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Native Americans and Type II Diabetes: A Review of the Literature

Tamara J. Tobin

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NATIVE AMERICANS AND TYPE II DIABETES:

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Tamara J. Tobin

University of Northern Iowa

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Dr. Michele Yehieli, Chair, Research Paper Committee

11/14/97
Date

Dr. Dennis Cryer, Member, Research Paper Committee

1/9/98
Date

Dr. Sue Doody, Coordinator, HPELS Graduate Division

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CHAPTER I

INTRODUCTION

Non-insulin dependent diabetes is a disease which is diagnosed every 60 seconds throughout the world (American Diabetes Association, 1996). According to the World Health Organization (WHO), 50 million people are living with this disease and its complications (Khaltaev, 1991). This is a serious chronic disease which inflicts devastating long-term disabilities, premature death, and expensive medical costs. Non-insulin dependent diabetes (NIDDM or Type II diabetes), is a global dilemma which is epidemic in many developing countries (Khaltaev, 1991). It is a medical crisis of the 20th century, and is exploding in numerous ethnic groups. Many have adopted the "western" lifestyle of rich foods and a sedentary lifestyle (Kotulak, 1995). According to Wiedman (1989) "acculturation to an industrial technology often results in a dramatic increase in Type II diabetes mellitus" (p. 237).

If uncontrolled, Type II diabetes can cause devastating long-term disabilities and secondary complications (i.e., blindness, amputations, coronary heart disease). Type II diabetes is well recognized for silently developing in its victims, over the years, with diagnosis only occurring when secondary complications are discovered. By this time, the body has incurred irreversible damage. Within the United States, it is the leading cause of blindness, leg amputations, and the fourth leading cause of death by disease. It reeks havoc on the renal system, can cause an array of circulatory problems, and increases one's risk for coronary heart disease (ADA, 1996). In the past, this disease would be found in the elderly, over the age of 65, but today it is more commonly found after the age of 35,

especially in certain high-risk ethnic groups (Knowler, Saad, Pettitt, Nelson, & Bennett, 1993). Fortunately, Type II diabetes may be prevented and complications can be controlled if early detection is followed by a proper nutritional regime and physical activity program (Kuller, 1993).

An alarming statistic is the increase of non-insulin dependent diabetes in younger populations. At one time, it was considered a disease of the elderly and to a great extent, still is within the Caucasian population. Yet, among Native Americans and other ethnic groups in the United States, onset is common between the ages of 35 to 45 (Knowler et al., 1993). This has a greater effect on the future health, productivity, and well-being for the victims and their children. Native American women are especially vulnerable to Type II diabetes during pregnancy (Benjamin, Winters, Mayfield, & Gohdes, 1993). They are two to three times more likely to develop gestational diabetes than national norms. The long-term complications are that the mother is at an increased risk of developing diabetes in the future, as is her child (Rith-Najarian, Ness, Faulhaber, & Gohdes, 1996).

Within the United States, 16 million individuals are believed to have Type II diabetes. Of those, only eight million were diagnosed (ADA, 1996). However ethnic minorities within the United States have been especially burdened by this recent phenomenon, and epidemiologists have seen a dramatic increase in this disease both in the number of cases and age of diagnosis. In the Caucasian population, the prevalence of Type II diabetes has remained constant, at approximately 17% of the adult population over the age of 65 (ADA, 1996). Within the African-American community, 25% of the population over the age of 65 is affected, while 33% of elderly Hispanics are believed to

have the disease (see Appendix A). The Native American community has had the greatest increase of Type II diabetes. Before the 1930s the disease was reported rarely in the Pimas, yet by the 1960s it had increased to epidemic proportions within many tribes (Ritenbaugh & Goodby, 1989). Today, some tribes have as many as 50% of the community, over the age of 35, inflicted with this disease (ADA, 1996).

Before the 1930s, Type II diabetes was rarely diagnosed in Native American indigenous communities across the United States (Freeman, Hosey, Diehr, & Gohdes, 1989). Today, in some native tribes Type II diabetes is an epidemic with 30% to 50% diagnosed (Knowler et al., 1993). Overall, Native Americans are 2.7 times more likely to acquire this noncommunicable disease than the rest of the American population (ADA, 1996). Their communities have been especially burdened by this disease.

The Indian Health Service (IHS) has designed and implemented various community prevention programs which have focused on the growing problem of Type II diabetes. Extensive studies on Native American communities and schools have focused on causes and broad prevention programs for the control of this disease. Although long range results of these programs are still pending, the rest of the world may benefit learning from these studies which increase awareness about diabetes, promote healthy lifestyles, and provide nutrition education (Broussard et al., 1995).

Non-insulin dependent diabetes is not an inevitable disease, but rather a condition which can be controlled and even prevented in some cases. Contributing risk factors for Type II diabetes are both genetically and environmentally linked. The evidence suggests that these two factors are the two most important factors for the onset of this disease

(Kuller, 1993). Awareness of this susceptibility and primary prevention is key to preventing this disease from taking away the best and most productive years of its victims' life.

Purpose of the Study

The purpose of this study is to review the related literature on the etiology of Type II diabetes in Native North Americans and its implications for community-based education/prevention programs.

Definition of Terms

The following terms are used frequently in this review and are defined as follows:

1. Acculturation: "the process of becoming adapted to a new or different culture with more or less advanced patterns" (Webster's New World Dictionary, 1986, p. 10).
2. Autoimmune disease: when the immune system of the body attacks and destroys one's own body (American Diabetes Association, 1996).
3. Epidemic: "prevalent and spreading rapidly among many individuals in a community at the same time; widespread" (Webster's New World Dictionary, 1986, p. 470).
4. Epidemiology: "the branch of medicine that investigates the causes and control of epidemic occurrence of a disease in a population" (Webster's New World dictionary, 1986, p. 470).
5. Etiology: "the science of causes or origins of disease" (Webster's New World Dictionary, 1986, p. 481).

6. Gestational diabetes: a mild form of diabetes which develops during a pregnancy and usually goes away after the baby is born (Benjamin et al., 1993).
7. Insulin: "a protein hormone secreted by the islets of Langerhans, in the pancreas, which helps the body use sugar and other carbohydrates" (Webster's New World Dictionary, 1986, p. 731).

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to review the related literature on the etiology of Type II diabetes in Native North Americans and its implications for community-based education/prevention programs.

Introduction to Diabetes

There are two types of diabetes which are considerably different and contribute to the development of long-term disabling health. First, insulin dependent diabetes or Type I diabetes occurs in 10% of all cases and its onset is most common in the teenage years (ADA, 1996). This is a genetic problem that develops when the pancreas is unable to produce insulin. The only way the body is able to function is with insulin injections. Without these injections, death is imminent (ADA, 1996).

Insulin is a hormone, produced in the pancreas, which is critical for allowing energy in the form of glucose to enter the cell (ADA, 1996). When the pancreas, located behind the stomach, does not function properly, an elimination or reduction of insulin output occurs (Kotulak, 1995). Without insulin, the body will accumulate high amounts of glucose in the blood which can cause vascular problems, coma, and death when left uncontrolled (Urdaneta & Krehbiel, 1989). Type I individuals must monitor their blood sugar levels and receive daily insulin injections. The highest incidences among ethnic groups for Type I diabetes are native residents of Scandinavian countries and Caucasians within the United States (ADA, 1996).

The most common form of diabetes, occurring in 90% of all diagnoses in the United States, is non-insulin dependent diabetes or Type II diabetes. In Type II diabetics, the pancreas is capable of making insulin, but there is a metabolic disorder, in which either not enough insulin is produced, or the body is unable to utilizes this hormone (ADA, 1996). Another name for Type II diabetes is "adult onset diabetes," as it is common in the elderly as their body is unable to produce enough insulin or properly use it. In the United States Caucasian population, between the ages of 65 to 75, 10% have been diagnosed with Type II diabetes. These numbers have remained constant over the past decade, however in some Native American communities, rates soar as high as 50% diagnosed within this same age bracket (Knowler et al., 1993).

Although Type II diabetes can not be cured, it can be successfully managed through diet and exercise. In some advanced cases, however, oral medicine and insulin must be administered. Type II diabetes may sound less harmful than Type I, but it also can be life debilitating and deadly (ADA, 1996). In most cases, the beginning stages of Type II has mild symptoms. The first symptoms can be frequent urination, excessive thirst, and weight gain; many times these symptoms go unnoticed as the disease takes its toll on the body (Urdaneta & Krehbiel, 1989). It is in these silent years when the beginning of destruction of the vascular system takes place.

Two other recently recognized stages of diabetes are believed to be precursors to Type II diabetes. Individuals who are diagnosed as "insulin resistant" and "impaired glucose intolerant" are at the initial stages of this disease (Kotulak, 1995). These are widespread, but tend to go undiagnosed as they are symptom free. Yet, the implications

for damage on the body is great even at this level and requires adoption of a healthier lifestyle. These two diagnoses are especially important in the screening process to catch the disease at the initial stages.

Epidemiology

Type II diabetes is on the increase in most developing nations in the world. In extreme cases some populations have more than one third of their citizens diagnosed. The World Health Organization (WHO) estimates the global incidence to be 50 to 100 million and that number is expected to rise drastically (as cited in Khaltaev, 1991). The WHO also states that the populations at greatest risk are in developing countries, which are rapidly becoming industrialized. Similarly, there seems to be a connection between rapid change in lifestyles, acculturation, and the increase of Type II diabetes within low-income Native Americans in the United States (Khaltaev, 1991).

Ethnic groups within the United States have had the greatest change in disease incidence. Native Americans in particular have been severely affected. Before the 1930s, Type II diabetes rarely occurred in Native American communities across the United States (Freeman et al., 1989). Today, Type II diabetes in some native tribes has reached epidemic proportions, with 30 to 50% of their populations diagnosed. The Pimas, in the southwestern United States, hold the world's highest incidence rates for reported prevalence and incidence of Type II diabetes. They are 11.9 times more likely to develop non-insulin dependent diabetes than the rest of the United States population (Sievers, Nelson, & Bennett, 1990). Overall, Native Americans are 2.7 times more likely to acquire this non-communicable disease than the rest of the American population (ADA, 1996).

The age-adjusted and sex-adjusted mortality rates are even more alarming, as Native Americans are 12 times more likely to die from diabetes complications than the national norm (Sievers et al., 1990).

Pregnant women and teenagers are not immune from this disease. Native American women are at an increased risk for gestational diabetes and without proper medical attention, complications can put the mother and child at risk (Rith-Najarian et al., 1996). Those women who had gestational diabetes and their offspring are at a higher risk for developing this disease later in life. Most women with gestational diabetes, upon delivery of the child, return to normal blood glucose levels after delivery. Rith-Najarian et al. (1996) compared three studies of gestational diabetes in Native American women. In the Chippewa tribe, women were 5.8 times more likely to be diagnosed with gestational diabetes than the average 2% to 3% incidence rates of urban American women. Navajo women were 4.1% higher, and the Tohono O'odham women were at 3.2% increased risk.

It is also noteworthy to mention that Native American women are at greater risk for type II diabetes than Native American men (see Appendix B). Freeman et al. (1989) found in the Pacific Northwest area, that Native American women were 1.3 times more likely to develop this disease than Native American men. Women have a tendency to store greater amounts of fat as well as experience large weight gains during pregnancy, both of which are contributors to the disease at an earlier age.

Sadly enough, our nation's children are even at risk for this debilitating disease. A 1995 pediatric regional study found cases of Type II diabetes had increased 10 times when compared to incidence rates between 1982 to 1992 (Godbey & Goldstein, 1996).

The average age of diagnosis was 13 years of age. These increasing numbers are often explained by our nation's increase of childhood obesity and sedentary lifestyles. The critical factor is the immediate need to control the disease with lifestyle changes to decrease future destruction to the body (Godbey & Goldstein, 1996).

Direct and Indirect Costs

The economic costs of diabetes in the United States are not easy to measure, but an estimated 92 billion dollars were spent in 1992 on direct and indirect costs for the complications of diabetes (ADA, 1996). The direct medical costs can be easier to ascertain, such as medical procedures and interventions required to treat the disease. End Stage Renal Disease is a severe complication and dialysis related to this disease can cost an individual $40,000 annually. Nationally, limb amputation also is costly, and can be as high as 600 million dollars annually. The greatest hospitalization costs were from complications of heart disease, which can occur as a result of diabetes (Leese, 1992).

The indirect costs are harder to measure as they address factors such as the loss of productivity of these individuals during the prime of their lives (Leese, 1992). This does not include the loss of productivity of their caretakers. Although there may not be a direct dollar figure on this, it carries a heavy mental, physical, and emotional toll on both the victim and caretaker (Leese, 1992).

The personal costs of diabetes are difficult to measure as well. The incidence of diabetes is disproportionately higher in minority groups in the United States, and one failure to meet this need is with inadequate access to health care, therefore many members of ethnic cultures go undiagnosed (Washington, 1993). When diabetes is diagnosed and

controlled, the disease process can be slowed and managed. Individuals who do not receive proper screening and medical care are at greatest risk for long-term complications. The IHS has recently revised their program on diabetes prevention and management to combat the growing burden of this disease on their budget (Acton et al., 1993). The IHS is attempting to provide screening programs which are easily assessable and affordable to meet the needs of communities with poor or no health care (Acton et al., 1993).

Demography of Native Tribes

The majority of 1.9 million Native Americans choose to reside on one of 507 reservations located within 28 states (see Appendix C). These areas have been designated by the United States government to be separate territories which have their own government and legal systems (Breda, 1989).

Although Native American populations as a whole have widespread Type II diabetes, there are discrepancies between tribes and areas of the United States. The Plains area tribes are the highest at risk, and the Alaskan tribes are the least affected. Although much emphasis has been placed on the southwestern tribes, research noted that the crisis was not limited to this area. Tribes and disease incidence vary from 2% in Alaska to over 50% of Pimas. When combined, 39.7% have Type II diabetes, which is considerably higher than the 15.4% reported in 1986 (Gohdes et al., 1993).

Even though there are differences between tribes and areas, overall the incidence of diabetes is increasing among Native Americans, and there appears to be a relationship between genetic ancestral roots and susceptibility in addition to a changing lifestyle. For example, an extensive epidemiology study by Sugarman, Hickey, Hall, and Gohdes (1990)

on the Navajos noted that they have lower rates than other tribes in the same southwestern areas, but they are still two times more likely to develop Type II diabetes than the rest of the general United States population. The Navajo population is not genetically related to the many southwestern tribes that surround its region. Anthropologists believe that centuries ago the Navajos migrated from Northern Alaska and are descendants of the Athapaskan people. A theory has developed that there is a relationship between descending from the Alaskan region and lower rates of Type II diabetes with the Navajo people. They also noted that other tribes residing in the southwestern areas descended from the Mesoamerican Hohokam cultural group, which makes them genetically different from the Navajos (Sugarman et al., 1990).

There is also a correlation between the amount of Native American heritage and susceptibility to the disease. A study by Knowler et al. (1993) on the Pimas, noted that the onset of Type II diabetes is closely related to the percentage of heritage. Those who are of full heritage have a greater risk of the disease than those who have part Caucasian heritage (see Appendix D). This adds support for theories that a genetic component has an influence on susceptibility to this disease among Native Americans (Knowler et al., 1993).

Anthropology of Native Americans Related to Diabetes

Ritenbaugh and Goodby (1989) reported that the leading theory on the prehistoric migration of Native Americans was via a pathway from Asia across the Beringian land bridge, and then southward. This is a harsh arctic environment which has sporadic wildlife and green vegetation. It is theorized that the Native American's metabolism became very

efficient in this lifestyle which was composed mainly of proteins and little fat (Szathmary, 1989).

Abundant supplies of plant life became available as they continued their migration southbound. Agriculture was then introduced as the migrating tribes began planting corn, beans, and squash (Ritenbaugh & Goodby, 1989). This type of agriculture was a dominant part of their society for 1,400 years until the advent of industrial technology in the 1930s (Wiedman, 1989). Although their diet after migration was much higher in carbohydrates and calories, it was counterbalanced by a large energy expenditure related to the rigorous demands of farming and hunting (Wiedman, 1989).

More recently, Native Americans have moved away from their native foods and adopted the "Western diet" of high fatty diets with large amounts of readily available foods (Urdaneta & Krehbeil, 1989). Many tribes have been moved from lands which have for centuries been considered their home. For example, the Cherokee, who once farmed the lands of southern Appalachia, were uprooted and moved to a reservation in Oklahoma. The area soon became crowded and the lands were over-farmed. Thus, they began to rely on government food commodities which were very different from their native diet (Wiedman, 1989).

The "Agricultural Adjustment Act" of the 1930s placed limitations on Native American farming during the depression. This produced great hardship and much of the land of the Kiowa, Comanche, and Apache was left unattended (Wiedman, 1989). Soon, many of the tribes relied on government food subsidies and modern conveniences such as automobiles, refrigeration, and stoves (Wiedman, 1989). Cash income from various jobs

such as logging and ranching provided them with the opportunity to purchase additional foods, and thus began the great nutritional shift towards refined, processed, and fatty foods (Wiedman, 1989).

Biological Etiology of Type II Diabetes

The biological etiology of Type II diabetes has been investigated as a major question within the medical/health community. Current research indicates that Type II diabetes definitely has a genetic component which when activated results in this disease (Kuller, 1993). It is of no doubt that certain risk factors such as obesity and inactivity are also links to triggering this disease process.

Diabetes was once known as a "benign" disease which did not affect Native Americans before the 1930s. The first Native American diabetes-related death was recorded in the Cherokee tribe in 1942 (Wiedman, 1989). Native Americans did not have a word in their vocabulary to describe Type II diabetes and were ignorant about strategies to prevent this disease. It was commonly referred to as the "new disease brought by the white man" (Wiedman, 1989, p. 240). Moreover, a historical perspective describes a significant change in the prevalence of this disease within Native American tribes beginning in the 1960s when the disease increased dramatically in many Native American communities (Ritenbaugh & Goodby, 1989). Urdaneta and Krehbiel (1989) discuss a significant theory for this vexing problem, first proposed by Neel in 1962, in regard to a predisposing genetic component which may trigger Type II diabetes in Native Americans. Scientists hypothesized that cultures which have been previously regarded as "feast and famine" cultures, are more at risk for having what they call a "thrifty gene" (p. 227).

These same genes, which at one time may have protected an agrarian culture from starving by conserving energy and efficiently storing fat for survival, are a malady in industrial societies (Urdaneta & Krehbiel, 1989).

Studies published in the New England Journal of Medicine documented the results of three international teams who isolated these mutated genes, which are believed to play a role in the onset of type II diabetes (Mack, 1995). The "thrifty gene" is a contributor for storing fat, and too much adipose can have a negative effect on the muscle's ability to effectively utilize insulin. Although these genes may not directly cause the disease process to take place, the combination of a sedentary lifestyles and obesity may trigger increased blood glucose levels. This gene was discovered in the Pimas in Arizona. The Pimas have a high obesity rate which has been associated with an increased risk of getting this disease at a younger age (Mack, 1995).

Szathmanry formulated another etiologically theory known as the "glucose-sparing" genotype, which again emphasizes prehistoric migration from the Arctic to North America (as cited in Ritenbaugh and Goodby, 1989, p. 228). This theory assumes that the population had to adapt to a different environment and throughout the years of northern hunting, a "filter effect" took place (Ritenbaugh & Goodby, 1989, p. 228). Only those who could survive on a lean diet, protein, and little glucose were able to thrive. In essence, these genes have not been able to adapt to the lifestyle of plentiful food and sedentary lifestyles.

Inheritance is another theory related to increased susceptibility to this disease. Offspring of parents who develop this disease younger than age 65 years have a greater

chance themselves of developing it, with onset at an even earlier age. Prevalence of this disease is also high in those individuals over the age of 65, even if neither of their parents had the disease. This suggests that it is not necessarily a dominant gene which passes on this disease (Knowler et al., 1993).

Studies on separated twins among the general United States population suggests that genetics do play an important role in the development of obesity. Children who were adopted share the same weight tendency of their biological parents. Bouchard reported that some genotypes are more sensitive to the influences in their environments (as cited in Ravussin, 1993). Most significantly, basal metabolic rates (BMRs) have been noted as different between those Native Americans who are obese and those who are not obese within the Pima tribe (Kuller, 1993).

Pregnant women also give insight to the "thrifty gene." As women developed gestational diabetes, scientists have been able to study their metabolism before the onset of this condition. Robinson and Johnston found that while most women burn calories more efficiently while pregnant, women with gestational diabetes tend to need lower amounts of calories (as cited in Mack, 1995). This need for fewer calories took place months before any symptoms of diabetes. They hypothesized a diet of fewer calories would be crucial for these women who were pregnant and predisposed to diabetes. They also found that women with gestational diabetes were not able to sufficiently metabolize the available insulin.

Wiedman (1989) found that the aging process was a significant risk factor for Type II diabetes. As individuals grow older, they tend to have a decrease in their glucose

tolerance. Knowler et al. (1993) found that gender also has an influence on getting this disease. Women have higher rates of onset during their childbearing years from excessive weight and physiological factors associated with pregnancy. A current trend which has been documented since 1965, shows an increase in female diabetics and a decrease in the age of onset to middle age. Historically the disease was most prevalent in individuals over the age of 65, but those most at risk today are between the ages of 45 to 54 within the Native American communities. The younger cases now have to deal with the future complications of the disease if uncontrolled and it places an even greater burden on the already strained health care system (Johnson & Strauss, 1993).

Obesity

Obesity is considered a prime risk factor for the onset of Type II diabetes. Although it is not the only indicator, 60 to 90% of those diagnosed with this disease are obese (Wiedman, 1989). Across all genetic and ethnic backgrounds, obesity and more specifically obesity of the upper body, magnifies one's chances of developing this disease (Wiedman, 1989). Contributing factors for obesity are numerous, but primarily involve genetics, diet, cultural background, and lifestyle choices (Ravussin, 1993). Some of the genetic theories which may have had an influence on Type II diabetes have been previously discussed. Lifestyle factors are also a significant contributor and are the main focus of health behavior change programs (Broussard et al., 1995).

A national survey conducted by the 1987 National Medical Expenditure, using a behavioral risk factor surveillance system, looked at the prevalence of obesity in the IHS communities. Broussard et al. (1995) found that Native American men, women, and

children were significantly heavier than the rest of the American population. Thirty three percent of men and 40.3% of women were defined as obese. The 1995 rates in the general population of the United States for obesity were 24.1% for men and 25% for women.

The Pima, who have the largest numbers of diabetics in the United States and the world, also have 75-87% of their population, aged 20 to 54, labeled as obese (Ravussin, 1993). Studies have provided insight as to when rapid weight gain takes place within this indigenous tribe (see Appendix E). Kuller (1993) found that men seemed to gain most of their weight gradually after the onset of puberty until they peaked at the age of 45. Women, on the other hand, tended to gain the most weight during pregnancy as well as early postmenopausal ages.

The duration of time an individual is obese also seems be related to the onset of Type II diabetes. Those individuals who were obese for 5 to 10 years are at an even greater risk for the onset of diabetes (see Appendix F). A review of longitudinal data on residents of the Gila River Indian reservation found that among those obese 0-5 years 24.8% were at-risk, those with 5-10 years of obesity 35.2% were at-risk, and among those obese more than 10 years 59.8% were at-risk for Type II diabetes. This correlation may place heavier children at increased risk for this disease as they have the potential for prolonged obesity (Everhart, Pettitt, Bennett, & Knowler, 1992).

This is especially important for Native American children who are burdened at an early age with excessive weight. A Canadian study by Bernard, Lavallee, Gray-Donald, and Delisle (1995) found not only are the Cree children four times more likely to be obese

than the rest of the general population, but they also noted that those who were defined as obese at the 85th percentile, consumed a less varied diet. They theorized that the major contributors to weight gain were sedentary lifestyles and poor nutrition. The consumption of milk products, fruits, and vegetables were significantly lower in those children than that of other Canadian students. Not only are these children eating foods high in calories, but they may not be consuming enough calcium and fiber. The study reported that Cree who attended schools which emphasized organized sports activities were more involved physically and had greater calcium consumption.

Another study of Navajo children, who are part of the biggest tribe in the United States, noted a significant change in the weight of Navajo children in the past 35 years. Sugarman, White, and Gilbert (1990) found that twice as many Navajo children were above the 95th percentile than reported in previous research analyzed in 1955. Also, there seems to be a trend towards larger babies at birth. Broussard et al. (1995) reported that "from birth, American Indian infants are larger than those of other U.S. races" (p. 290). Gestational diabetes is the main risk factor for heavier infants and they also are at an increased risk to be heavier as children and adults. These heavier babies are now at increased risk for obesity and Type II diabetes at an earlier age. The literature review did not result in any data/information related to the prevalence of Type II diabetes in Native American children, but obesity levels are significant.

Socio-Cultural Factors Contributing to Type II Diabetes

Acculturation into the Western lifestyle has been another factor resulting in changing dietary/activity patterns of Native Americans. The Pimas dietary intake was

documented to have similarities to the Western diet, but consumption of greater quantities was noted (Ritenbaugh & Goodby, 1989). There has been a change to increased fats, increased simple sugars, and less fiber. The "famine" aspect of their diet has been replaced by readily available foods. Labor intensive agriculture is less common among Native Americans. Today, sedentary jobs and labor-saving production techniques have cut the amount of energy expended (Ritenbaugh & Goodby, 1989). Increases in diabetes seem to parallel the amount of acculturation a tribe has undergone (Wiedman, 1989).

The Pimas have the largest recorded amount of Type II diabetes in any genetically similar population in the world. Approximately 8,000 Pimas reside southeast of Phoenix, AZ. They are genetically homogeneous and have resided in an isolated area for the past 2,000 years (Ravussin, 1993). Climatic living conditions are dry and desolate, but this tribe was efficient at agriculture and used the Gila river for land irrigation. As white settlers began farming close to the Pima settlement, they began to divert the river for their own farming needs. Toward the turn of the 19th century, the reliability of the river to meet the Pima's needs was wavering. Soon drought and famine blanketed the community and agriculture was abandoned for commercially grown foods and resources (Ravussin, 1993).

Adopting a sedentary lifestyle and diet changes increased the incidence of obesity and chronic diseases. More than 75% of the adult population of Pimas are obese and over 45% of the adult population have Type II diabetes (Ravussin, 1993). Obesity, like diabetes, is also a recent phenomena. A current environmental theory related to the dramatic increase of obesity within these communities is the provision of government subsidized food commodities. These food subsidies have been a staple in their diets since

the late 1800s. Commodities such as flour, lard, oil, pinto beans, bacon, coffee, salt, etc. became the main diet and gone were the traditional grains and low fat foods (Wiedman, 1989).

Indian reservations within the United States are often dubbed "America's Third World" (Breda, 1989). Poverty has been a reality for many Native Americans. The United States Department of Commerce reported that 68.8% of the tribe on the Muckelshoot Reservation in Washington, lived on incomes below $14,000. This was below the poverty line designated by the United States government (as cited in Breda, 1989). Poor housing and unsanitary living conditions contribute to the degenerative conditions. Unfortunately, these poverty conditions created a need for food commodities and subsidies from the United States Government. A recent phenomenon is the financial profits of Native American gambling casinos which are generously shared with its tribal members. For example, each adult member of the Sycuan Kummeyaay tribe, located in California, receive $4000.00 per month, promised jobs with the casinos, and trust funds for their children. In California, profits from 40 Native American Gambling casinos had a combined net profit of 1 billion in 1996 (Magagnini, 1997). Yet, three out of four California Native American tribes are still living in poverty despite the success of some tribes (Magagnini, 1997).

Nutritional inadequacies in the diet also parallel poverty. This has its greatest impact on children. Breda (1989) claimed that nutritional inadequacy was the leading contributor for Type II diabetes. Government subsidies, which are readily consumed, are mainly low in fiber, and high in fat and refined sugars (Breda, 1989). Grady (1997)

commented on the results of a recent study of 65,173 female nurses. This was a six year longitudinal study conducted by Harvard researchers which surveyed diets of these women. The results of the study noted that fiber and low glycemic loads were key in the reduction of Type II diabetes. Foods low in fiber and high in carbohydrates increase the risk of diabetes in women. These foods, which the United States government has been providing many Native Americans do not meet the highest nutritional standards and inadvertently may be contributing to this disease (Wiedman, 1989).

Education is a factor for understanding and processing information on health. Breda (1989) notes that Native American children have the highest high school drop-out rate as well as the lowest levels of academic success within the United States. The National Health Interview Survey found that 50% of Native Americans with diabetes had less than a 12^{th} grade education (Gohdes, 1988). This has a direct effect on the amount of health-related information which can be processed by patients. Patient education is a key component to prevent or manage behaviorally induced chronic disease. It is important that students learn about their susceptibility to this disease along with the educational information related to good nutrition and active lifestyles (Gohdes, 1988).

CHAPTER III

INDIAN HEALTH SERVICE

The purpose of this study is to review the related literature on the etiology of Type II diabetes in Native North Americans and its implications for community-based education/prevention programs.

As of 1989, there were 507 federally recognized tribes with distinct languages, cultures, and unique perspectives on health (Breda, 1989). The United States government has taken responsibility for the health care of the one million Native Americans, and since 1955 the Indian Health Service (IHS) has taken responsibility for the comprehensive care of its patients (Gohdes, 1986). With this came the need to get the message out to Native Americans about the importance of diabetes awareness and disease prevention.

The Indian Health Service has conducted excellent research studies on the epidemiology of diabetes within its jurisdictions. Kimball, Goldberg, and Oberle (1996) reported the IHS goal is to "raise the health status of American Indians and Alaska Natives to the highest possible level" (p. 264). The IHS is a branch of the Public Health Service and represents all federally recognized tribes. Much support and funding has been allotted for the advancement of community programs for the prevention of diabetes (Kimball et al., 1996).

Health Care Implications

The leading causes of death among Native Americans has changed in the past 30 years from infectious conditions to diseases which are behavioral and sociologically influenced (Davis, Hunt, & Kitzes, 1989). Much of the medical community still regard

diabetes as a "clinical disorder" occurring naturally in the elderly. Yet, some suggest it should be considered a public health disorder (Vinicor, 1994). Research has challenged the "clinical disorder" theory and suggest that community education programs can have a positive impact on preventive factors and behavioral changes. These programs are believed to lower the risk of developing Type II diabetes and increase the individual's control over their own lifestyle (Vinicor, 1994).

According to the 1990 census, the Native American population is now composed of 1.9 million people (Broussard et al., 1995). This is a young, rapidly growing population with 60% of the population under the age of 25 (Davis et al., 1989). The IHS serves 507 reservations in 28 states and is an agency of the Department of Health and Human Services (see Appendix G). This health care system is self-determined and self-managed and places great emphasis on improving diabetes programs (Broussard et al., 1995).

Most Native American Indians use the IHS for their health care needs. Treaties guaranteed health care to federally recognized Native American tribes, but did not clarify the quality of this health care. Many Native Americans can be referred to non-IHS facilities when their service provider can not manage their problem. Funding for these services is usually provided through Medicaid and Medicare (Gohdes, 1988).

As federal programs have attempt to cut costs and lower spending, the IHS health-care system has suffered. Gardner (1996) states that federal fiscal year 1994 data reflected 89.8 physicians per 100,000 Native Americans. This is much lower than the general United States ratio of 263 physicians per 100,000. Many government officials and

activists believe that Native American health care is under-funded. Per person spending was $1,153.00 for Native Americans; again much lower than spending for the general population which was $2,912.00 per person.

Some tribes are now using gambling revenues to create and enhance medical services to their communities. According to Gardner (1996), such tribes as the Mille Lacs, Oneida Indian Nation, and the Oneida Nation of Wisconsin are feeling a sense of empowerment and flexibility as they contribute to the development of community health-care facilities. This feeling of self-reliance and self-governing has given way to a new mentality of thinking about their health care. These tribes believe that they now are able to financially support a health care system which until recently was inadequately funded and make it better.

Type II diabetes is both genetically and environmentally induced. The genetic factor is basically a draw in the lottery of life, and is limited to physiological change or control (Kuller, 1993). However some researchers believe that the prevention and control of this disease may be more biologically-based than environmentally. If the "thrifty gene" is a genotype which reacts abnormally to adipose tissue and sedentary activity, then maybe the key to prevention will be contained in a pill which will inhibit this gene. There is a newly developed drug which improves insulin resistance called troglitazone. Although it is still in the initial trial stage, results seem promising (Mudaliar & Henry, 1997).

Yet, this is only part of the primary control process. Most extensive programs still emphasize changing diets, which can be complex. A survey which asked university students about their knowledge of six types of ethnic foods, indicated that Native

American foods were least understood (Gohdes, 1988). As dietary changes can be very complex and difficult to adhere to, it is better to adopt cultural foods in a manner that is healthy and satisfying. The main reason for dietary noncompliance was the unfamiliarity with recommended foods which represented mainstream America (Gohdes, 1988).

Programs which are not designed at an appropriate educational level are also not going to reach the intended target population. The South Carolina Diabetes Control Program found that their educational materials for diabetics were not at the appropriate educational level for its patients. Instead of being developed at fifth grade readability level as necessary, they were at the tenth grade level, thus losing 50% of the target population to illiteracy (as cited in Gohdes, 1988).

Although Native Americans do share the devastating effects of this disease, an awareness and understanding of the differences between tribal groups should be the first step when initiating a health care program. According to Breda (1989), programs that are sensitive to each tribes' beliefs, values, and traditions have a greater chance for stimulating change than programs which ignore the cultural differences.

Barriers also exist in regard to health care programs which are for Native Americans but created by "Western medicine." Mirande reports that Native Americans have resisted change to the western society more than any other minority group in the United States (as cited in Staples & Mirande, 1989). Many times elders speak and read limited amounts of the English language and become confused and irritated when programs are not acclimated to their needs (Lemaster & Connell, 1994). Health education programs need to take into consideration each tribe's culture, diet, belief system, healing

practices, and physical activity levels before introducing foreign values. For example, the Ojibwa tribe in Canada believe high blood pressure is caused by a physical imbalance of blood as it rises upward into the body, which must be balanced to relieve the symptoms (Lemaster & Connell, 1994). Other Native American tribes have a growing interest in returning to their native diets consisting of foods such as fish, berries, and roots (Brody, 1991). Respect for these beliefs and accepting them as serious factors is an important consideration in the initial design stage of any disease awareness/prevention program.

The clarity and conciseness of the educational message are also important concerns when designing and implementing a health care program. According to Gohdes (1988), the greatest success in nutritional adaptation among Native Americans occurs by simplifying the target message. For example, "eat less food" and "eat less fat" messages were considered successful in changing eating behaviors within the Winnebago and Omaha Indian communities. This model framework was based on self-efficacy and successful adoption of new behaviors in gradual steps.

A final note on the implications of health care relates to the unique physiological diagnostic process for Type II diabetes within some Native American communities. Szathmary (1989) studied the Dogrib Indians residing in the Canadian Northwest Territories and found a difference in their Oral Glucose Tolerance Test (OGTT). Their fasting glucose was similar to those rates of Caucasians, but after a 100gm glucose tolerance test, it climbed significantly higher than the Caucasian norms. The Navajos who are linked genetically to their ancestors of the north, also display similar results on the OGTT. This suggests that adoptation of the high protein/low carbohydrate diet of the

Arctic region has influenced their insulin production, which varies from other Native American populations. This study is significant because not only does it support the "thrifty gene" theory, but it also challenges universal diagnostic testing for Type II diabetes, as recommended by the WHO. This study emphasized that each tribe has its own unique nutritional intake which must be analyzed before subjecting them to OGTT. As for the Dogrib tribe, their OGTT was effectively analyzed without subjecting them to unnecessary increases in their carbohydrate intake (as cited in Ritenbaugh & Goodby, 1989).

Community Health Programs

The Indian Health Service has taken on the challenge to implement diabetes awareness, prevention, screening, and management programs which are designed for and delivered by the Native American people. Non-insulin dependent diabetes has a number of contributing factors which influence its onset, but behavior and cultural influences are prime targets for prevention and control of diabetes (Duchin & Brown, 1990). Community level intervention programs have been successful in influencing populations to embrace healthier lifestyles (Broussard et al., 1995).

According to Healthy People 2000, people should be empowered to change their health behaviors and an essential strategy for encouraging these changes is education provided through their community, schools, and workplaces. Five strategies are recommended to be used: (1) recognize the problem, (2) determine if it is a public health threat, (3) develop strategies to solve the problem, (4) implementation of these strategies, and (5) evaluation of programs (as cited in Stoto, Behrens, & Rosemont, 1990).

The community is described as a critical element in contributing to the development and delivery of behavior strategies for various groups of people. This has been especially desirable in cases of indigenous people and culturally-related people (Stoto et al., 1990). The rationale behind involving the population of interest is that the community itself can develop culturally relevant prevention/intervention programs, and disseminate this information in a manner which will empower the people. Therefore, it is critical that the population of interest is involved in the planning, marketing, implementing, and evaluation stages (Stoto et al., 1990).

Bracht (1990) states that the internationally adopted definition of health promotion from the Ottawa Charter is that "health promotion is the process of enabling people to increase control over and to improve their health" (p. 36). A new form of health care has developed which takes into consideration other cultures and communities ideology on health care, rather than pushing only the "Western" forms of health care. The large bureaucracies of medicine have tried to manage the health of the masses, but are now trying to give the responsibility back to the people and communities (Bracht, 1990).

This is especially significant with Native American cultures, as they have primarily depended upon the government for health care until recent legislation was passed. New laws for "self-determination" include the Indian Civil Rights Act of 1968, the Indian Self-Determination and Education Assistance Act of 1975, and a special provision in Public Law 93-638. This provision gave Native American communities the ability to govern themselves while empowering their services to meet the needs of their people (Buehler,

1993). The Indian Health Service has taken on the challenge to implement diabetes programs which best meet the needs of its population.

According to Airhihenbuwa (1994), empowerment of the community is a critical aspect to the success of changing and adopting healthy behaviors. This "empowerment theory" emphasizes that as individuals gain deeper insight and knowledge about susceptibilities and health care issues, they gain a deeper conception of personal control and ownership of the disease. Individuals who are personally involved in this learning and goal setting process have a greater chance of controlling their disease. Indigenous community residents must be a part of the development of health-related programs because they understand and admire the unique cultural dynamics relevant to the recommended health behavior changes. It is a system based on delivery of messages in a culturally relevant manner (Bernal, 1993).

Stracqualursi, Gohdes, Rith-Najarian, Hosey, and Lundgren (1993) discuss the importance of self-care and culturally relevant programs in regard to Native Americans and Type II diabetes. Although the IHS has adopted many of the national criteria which were established by the American Diabetes Association, they have also re-evaluated and adapted these criteria to be culturally relevant and specific to many of the Native American communities they serve. The IHS has developed "Model Diabetes Programs" which have adopted strategies such as diabetes teams incorporating mediation between tribal leaders and the IHS, the use of interpreters, and soliciting tribal contributions to program. This model has been useful in providing a framework for other rural areas that are creating and implementing diabetes programs (Stracqualursi et al., 1993).

A major frustration for the IHS is the inability of the target population with Type II diabetes to stay on a prescribed diet plan (Stegmayer, Lovrien, Smith, Keller, & Gohdes, 1988). The patient has ultimate control over foods which they digest and how well they are able to control the disease (Duchin & Brown, 1990). Dietary plans have been the commonly prescribed way to control glucose levels within the blood. The first community program on diabetes was introduced to eastern Nebraska tribes in 1979. Calorie reduction was the key theme of the program with emphasis on a simplified food program using an exchange system. A follow-up study found that dietary compliance was not achieved because of the selection of cultural foods (Stegmayer et al., 1988).

Screening is considered the most important job in this population. People can often be screened for impaired glucose tolerance through a simple blood test that identifies those who have abnormal glucose levels (Mudaliar & Henry, 1997). These easy, pain-free screening methods usually identify the largest number in the initial stages of the disease. The purposes of the screening program are to diagnosis individuals with the disease and possibly reduce the effects of the disease with early therapies.

A strong, cohesive strategy when building and organizing a community program is to involve and encourage the community leaders and elders to lead the way (Lemaster & Connell, 1994). The tribal leaders' endorsement of the program is a way of building a bridge between the tribe members and the outside health team in relaying messages and understandings. Having the community involved in the creation of a program has shown to be a factor in successfully involving more of its members (Lemaster & Connell, 1994).

Heath, Wilson, Smith, and Leonard (1991) discussed the results of the Zuni Diabetes Project in southwest New Mexico. This was a 1983 community diabetes research project, which has become an important community health model in regard to health behavior change. The focus of this research was primarily weight reduction and primary/secondary control of Type II diabetes. Their study found that competition seemed to motivate participants to lose weight and exercise. Program participants were more often younger women participants who had Type II diabetes. Three areas which were identified as positive factors for the success of this program were that males stayed with the program the longest, women who were heavier had greater interest than thinner women, and those keeping an exercise journal had greater success with behavior changes (Heath et al., l991). The authors concluded that although weight loss and diabetes control were only moderate, the ability to achieve mobilization and involvement of the community was encouraging (Heath et al., l991). Initially this program was coordinated by the IHS, but it is now successfully run by the Zuni Wellness Center, which is owned by the Zuni tribe (Heath et al., 1991).

Culture plays an important role in the attitudes and health behaviors of indigenous communities. LeMaster and Connell (1994) reported that successful diabetes intervention programs have revolved around embracing and incorporating the community in the intervention process. For example, the Indian Diabetes Intervention Program developed by the Ute Indians incorporated the elders and health personnel from the tribe to assist in the planning, promotion, and implementation of the program. This program increased

awareness, knowledge, clinical participation, and developed improved techniques for personal responsibility for controlling blood glucose levels.

Primary Prevention Programs for Native American Children

Children should learn about their vulnerabilities to diabetes at an early age. A few programs have been initiated by the IHS which focus on child wellness. The IHS developed a model diabetes program which focused on community involvement with an emphasis on children between the ages of 4 to 13. Because obesity is a general health risk and a significant risk factor for Type II diabetes, they hoped to reduce childhood obesity by the "Growing Healthy" campaign (Broussard et al., 1995). The program was part of the school curriculum beginning in 1990, and lower body mass index (BMI) results occurred over a one year period.

Another youth-oriented program introduced into the Gila River Indian community included fitness and nutrition education. A health education curriculum was developed for third and fourth graders which emphasized walking and jogging, nutritional lunches, and other home health activities. Results showed improvement in the children's abilities to run further distances than children from non-participating schools. The majority of school systems in the Bureau of Indian Affairs (BIA) do not have the resources to develop these programs, but the pilot programs were promising and warrant further investigation (Broussard et al., 1995).

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study is to review the related literature on the etiology of Type II diabetes in Native North Americans and its implications for community-based education/prevention programs.

Summary of Findings

The main care for Type II patients has been a need for secondary care so the patient can manage and control their disease. Although diet-related behavior change is a common strategy for these individuals, most of the reviewed studies showed minimal weight loss and blood glucose control. Unfortunately, by the time these individuals have attempted behavior change strategies, they already have health and life threatening conditions such as obesity, vascular and foot problems, or eye problems which place limits on the type and amount of personal activity changes they can make. Weight loss is a key in diabetes management, but this can be an extreme challenge when a lifetime of unhealthy eating and exercise habits are well ingrained. Although I believe that community health interventions and behavior change strategies are a benefit to adult Native American populations, I also recommend placing a greater emphasis on teaching Native American children about healthy life choices to empower them to stop this disease before it has a chance to occur.

Prevention is known to be more cost effective in human and financial terms than treatment. This is especially true in regard to Type II diabetes which can be prevented, and most certainly controlled, with healthy lifestyle choices. The best place to ingrain

these choices is in the youngest members of the community. According to Hochbaum (1981), the goal of health education is not only to change behaviors, but also to "fortify an already existing health-supportive behavior in order to prevent it from deteriorating into health-threatening behavior" (p. 3). Hochbaum's theories suggest that strategies to resist unhealthy behaviors, are as important as assisting individuals to adopt healthy behaviors. Therefore, reviewing the studies that focused on Native American children as well as adults will give health promotion specialists an idea about which prevention programs seem to be working and implications for future programs. Although management and control programs are necessary for the adult populations, the literature review made me believe that the children should be the main focus for primary control of this disease. More programs should be directed at the school-aged child which promote healthy living and increase disease awareness and perceptions of susceptibility to this disease, as well as preventive strategies related to Type II diabetes.

Although the programs reviewed did report improvement in the children's overall fitness and weight-loss, none of them addressed the importance of knowledge about Type II diabetes, understanding one's susceptibility to NIDDM, and the implications for a healthy lifestyle. Numerous studies have been conducted on adults and guidelines have been set, yet there are still no specific guidelines which are mandatory in the schools to help address the important issues of obesity, exercise, and healthy eating. Behavior change should not always be the focus. Hochbaum (1981) theorizes that assisting individuals in developing the "cognitive and affective states and processes to resist changing to unhealthy behaviors" (p. 3) is the primary objective health education. Once

unhealthy behaviors have begun without the knowledge of their inherent risk factors, the harder it will be for the health educator to assist students to make a change.

Implications for Health Promotion Programs

Health promotion specialists and health educators are encouraged to assist individuals, preferably at a young age, to adopt healthy behaviors which are an important part of their well-being. Primary prevention programs by the IHS should be focused on youth in the schools and communities. School programs should promote healthy food choices such as fruits, vegetables, skim milk, and breads high in fiber. The health curriculum must establish diabetes awareness programs as an essential part of the program and promote attendance. The activity center of the school should encourage different types of sporting activities which involve interscholastic sports and intramural activities. Intramural sports gives all children the opportunity to participate without the pressure of being cut from a team.

Screening programs are critical for identifying individuals with the disease and those high at risk. More IHS funding should be spent on the screening process so it is easily accessible. This is especially important for pregnant women, as they have another life which can be affected by her disease. Most importantly, Native Americans have to understand their susceptibility to Type II diabetes and the importance of the screening process. The IHS has to continue with their diabetes intervention programs to encourage yearly screening and nutritional counseling. Diabetes campaigns should also contain language and content which is appropriate to the masses of the community. Cultural relevancy and sensitivity should be the backbone of the program.

Secondary care is significant in the management and control of this disease. With successful management individuals can live free from many of the previously mentioned debilitating disabilities. The IHS should continue their community outreach programs which promote health enhancing programs such as fund-raising marathons for diabetes and community wellness centers. Wellness centers should have diabetes education and screening programs which are developed and supported by the community. More funds should be spent developing community wellness centers which can be used by the young and old.

The individual with Type II diabetes has the ultimate control with managing and controlling this disease. It is extremely important that the health care provider is sensitive in the delivery message and process of managed care. Involving Native Americans in designing their own personal and community diabetes programs should be the ultimate focus. Listening to the needs and desires of the patients is critical for assisting participants to adopt a new lifestyle. Non-Native American health care providers must try to learn about the tribal culture they serve and have a sensitivity toward traditional healing practices and ethnicity of this cultural. Building a bridge of trust with Native Americans is especially important for non-Native American health care providers. The best way is through developing an open and sensitive communication process with the elders and community of the tribe while delivering a culturally appropriate diabetes program.

Finally, the United States Government should reassess the food commodities it distributes to Native Americans and provide food choices which are diabetes friendly. The IHS should continue to demand support from the United States government as some tribes

begin to strengthen their own medical facilities. Tribes who do not have adequate independent revenues should encourage the United States government to provide better medical care and healthier food commodities. Most importantly the United States medical care must be sensitive to the susceptibility of Native American children and adults who do not reside on the reservation. Programs outside the reservation should also provide screening and educational opportunities for Native Americans who are of mixed heritage. Healthy nutritional choices and exercise programs should be a part of all school curriculums and awareness campaigns delivered to promote healthy lifestyle choices and susceptibility of Type II diabetes.

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Appendix A

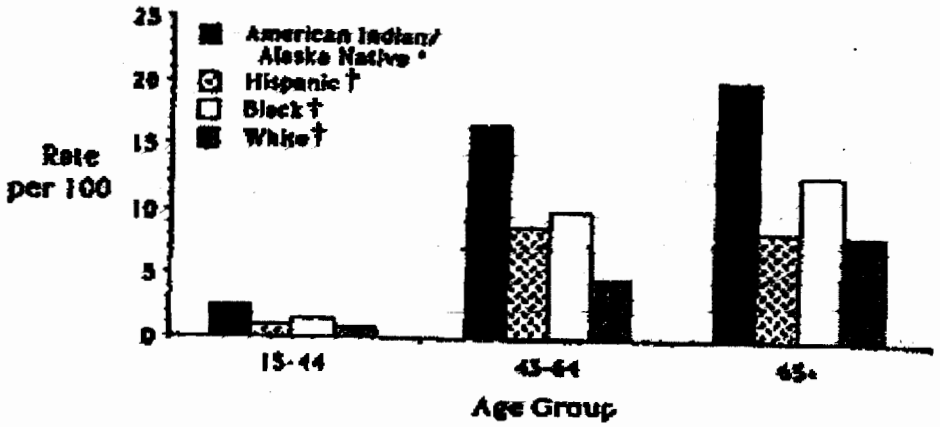

Figure 1-Age-specific prevalence of Type II diabetes in various ethnic groups

Note: From "Diabetes in American Indians," Gohdes, D., Kaufman, S., & Valway, S. (1993). Diabetes Care, 16(1), 239.

Appendix B

Figure 2 -IHS areas, 1987

Note: From "Diabetes in American Indians," by Gohdes, D., Kaufman, S., & Valway, S. (1993). Diabetes Care, 16(1), 240.

Appendix C

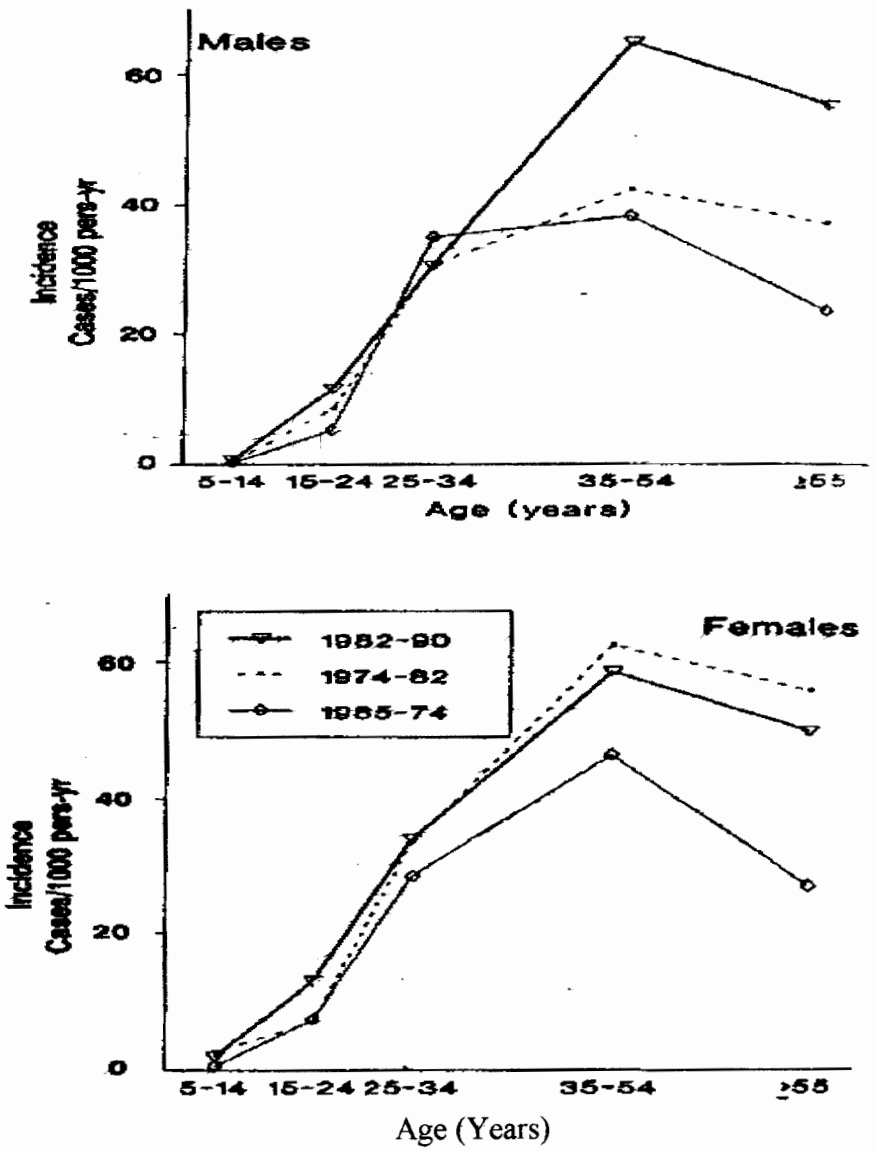

Figure 3-Diabetes age and sex incidence rates in the Pima Indians.

Note: From "Determinants of diabetes mellitus in the Pima Indians," Knowler,W. C., Saad, M. F., Pettitt, D. J., Nelson, R. G., & Bennett, P. H. (1993). Diabetes Care, 16(1), 216-225.

Appendix D

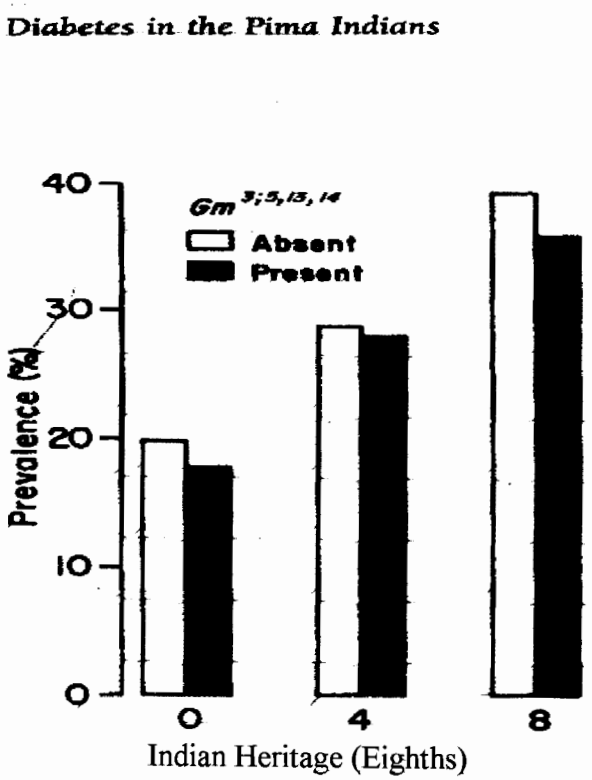

Figure 4-Prevalence of diabetes and amount of Indian heritage

Note: From "Determinants of diabetes mellitus in the Pima Indians," by Knowler et al.(1993). Diabetes Care, 16(1), 217.

Appendix E

Table 2—*Prevalence (%) of diabetes in Pima Indians by age, sex, and time period*

		Period of study		
	Age (yr)	1965–1974	1974–1982	1982–1990
Males	5–14	0	0	0
	15–24	2	5	5
	25–34	22	24	20
	35–44	37	53	49
	45–54	45	50	67
	55–64	42	55	69
	≥65	39	59	65
Females	5–14	0	1	1
	15–24	1	4	5
	25–34	22	22	21
	35–44	39	50	46
	45–54	53	67	62
	55–64	71	72	86
	≥65	58	71	74

For each period data from each subject obtained at the biennial examination closest to the midpoint of the period are used.

Figure 5-Prevalence of diabetes in Pima Indians by age, sex, and time of period.

Note: From "Determinants of diabetes mellitus in the Pima Indians," by Knowler et al. (1993). Diabetes Care, 16(1), 218.

Appendix F

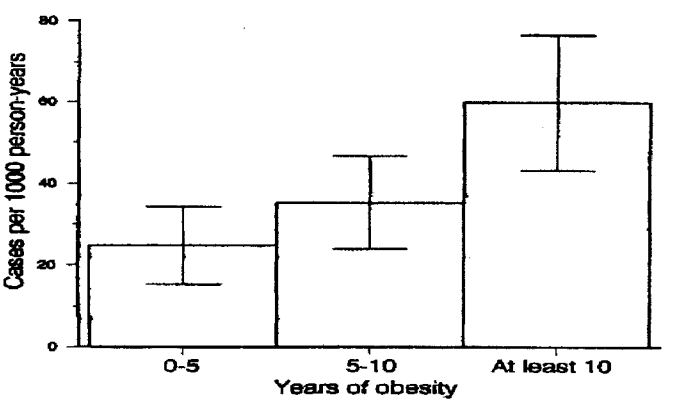

Figure 6-Incidence of type II diabetes and duration of obesity

Note: From "Duration of obesity and incidence of NIDDM," by Everhart, J. E., Pettitt, D. J., Bennett, P. H., & Knowler, W. C. (1992). Diabetes, 41, 238.

Appendix G

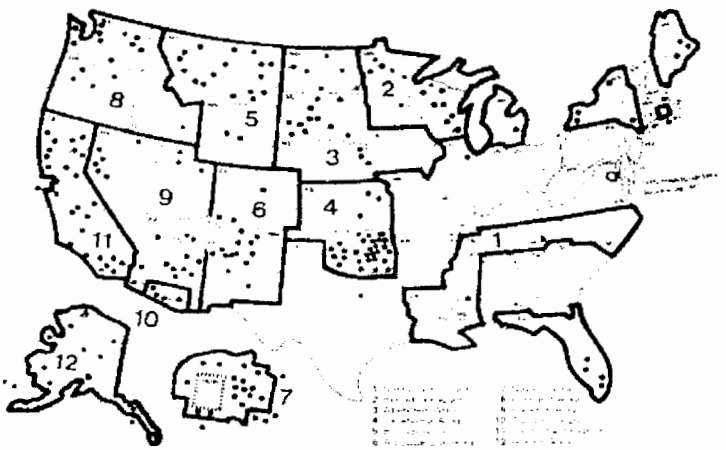

FIG. 1. Facility locations in Indian Health Service areas.

Figure 7-Indian Health Service Facility Locations

Note: From "Diabetes in American Indians," by Gohdes, D. M. (1986). Diabetes Care, 9(6), 610.