the range was 10 to 174. Table 4, also produced using SPSS, simply shows the average number of potential prenatal-care providers available within each distance category for Native Americans and whites.

**Table 1: Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 25 and 50 Miles of Women**

		Average Number of Visits (Native American)	Average Number of Visits (White)	Average Month of Start of Care (Native American)	Average Month of Start of Care (White)
<b>Number of Potential Providers within 25 Miles</b>	0	10.42 (12)	9.77 (1,426)	3.42 (12)	2.93 (1,428)
	1-5	8.17 (3,094)	10.21 (24,016)	3.56 (3,104)	2.81 (24,093)
	6-10	8.03 (5,975)	10.57 (15,956)	3.67 (6,007)	2.72 (16,061)
	11-15	8.33 (692)	10.51 (2,237)	3.48 (696)	2.73 (2,239)
	16-20	9.43 (184)	10.47 (7,987)	3.36 (184)	2.56 (8,010)
	21-25	8.46 (78)	9.82 (4,738)	3.39 (79)	2.61 (4,730)
	26-30	8.12 (236)	11.20 (7,203)	3.86 (237)	2.65 (7,246)
	31-35	8.46 (1,038)	11.05 (33,548)	3.59 (1,041)	2.65 (33,769)
	36-40	8.73 (515)	11.50 (14,758)	3.79 (517)	2.70 (14,902)
	41-45	9.63 (76)	11.49 (1,764)	3.41 (76)	2.70 (1,792)
	45-46	9.66 (32)	10.75 (1,038)	3.34 (32)	2.53 (1,047)
<b>Number of Potential Providers within 50 Miles</b>	0	9.13 (147)	9.73 (3,424)	3.26 (148)	2.90 (3,446)
	1-5	7.86 (2,073)	10.50 (13,152)	3.66 (2,078)	2.79 (13,214)
	6-10	7.92 (4,236)	10.23 (10,465)	3.72 (4,262)	2.75 (10,515)
	11-15	8.52 (479)	10.60 (794)	3.41 (486)	2.70 (798)
	16-20	9.00 (5)	9.81 (343)	3.40 (5)	3.16 (344)
	21-25	8.82 (33)	10.18 (1,195)	3.58 (33)	2.95 (1,198)
	26-30	8.34 (401)	10.99 (7,103)	3.74 (401)	2.55 (7,124)
	31-35	8.11 (1,238)	10.95 (24,833)	3.65 (1,242)	2.65 (24,992)
	36-40	8.67 (1,307)	10.91 (19,876)	3.43 (1,310)	2.68 (19,983)
	41-45	8.73 (1,214)	10.91 (21,986)	3.48 (1,220)	2.68 (22,119)
	55-60	8.59 (554)	10.94 (9,500)	3.67 (560)	2.68 (9,582)

Singleton births only; numbers in parentheses refer to number of cases; only women reportedly receiving prenatal care are included in averages; for average number of visits, records reporting more than 20 visits are not included; potential providers include all recorded Certified Nurse Midwives, Family Practice Physicians, and Obstetrician/Gynecologists.

**Table 2: Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 75 Miles of Women**

		Average Number of Visits (Native American)	Average Number of Visits (White)	Average Month of Start of Care (Native American)	Average Month of Start of Care (White)
<b>Number of Potential Providers within 75 Miles</b>	5-10	8.64 (55)	9.88 (1,927)	3.34 (56)	2.86 (1,939)
	11-20	7.67 (4,881)	10.19 (14,415)	3.83 (4,895)	2.80 (14,469)
	21-30	8.84 (1,603)	10.45 (4,568)	3.18 (1,627)	2.72 (4,586)
	31-40	10.50 (8)	10.11 (456)	2.62 (8)	2.82 (457)
	41-50	8.03 (1,180)	10.94 (15,084)	3.77 (1,181)	2.78 (15,213)
	51-60	8.15 (1,493)	10.80 (24,543)	3.76 (1,498)	2.77 (24,682)
	61-70	8.44 (1,260)	11.15 (29,297)	3.64 (1,265)	2.59 (29,481)
	71-80	9.34 (299)	11.09 (9,944)	3.37 (301)	2.62 (10,022)
	81-90	9.20 (564)	10.53 (7,930)	3.07 (564)	2.54 (7,948)
	91-100	9.04 (454)	10.02 (5,640)	3.08 (455)	2.66 (5,648)
	101-106	9.21 (135)	9.97 (867)	3.18 (135)	3.05 (872)

Singleton births only; numbers in parentheses refer to number of cases; only women reportedly receiving prenatal care are included in averages; for average number of visits, records reporting more than 20 visits are not included; potential providers include all recorded Certified Nurse Midwives, Family Practice Physicians, and Obstetrician/Gynecologists.

**Table 3: Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Availability of Potential Providers within 100 Miles of Women**

		Average Number of Visits (Native American)	Average Number of Visits (White)	Average Month of Start of Care (Native American)	Average Month of Start of Care (White)
<b>Number of Potential Providers within 100 Miles</b>	10	...	9.18 (50)	...	2.53 (51)
	11-20	7.59 (1,512)	10.08 (5,799)	3.62 (1,514)	2.72 (5,823)
	21-30	8.68 (1,650)	10.03 (8,254)	3.26 (1,672)	2.85 (8,286)
	31-40	9.15 (462)	10.61 (1,338)	3.21 (470)	2.62 (1,342)
	41-50	7.71 (354)	10.26 (875)	3.46 (354)	2.85 (877)
	51-60	7.84 (1,424)	10.63 (4,676)	3.71 (1,428)	2.78 (4,704)
	61-70	8.03 (1,327)	11.19 (4,999)	3.73 (1,331)	2.75 (5,038)
	71-80	8.16 (501)	10.96 (15,842)	3.76 (499)	2.74 (15,887)
	81-90	7.62 (1,781)	11.00 (16,278)	4.12 (1,789)	2.66 (16,343)
	91-100	8.19 (1,377)	11.02 (13,053)	3.77 (1,382)	2.71 (13,150)
	101-110	9.24 (522)	11.24 (10,588)	3.16 (521)	2.72 (10,747)
	111-120	9.53 (434)	10.97 (7,077)	3.13 (436)	2.73 (7,157)
	121-130	9.20 (203)	10.67 (8,815)	3.32 (203)	2.59 (8,851)
	131-140	8.55 (222)	10.29 (9,397)	3.65 (224)	2.73 (9,424)
	141-150	9.30 (10)	9.92 (454)	2.40 (10)	2.65 (455)
	151-160	9.03 (29)	10.32 (1,548)	3.39 (28)	2.41 (1,550)
	161-170	9.09 (88)	10.39 (5,012)	3.14 (88)	2.38 (5,013)
171-174	10.83 (36)	11.24 (616)	3.00 (36)	2.43 (619)	

Singleton births only; numbers in parentheses refer to number of cases; only women reportedly receiving prenatal care are included in averages; for average number of visits, records reporting more than 20 visits are not included; potential providers include all recorded Certified Nurse Midwives, Family Practice Physicians, and Obstetrician/Gynecologists.

**Table 4: Average Number of Potential Prenatal Care Providers Available within 25, 50, 75, and 100 Miles of the Modal Population Center of a County's Native American and White Women**

	<b>Native Americans</b>	<b>Whites</b>
<b>Within 25 Miles</b>	11.36	21.67
<b>Within 50 Miles</b>	24.87	34.43
<b>Within 75 Miles</b>	38.81	56.07
<b>Within 100 Miles</b>	65.35	90.61

#### Analysis and Discussion of Patterns of Locational Access to Providers

To determine the impact of locational access on prenatal-care use, tables 1, 2, and 3 were generated to summarize and review relationships between locational access and average number of visits and average month of start of care. Table 1 shows the average number of prenatal-care visits and average month of start of prenatal care at different levels of provider availability for the two races. In examining this descriptive information, it is readily apparent that there was no relationship between the dependent (prenatal-care use measures) and independent (availability of providers) variables. The same lack of relationship holds whether the number of providers available was considered at distances of 25, 50, 75, or 100 miles (excepting the case of average number of visits for both Native Americans and whites versus number of providers within 50 miles, in which case there was a weak, positive relationship). Table 1 shows distance zones of 25 and 50 miles; table 2 shows the 75-mile distance zone, and table 3 shows the results from the 100-mile distance zone.



Although there was no relationship between indicators of prenatal-care use and availability of potential providers within specified distances from women, there was a noteworthy relationship between the average number of providers available at each distance level between the two races. As table 4 illustrates, Native Americans, by virtue of their location in the State, have locational access to fewer providers at every distance level considered. Although the present research was unable to demonstrate that Native American women's lack of locational access to prenatal-care providers affected their use of prenatal care, the descriptive statistics in table 4 may be useful in explaining other differences in health patterns between Native Americans and whites. Whether or not there is an effect on prenatal-care use, Native American women have fewer options and more limited locational access to health-care providers in the State.

#### Tables Illustrating Patterns of Maternal Socio-Demographic Characteristics

As previously stated, one objective of the current research is to determine whether differences in prenatal-care utilization between Montana's Native American and white populations were due to differences in availability of potential providers in conjunction with individual characteristics of the mothers. It was anticipated that the variable of locational access in addition to variables regarding socio-demographic characteristics of mothers would be compared with prenatal-care use variables through the use of a regression model. However, since there was no correlation between locational access to providers and either timing of first visit or total number of visits for either Native Americans or whites, a regression model was futile.

As already demonstrated by Reed, McBroom, and Sperry (1991) and Montana Department of Health (1991), socio-demographic characteristics of mothers do influence prenatal care use in Montana. Since the data were readily available, comparisons were made between two indicators of prenatal-care use (timing of first visit and average number of prenatal-care visits) for several different categories of socio-demographic characteristics of women delivering during the study period. To be consistent with other analyses, only singleton births are considered. Additionally, records in which needed fields were coded as “missing” were excluded from consideration. The resulting tables show, for each race, average number of prenatal-care visits and average month of start of prenatal care by different categories of marital status, age, education, and parity (table 5) and percentage of births in which women received no prenatal care in the same categories (table 6).

#### Analysis and Discussion of Maternal Socio-Demographic Characteristics

Whereas there were no visible patterns between prenatal-care use and locational access to prenatal-care providers (tables 1, 2, and 3), there were certainly patterns of prenatal-care use associated with marital status, age, education, and parity (tables 5 and 6). Table 5 illustrates that in Montana during the 1980-1989 decade, married women of both races averaged more visits and earlier care. Additionally, the younger a woman, the more likely she was to have fewer prenatal-care visits and a later start with prenatal care. The exception to this pattern was that the number of visits started to decline for women of both races past age 40. Additional education also had an impact on number and timing of

**Table 5: Average Number of Prenatal-Care Visits and Average Month of Start of Prenatal Care by Marital Status, Age, Education, and Parity: Montana, 1980-1989**

		Average Number of Visits (Native American)	Average Number of Visits (White)	Average Month of Start of Care (Native American)	Average Month of Start of Care (White)
<b>Overall</b>		8.19 (11,932)	10.76 (114,671)	3.62 (11,985)	2.70 (115,317)
<b>Marital Status</b>	<b>Married</b>	9.16 (5,083)	10.92 (101,132)	3.19 (5,112)	2.58 (101,772)
	<b>Single</b>	7.48 (6,845)	9.57 (13,452)	3.94 (6,869)	3.57 (13,338)
<b>Age in Years</b>	<15	7.09 (193)	8.54 (364)	4.46 (194)	4.31 (366)
	16-17	7.71 (908)	9.53 (2,841)	4.12 (910)	3.66 (2,852)
	18-19	7.82 (1,731)	10.00 (7,624)	3.79 (1,731)	3.30 (7,660)
	20-24	8.10 (4,420)	10.68 (36,274)	3.67 (4,444)	2.77 (36,648)
	25-29	8.52 (2,782)	10.98 (39,427)	3.32 (2,794)	2.53 (39,648)
	30-34	8.62 (1,412)	10.96 (21,715)	3.40 (1,421)	2.51 (21,839)
	35-39	8.70 (434)	10.86 (5,616)	3.57 (438)	2.64 (5,663)
	40+	7.68 (50)	10.19 (797)	4.06 (50)	3.08 (809)
<b>Education in Years</b>	<11	7.46 (4,862)	9.56 (14,252)	3.90 (4,875)	3.38 (14,334)
	12	8.51 (4,862)	10.72 (49,024)	3.49 (4,343)	2.74 (49,253)
	13+	9.04 (2,682)	11.14 (51,079)	3.31 (2,695)	2.46 (51,378)
<b>Parity</b>	0	8.63 (3,837)	11.02 (45,473)	3.58 (3,861)	2.66 (45,791)
	1	8.23 (3,335)	10.81 (39,344)	3.51 (3,347)	2.60 (39,520)
	2	8.04 (2,330)	10.54 (19,101)	3.63 (2,338)	2.75 (19,198)
	3	7.95 (1,255)	10.16 (6,787)	3.69 (1,261)	2.95 (6,820)
	4	7.52 (606)	9.71 (2,278)	3.80 (606)	3.18 (2,289)
	5	7.24 (299)	9.20 (851)	4.04 (302)	3.38 (858)
	6+	6.67 (270)	8.76 (831)	4.16 (270)	3.70 (835)

Singleton births only; numbers in parentheses refer to number of cases; only women reportedly receiving prenatal care are included in averages (please see Table 6 for similar information on women receiving no care); for average number of visits, records reporting more than 20 visits are not included.

**Table 6: Percentage of Births in which Mother Received No Prenatal Care by Marital Status, Age, Education, and Parity: Montana, 1980-1989**

		Percent of Births with No Prenatal Care (Native American)	Percent of Births with No Prenatal Care (White)
<b>Overall</b>		3.14 (392)	0.56 (652)
<b>Marital Status</b>	Married	1.38 (72)	0.33 (343)
	Single	4.41 (320)	2.18 (303)
<b>Age in Years</b>	<15	2.99 (6)	4.88 (19)
	16-17	2.45 (23)	1.74 (51)
	18-19	3.43 (62)	0.98 (76)
	20-24	3.22 (147)	0.62 (227)
	25-29	3.18 (92)	0.36 (144)
	30-34	2.46 (36)	0.36 (80)
	35-39	4.54 (21)	0.66 (38)
	40+	9.09 (5)	2.05 (17)
<b>Education in Years</b>	<11	4.30 (221)	1.43 (210)
	12	2.66 (119)	0.59 (295)
	13+	1.63 (45)	0.27 (141)
<b>Parity</b>	0	2.02 (80)	0.52 (241)
	1	3.13 (109)	0.32 (127)
	2	3.01 (73)	0.56 (109)
	3	3.87 (51)	1.15 (80)
	4	3.48 (22)	1.75 (41)
	5	5.86 (19)	2.36 (21)
	6+	11.95 (38)	3.39 (33)

Singleton births only; numbers in parentheses refer to number of cases; only cases in which records were recorded as "no care" for both number of visits and start of prenatal care are included.

prenatal-care visits. The more education a woman had, the more likely she was to obtain timely care and the appropriate number of visits. Having fewer children also tended to increase the number of visits and early initiation of care.

A table outlining percentage of women receiving no care for the same categories of marital status, age, education, and parity (table 6) further supports the findings in table 5. Women who received no care, whether Native American or white, were more likely to be single, younger, and less educated, and have more children. In addition to showing these patterns overall, tables 5 and 6 illustrate that in all categories of marital status, age, education level, and parity, Native American women fare worse than whites in obtaining sufficient prenatal care.

#### **Locational Access and Maternal Socio-Demographic Characteristics: Concluding Remarks**

Analysis of data regarding locational access in the present research, like that of regional comparisons between availability of providers and indicators of prenatal care, refute the hypothesis that differences in prenatal-care utilization were due to differences in locational access to potential prenatal-care providers.

In comparing the number of available providers to average indicators of prenatal-care use, there was found to be no association. The most noteworthy finding of the locational access research was that Native Americans have fewer providers available to them at every distance zone. Although this fact did not appear to have any impact upon prenatal-care use, it may be useful in explaining other health-related differences between Native Americans and whites.

## CHAPTER 6

### CONCLUSIONS

The purpose of the present research was to describe regional patterns of prenatal-care utilization by Montana women giving birth during the period of 1980 to 1989 and to determine whether regional availability of health-care providers had an impact on these patterns. An additional objective was to determine whether the late initiation of care and less frequent usage of prenatal-care services by Montana's Native American women relative to white women could be attributed to different patterns of locational access to health-care providers.

It was hypothesized that differences in prenatal-care utilization patterns were due to regional variations in availability of health-care providers. Specifically, it was proposed that areas of Montana with limited locational access to appropriate health-care services during the 1980 to 1989 period also had less desirable levels of prenatal-care utilization. It was further hypothesized that when physician and midwife resources as well as individual characteristics of mothers were taken into account, differences in prenatal-care utilization between Montana's Native American and white populations would be lessened.

Regional patterns of prenatal-care utilization were described by mapping average month of start of prenatal care and number of visits, and percentage of women receiving

no prenatal care, and proportions of women obtaining Adequate, Intermediate, or Inadequate levels of prenatal care. Through these maps, several counties with very low levels of prenatal-care utilization were identified. Regional patterns in prenatal-care utilization revealed that Native Americans had less desirable levels of prenatal-care use in all counties and for all measures of prenatal-care use compared to whites.

It was hypothesized that increased regional availability of potential prenatal-care providers would improve prenatal-care use for all Montanans. Even if many of the potential prenatal-care providers did not actually provide care, it was presumed that they could influence women's use of care by improving the overall health knowledge and awareness of an area. However, both regional and individual level data did not support the hypothesis.

Based on the present research, differences in prenatal-care utilization patterns were not found to be attributable to availability of providers. However, a striking finding of the research was the relative lack of providers available to Native American women compared to white women. Perhaps by using a different methodology or by considering locational access to a different type of health-care service, the availability of providers may prove to be an important variable in issues of disparate access to health-care resources between Native Americans and whites in Montana.

There are several possible reasons the hypotheses were found to be false in this research. Firstly, availability of providers by number or ratio simply may not influence a woman's decision to obtain prenatal care. Obviously, a woman requires locational access to a provider to obtain care, but perhaps the number of providers available or distance to

them does not matter. Secondly, perhaps limitations of the data and methods influenced the outcome of the research.

### **Limitations of the Data and Methodology**

There were several limitations to the research presented. In regional thematic mapping, generalizations often mask community variations. For example, a given county may rate very highly in terms of the average total number of prenatal visits; however, within that county there may be small communities in which the average number of visits is alarmingly low. The maps, of course, would not be able to show these intra-county differences.

There were several limitations specific to the descriptive statistics. The values shown in tables 1 through 6, like the thematic maps, illustrate averages and do not accurately represent any particular woman. Although this limitation is not a problem per se, it is worthy of consideration.

Variables on locational access may also have been a source of error. Although measuring distance from central points (modal population centers in this case) is rather common, there may be problems with areal correlation (Shannon and Dever 1974, 91). Not all women in a given county live at the modal population center. The availability of providers then, again, represents an estimation and should be interpreted as such.

A problem with the provider variables was the lack of information on potential providers available in states or Canadian provinces bordering Montana. For many women in Montana, travel to a nearby state or province for medical care may be more practical



than travel to a nearby county of Montana. Unfortunately, the data regarding provider availability in Alberta, British Columbia, Idaho, North Dakota, South Dakota, and Wyoming could not be obtained. An additional consideration is that due to the nature of the data, only *potential* prenatal-care providers were considered. Had data been available on *actual* prenatal-care providers, the results may have been altered.

A limitation of the descriptive statistics overall is that they are not the result of ideal research design. As already indicated, a truly experimental model would have been unethical in this case. However, the descriptions provided a reasonable estimate of the effect of availability of providers or socio-demographic characteristics upon prenatal-care utilization.

An additional limitation pertains to the nature of the primary data set. The majority of the information provided on birth certificates is voluntary or at the discretion of the person filling out the form. Cases in which there are missing or inaccurate data may not be random. Such inaccuracies could have inadvertently skewed the results of the descriptive statistics.

### **Recommendations**

As is the case with most research studies, particularly ones in which a hypothesis is found to be false, additional study is recommended. A subsequent study of the spatial aspects of prenatal care in Montana would benefit from improved data and methods. In this case, it would be desirable to improve the scale of the locational information in the primary data set. For example, instead of grouping women by county, perhaps zip code or

census block would be more appropriate. Inclusion of data from surrounding states and provinces might also prove to be beneficial. An additional improvement for future study would include tracking of *actual* prenatal-care providers and the inclusion of Direct-Entry Midwives as the data become available.

Although the hypotheses of the research presented here were not supported, several findings of the study could prove useful to state and local agencies involved in issues of prenatal care. In particular, the relative lack of access by American Indian women to health-care providers is deserving of closer attention. Additionally, counties which were found to have undesirable levels of prenatal-care utilization could be examined closely for programs which support and improve use of prenatal care.

APPENDIX  
The Kessner Index

Medical Care Index	Gestation (weeks) <sup>*</sup>	Number of Visits
Adequate <sup>a</sup>	13 or less and	1 or more or not stated
	14 - 17 and	2 or more
	18 - 21 and	3 or more
	22 - 25 and	4 or more
	26 - 29 and	5 or more
	30 - 31 and	6 or more
	32 - 33 and	7 or more
	34 - 35 and	8 or more
	36 or more and	9 or more
Inadequate <sup>b</sup>	14 - 21 and	0 or not stated
	22 - 29 and	1 or less or not stated
	30 - 31 and	2 or less or not stated
	32 - 33 and	3 or less or not stated
	34 or more and	4 or less or not stated
Intermediate <sup>c</sup>	All other combinations than specified above	

\* Length of gestation is defined by the number of weeks elapsed since the first day of the woman's last normal menses.

<sup>a</sup>In addition to the specific number of visits indicated for Adequate care, the interval to the first prenatal visit had to be 13 weeks or less (first trimester), and the delivery must have taken place on a private obstetrical service.

<sup>b</sup>In addition to the specific number of visits indicated for Inadequate care, all women who started their prenatal care during the third trimester (28 weeks or later) were considered Inadequate.

<sup>c</sup>For this gestation group, care was considered Inadequate if the time of the first visit was not stated.

(Institute of Medicine 1973, 59)

## WORKS CITED

- Aday, L. A. 1975. Economic and non-economic barriers to the use of needed medical services. *Medical Care* 13: 447-56.
- Aday, L. A., R. Andersen, and G. V. Fleming. 1980. *Health care in the U.S.: Equitable for whom?*. Beverly Hills: Sage Publications. Quoted in c. A. Aday, G. V. Fleming, and R. Andersen. 1984. *Access to medical care in the U.S.: Who has it, who doesn't*. Chicago: Pluribus Press, Inc.
- Aday, L. A., G. V. Fleming, and R. Andersen. 1984. *Access to medical care in the U.S.: Who has it, who doesn't*. Chicago: Pluribus Press, Inc.
- American College of Obstetrics and Gynecology. 1988. *Guidelines for prenatal care*. Washington: American College of Obstetrics and Gynecology. Quoted in P. McClanahan. 1992. Improving access to and use of prenatal care. *Journal of Obstetric and Gynecologic Neonatal Nursing* 21: 280-4.
- American Nurses Association. 1987. *Access to prenatal care: Key to preventing low birthweight: Report of consensus conference*. By M. A. Curry, Project Director. Kansas City: American Nurses Association.
- Barrett, F. A. 1986. Medical Geography: concept and definition. In *Medical geography: progress and prospect*, ed. M. Pacione, 1-34. London: Croon Helm.
- Berry, B. J. L. 1967. *Geography of market centers and retail distribution*. Englewood Cliffs, N.J.: Prentice-Hall, Inc.
- Braverman, P., T. Bennett, C. Lewis, S. Egerter, and J. Showstack. 1993. Access to prenatal care following major Medicaid eligibility expansions. *Journal of the American Medical Association* 269: 1285-9.
- Brown, S. S. 1989. Drawing women into prenatal care. *Family Planning Perspectives* 21: 73-80, 88.
- Children's Defense Fund. 1991. *The state of America's children*. Washington: Children's Defense Fund. Quoted in E. E. Whipple. 1993. Access to prenatal care and county size: implications for service delivery. *Journal of Sociology and Social Welfare* 20: 138.

- Christaller, W. 1966. *Central places in southern Germany*. Trans. by C. W. Basken. Englewood Cliffs, N.J.: Prentice-Hall, Inc.
- Clarke, L. L., M. K. Miller, W. B. Vogel, K. E. Davis, and C. S. Mahan. 1993. The effectiveness of Florida's "Improved Pregnancy Outcome" program. *Journal of Health Care of the Poor and Underserved* 4: 117-32.
- Collins, M. S. and J. N. Natapoff. 1985. A descriptive analysis of the status of maternal and infant health care in New York State. *Journal of the New York State Nurses Association* 16: 11-17.
- Cooney, J. P. 1985. What determines the start of prenatal care? Prenatal care, insurance, and education. *Medical Care* 23: 986-97.
- Cramer, J. C. 1987. Social factors and infant mortality: identifying high-risk groups and proximate causes. *Demography* 24: 299-322.
- Defo, B. K. and M. Partin. 1993. Determinants of low birthweight: a comparative study. *Journal of Biosocial Science* 25: 87-100.
- Dott, A. B and A. T. Fort. 1975. The effect of availability and utilization of prenatal care and hospital services on infant mortality rates. *American Journal of Obstetrics and Gynecology* 123: 854-860.
- Eyles, J. and K. J. Woods. 1983. *The social geography of medicine and health*. London: Croon Helm.
- Florin, J. 1994. Introduction to *Geographic methods for health services research: A focus on the rural-urban continuum*, ed. T. C. Ricketts, L. A. Savitz, W. M. Gesler, and D. N. Osborne, 1-10. Lanham, Md.: University Press of America.
- Fossett, J. W., J. D. Perloff, P. R. Kletke, and J. A. Peterson. 1991. Medicaid patients' access to office-based obstetricians. *Journal of Health Care for the Poor and Underserved* 1: 405-21.
- Gortmaker, S. L. 1979. The effect of prenatal care upon the health of the newborn. *American Journal of Public Health* 69: 653-60.
- Gould, J. B. and S. LeRoy. 1988. Socioeconomic status and low birth weight: a racial comparison. *Pediatrics* 82: 896-904.
- Greenberg, R. S. 1983. The impact of prenatal care in different social groups. *American Journal of Obstetrics and Gynecology* 145: 797-801.

- Haas, J. S., I. S. Udvarhelyi, C. N. Morris, and A. M. Epstein. 1993. The effect of providing health coverage to poor uninsured pregnant women in Massachusetts. *Journal of the American Medical Association* 269: 87-91.
- Hale, S. 1991. *Barriers to prenatal care for Montana women.. See Montana Department of Health and Environmental Sciences.* 1991.
- Hicks, L. L. 1990. Availability and access of rural health care. *The Journal of Rural Health* 6: 485-505.
- Hoff, C., W. Wertelecki, E. Reyes, S. Zansky, J. Dutt, A. Stumpe, D. Till, and R. M. Butler. 1985. Maternal sociomedical characteristics and birth weights of firstborns. *Social Science and Medicine* 21: 775-83.
- Ingram, D. R., D. R. Clarke, and R. A. Murdie. 1978. Distance and the decision to visit an emergency department. *Social Science and Medicine* 12: 55-62.
- Institute of Medicine, Division of Health Promotion and Disease Prevention, Committee to Study the Prevention of Low Birthweight. 1985. *Preventing low birthweight.* Washington: National Academy Press.
- Institute of Medicine, National Academy of Sciences. 1973. *Infant death: An analysis by maternal risk and health care.* By D. M. Kessner, Project Director, J. Singer, C. E. Kalk, and E. R. Schlesinger. Washington: Institute of Medicine.
- Jarvis, E. 1851. On the supposed increase of insanity. *American Journal of Insanity.* 8: 333-64. Quoted in G. W. Shannon and G. E. A. Dever. 1974. *Health care delivery: spatial perspectives.* New York: McGraw-Hill Book Company. Also quoted in D. J. Walmsley. 1978. The influence of distance on hospital usage in rural New South Wales. *Australian Journal of Social Issues* 13: 73.
- Jehlik, P. J. and R. L. McNamara. 1952. The relation of distance to the differential use of certain health personnel and facilities and to the extent of bed illness. *Rural Sociology* 17: 261-5. Quoted in G. W. Shannon and G. E. A. Dever. 1974. *Health care delivery: spatial perspectives.* New York: McGraw-Hill Book Company.
- Joseph, A. E. and D. R. Phillips. 1984. *Accessibility and utilization: Geographical perspectives on health care delivery.* New York: Harper & Row, Publishers.
- Kalmuss, D. and K. Pennelly. 1990. Barriers to prenatal care among low-income women in New York City. *Family Planning Perspectives* 22: 215-18, 231.

- Kessner, D. M., J. Singer, C. E. Kalk, and E. R. Schlesinger. 1973. *Infant death: an analysis by maternal risk and health care*. See Institute of Medicine. 1973.
- Korenbrodt, C. C., L. Simpson, and C. S. Phibbs. 1994. Prenatal care needs assessment comparing service use and outcomes in Fresno, CA. *Public Health Reports* 109: 68-76.
- Leatherman, J., D. Blackburn, and R. Davidhizar. 1990. How postpartum women explain their lack of obtaining adequate prenatal care. *Journal of Advanced Nursing* 15: 256-67.
- Lia-Hoagberg, B., P. Rode, C. J. Skovholt, C. N. Oberg, C. Berg, S. Mullett, and T. Choi. 1990. Barriers and motivators to prenatal care among low-income women. *Social Science and Medicine* 30: 487-95.
- Mayer, J. P., C. D. Johnson, J.W. Condon, and C. L. Berquist. 1987. *Multi-State Prenatal Needs Determination Project -- Final Report*. Lansing: University Associates. Quoted in Montana Department of Health and Environmental Sciences. 1991. *Barriers to prenatal care for Montana women*. Report prepared by S. Hale. Helena.
- McBroom, W. H. and F. W. Reed. 1992. Montana maternal and child health indicators: county and regional distributions. Center for Population Research, University of Montana, Missoula.
- McDonald, T. P. and A. F. Coburn. 1988. Predictors of prenatal care utilization. *Social Science and Medicine* 27: 167-72.
- Meade, M. S., J. W. Florin, and W. M. Gesler. 1988. *Medical geography*. New York: The Guilford Press.
- Montana Department of Health and Environmental Sciences. 1990. *MIAMI Montana's initiative for the abatement of mortality in infants: Accomplishments and recommendations*. Helena.
- \_\_\_\_\_. 1991. *Barriers to prenatal care for Montana women*. Report prepared by S. Hale. Helena.
- Montana Medical Association. 1980. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1981. *MMA directory of Montana physicians*. Helena: Montana Medical Association.

- \_\_\_\_\_. 1982. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1983. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1984. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1985. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1986. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1987. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1988. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- \_\_\_\_\_. 1989. *MMA directory of Montana physicians*. Helena: Montana Medical Association.
- Paul, B. K. 1991. Health service resources as determinants of infant death in rural Bangladesh: an empirical study. *Social Science and Medicine* 32: 43-9.
- Pacione, M. 1986. Preface to *Medical geography: Progress and prospect*, ed. M. Pacione. London: Croon Helm.
- Peoples, M. D. and E. Siegel. 1983. Measuring the impact of programs for mothers and infants on prenatal care and low birth weight: the value of refined analyses. *Medical Care* 21: 586-609.
- Phillips, D. R. 1979. Spatial variations in attendance at general practitioner services. *Social Science and Medicine* 13D: 169-81.
- \_\_\_\_\_. 1986. The demand for and utilisation of health services. In *Medical geography: Progress and prospect*, ed. M. Pacione, 200-47. London: Croon Helm.
- Puentes-Markides, C.. 1992. Women and access to health care. *Social Science and Medicine* 35: 619-26.



- Pyle, G. F. 1979. *Applied medical geography*. Washington: V. H. Winston & Sons.
- Reed, F. W., W. H. McBroom, T. D. Berkhouse, D. Bowker, K. J. Copenhaver, Z. Feng, C. R. Harris, J. L. Haubenreiser, L. J. Peebles, and L. M. Rapp. 1993. Trips for birthing: Inequality in access to medical resources in Montana, 1980-1989. Department of Sociology, University of Montana, Missoula.
- Reed, F. W., W. H. McBroom, and S. H. Sperry. 1991. Sequelae of traveling substantial distances for prenatal care and birthing: the use of birth and linked birth/infant death records to assess racial differentials in health care. In *The 1990's: A decade of decisions for vital and health statistics: proceedings of the 1991 public health conference on records and statistics conference held in Washington, D.C., July 15-17, 1991*, by the National Center for Health Statistics. Atlanta: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, 93-8.
- Ricketts, T. C. and L. A. Savitz. 1994. Access to health services. In *Geographic methods for health services research: A focus on the rural-urban continuum*, ed. T. C. Ricketts, L. A. Savitz, W. M. Gesler, and D. N. Osborne, 91-112. Lanham, Md.: University Press of America.
- Ricketts, T. C., L. A. Savitz, W. M. Gesler, and D. N. Osborne, ed. 1994. Glossary to *Geographic methods for health services research: A focus on the rural-urban continuum*. Lanham, Md.: University Press of America.
- Robert Wood Johnson Foundation. 1991. *Challenges in health care*. Princeton: The Robert Wood Johnson Foundation.
- Ryan, G. M., P. J. Sweeney, and A. S. Solola. 1980. Prenatal care and pregnancy outcome. *American Journal of Obstetrics and Gynecology* 137: 876-81.
- Shannon, G. W. and G. E. A. Dever. 1974. *Health care delivery: spatial perspectives*. New York: McGraw-Hill Book Company.
- Showstack, J. A., P. P. Budetti, and D. Minkler. 1984. Factors associated with birthweight: an exploration of the roles of prenatal care and length of gestation. *American Journal of Public Health* 74:1003-1008.
- Thaddeus, S. and D. Maine. 1994. Too far to walk: maternal mortality in context. *Social Science and Medicine* 38: 1091-110.
- Thomas, P., J. Golding, and T. J. Peters. 1991. Delayed antenatal care: does it effect pregnancy outcome? *Social Science and Medicine* 32: 715-23.

- U.S. Bureau of the Census. 1992. *Census of population and housing, 1990*. On CD-ROM. Washington: U.S. Department of Commerce.
- U.S. Department of Commerce. Economic and Statistics Administration. Bureau of Census. 1991. *State and metropolitan area data book*. 4th ed. Washington: U.S. Government Printing Office.
- U.S. Department of Health and Human Services. Public Health Service. 1992a. *Health United States and prevention profile*. Hyattsville, Md.: Department of Health and Human Services.
- \_\_\_\_\_. 1992b. *Healthy people 2000: national health promotion and disease prevention objectives*. Boston: Jones and Bartlett Publishers.
- Verhasselt, Y. 1993. Geography of health: some trends and perspectives. *Social Science and Medicine* 36: 119-23.
- von Reichert, C., P. B. Wilson, D. J. Bowersox, F. A. Fulop, B. L. Johnston, K. L. Knowles, M. L. Livermore, J. M. Rogers, T. J. Sullivan, and Y. Tang. 1993. Access to health care and spatial mobility: trips for birthing in Montana. Department of Geography, University of Montana, Missoula.
- Walmsley, D. J. 1978. The influence of distance on hospital usage in rural New South Wales. *Australian Journal of Social Issues* 13:72-81.
- Wegman, Myron E. 1991. Annual summary of vital statistics, 1990. *Pediatrics* 88: 1081-1105.
- Weiss, J. E. and M. R. Greenlick. 1970. Determinants of medical care utilization: The effect of social class and distance on contacts with the medical care system. *Medical Care* 8: 456-62.
- Wheeler, J. O. and P. O. Muller. 1986. *Economic geography*. 2d ed. New York: John Wiley & Sons.
- Wilson, A. L., D. P. Munson, D. B. Schubot, G. Leonardson, and D. C. Stevens. 1992. Does prenatal care decrease the incidence and cost of neonatal intensive care admissions? *American Journal of Perinatology* 9: 281-4.
- Zambrana, R. E., C. Dunkel-Schetter, and S. Scrimshaw. 1991. Factors which influence use of prenatal care in low-income racial-ethnic women in Los Angeles County. *Journal of Community Health* 16: 283-95.