THE IMPACT OF THE UNDER-REPORTING OF VITAL EVENTS UPON EPIDEMIOLOGICAL AND DEMOGRAPHIC MEASURES OF THE MANITOBA REGISTERED INDIAN POPULATION: AN EXERCISE IN DATA QUALITY.

by

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In Partial Fulfillment of the Requirements

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The Impact of the Under-Reporting of Vital Events Upon Epidemiological and Demographic Measures of the Manitoba Registered Indian Population: An Exercise in Data Quality

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ABSTRACT

In order for the various levels of government, the biomedical research community, and Aboriginal leadership to more carefully assess the needs of the Canadian Aboriginal population they must have an accurate picture of its demographic and epidemiological characteristics. Researchers of Aboriginal health have often used various data sources without a full appreciation of the flaws inherent in the data. This thesis examines the effect of the under-reporting of vital events upon one such data source, namely the Indian Register, and subsequent ramifications for the epidemiological and demographic analysis of the Manitoba Status Indian population. The study compares the magnitude of the problem for the aggregate of six bands from 1979 through 1983 with further differentiation into sex, residential and regional categories. Each of these populations was adjusted for the late- and under-reporting of vital events in order to obtain a corresponding set of population data for comparison purposes. The principal methodologies employed include direct and indirect standardization of mortality rates, life table analysis of mortality, and analysis of fertility and reproduction. These analyses reveal a preponderance of both birth and death reporting problems associated with the off-reserve populations although all populations were affected to some degree. Demographic and epidemiological calculations for all populations were affected to an extent depending upon the magnitude of the reporting problems and the age strata in which they were concentrated. Mortality rates tended to be inflated as a result of reporting problems.

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Any errors and omissions in this work are entirely mine.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

The demographic compositions of Canadian Aboriginal populations are not well known or documented. While there is no scarcity of data concerning the populations, the data sources upon which analyses and inferences must be based have been increasingly scrutinized and criticized over the last two decades. Epidemiologists and demographers alike have used the various data sources in their research, often without a full appreciation of the flaws inherent in the data (Sugerman et al, 1993; Sugerman & Lawson, 1993; Snipp, 1986; Frost et al, 1992). These data quality issues must be addressed, especially if the research results are to be considered in program and policy planning, implementation, and evaluation. Implications of these for planning and programming employment, housing, social assistance, education, and health care delivery are especially profound.

Issues pertaining to the health of the Canadian Aboriginal populations are prominent among the interests of various levels of government, the biomedical research community, as well as Aboriginal leadership. In order for these parties to more carefully assess the needs of the populations they must have an accurate picture of demographic and epidemiological characteristics (e.g. population size and age/sex structure, mortality, fertility, and residential distribution). Several authors have mentioned the need for more reliable, meaningful data concerning the Aboriginal population (Mao et al., 1992:350; Piche & George, 1973: 367; Cook, 1980:3). As well, various studies indicate that this population is not as healthy as the general Canadian population (e.g. Mao et al., 1986; Young, 1992; Mao et al., 1992; Morrison et al., 1986; Evers & Rand, 1982). As of 1993

the infant mortality rate among Aboriginal infants had decreased but was still 1.7 times that of the larger population. Suicide rates, especially for ages 15 through 24 are five to eight times greater than the national rates (Lemchuk-Favel, 1996). Mortality rates in general tend to be higher for every age group and category. The need for accurate, reliable data concerning the Aboriginal population in Canada is clear.

Two major problem areas complicate the task of the researcher of Aboriginal health. The first of these is associated with the seemingly straightforward problem of defining the population of interest. The second area includes problems of a methodological nature. Each source of information concerning Canada's Aboriginal population has its own inherent advantages and disadvantages. Nevertheless, lack of synchrony between data resources confound methodological considerations as well as interpretations of results.

A Note on Terminology: For this analysis the Canadian "Aboriginal" population will include all descendents of the original inhabitants of what is now Canada. This includes those groups designated by the Canadian government as Indian, Metis and Inuit. The primary focus of the research will be specifically the Status or Registered Indian population and this designation is described below.

PROBLEMS FACED BY THE RESEARCHER OF ABORIGINAL HEALTH

Problem I: Defining the Registered Indian Population:

A first stage in any demographic or epidemiological investigation involves a definition of the population of interest and herein lays the first problem confronted by the

researcher of Aboriginal health. The problem has its roots in the very nature of ethnic identity. How is the Status "Indian" defined? Unfortunately when it comes to the definition of an Indian one notes the blurring of legislative and biological meanings. As will become clear the "Status" Indian definition is based substantially upon legislative and legal criteria rather than upon biological or sociological criteria. Another difficulty encountered in defining the Indian population is related to the ever-changing nature of the definition. From its legislative origins to the present day the Status Indian population has changed not only in real demographics but also as a simple result of changes in definition.

Who is a Status Indian?:

The population of interest for this research is the Status or Registered Indian population of Manitoba. In 1962, Ferd Owl attempted to address the question of "Who and what is an American Indian"? The answer to this question was long and complex and displayed a large number of labels that are applied to people of Native descent. The question is equally appropriate, and the results as complicated, if it is asked of the Canadian Indian. Snipp (1986:237) comments on the difficulty of analyzing a phenomenon such as ethnic identity. What criteria must an individual meet in order to be considered a member of Canada's Status Indian population? To be brief, if an individual meets the criteria embodied in government legislation (in its original and/or revised forms) then that individual is considered a "Status", "Treaty" or "Registered" Indian. The individual's name and unique treaty number is recorded upon a band-organized list and then, he or she is granted treaty or legislative rights and privileges that are not available to "non-Status" Indians, other individuals of Aboriginal ancestry, or non-Indians.

Presently these rights and privileges include, but are not restricted to, access to post-secondary education assistance, uninsured health benefits, and hunting, fishing and trapping rights. In many respects therefore the "Indian" population has been defined in large part by the Canadian government and not by Canadian Aboriginals themselves. As a consequence it is incorrect to assume that this "legislatively-defined population" is a realistic portrayal of Canada's Aboriginal population. Instead it is an attempt by the Canadian government to define a service population (Isfeld,1997). This will become ever more apparent through an illustration of the government legislation related to the Canadian Aboriginal.

Another aspect of the problem has already been alluded to and concerns the consequences of the ever-changing nature of the Status Indian definition. Government legislation concerning Canadian Aboriginals has periodically changed over time and so has the definition of an "Indian". As a result the Indian Register has undergone changes as well. This has had the effect of essentially changing the size and characteristics of the population. For example, the impact of Section 12 (and the resulting enfranchisements) of the Indian Act of 1951 would be most felt by young to middle-aged women and their children. Depending on government legislation individuals may gain or lose Indian Status. This continuous change in legislation therefore leads to changes in the nature of the Indian population as defined by the Department of Indian and Northern Affairs Canada (INAC). Halli, Trovato and Driedger (1990) have commented on the difficulty of describing a population that can gain and lose members simply through changes in the legal status of individuals. In order to illustrate the legislative and ever-changing nature

of the Indian definition it is necessary to briefly examine the government legislation pertaining to it.

Government Legislation in the Beginning:

The first statutory definition of an "Indian" was set forth in 1850 through the Act for the Better Protection of the Lands and Property of the Indians in Lower Canada. An Indian was defined as:

1. First - All persons of Indian blood, reputed to belong to the particular Body or Tribe of Indians interested in such lands, and their descendents.
2. Secondly - All persons intermarried with any such Indians and residing amongst them and the descendants of all such persons.
3. Thirdly - All persons residing among such Indians, whose parents on either side were or are Indians of such Body or tribe, or entitled to be considered as such; and
4. Fourthly - All persons adopted in infancy by any such Indian, and residing in Village or upon the lands of such Tribe or Body of Indians, and their Descendents (Frideres, 1998: 20).

It is important to note the biological, cultural and inclusive nature of this definition. With time the definition of who is to be considered an Indian has narrowed in scope and become increasingly legislative or legal to the exclusion of biological or cultural considerations (Frideres, 1998). This can be illustrated by comparing the four points above to the "Indian definition" outlined much later in the Indian Act of 1951. Section 11 of the Indian Act outlined inclusionary guidelines for Registered Indian Status. According to this legislation the following individuals were eligible for Indian Status:

(a) Anyone who, on May 26 1874 was.....considered to be entitled to hold, use or enjoy the lands and other immovable property belonging to or appropriated to the use of the various tribes, bands, or bodies of Indians in Canada.

(b) Is a member of a band,
    (i) for whose use and benefit, in common, lands have been set apart since May 26 1874, have been agreed by treaty to be set apart, or
    (ii) that has been declared by the governor in Council to be a band....

(c) Is a male person who is a direct descendent in the male line of a male person described in paragraph (a) or (b).

(d) Is the legitimate child of,
    (i) a male person described in paragraph (a) or (b), or
    (ii) a person described in paragraph (c).

(e) Is the legitimate child of a female person described in paragraph (a),(b) or (d).

(f) Is the wife or widow of a person who is entitled to be registered by virtue of paragraph (a), (b), (c), (d), or (e).

Two important observations are apparent in a comparison of the two legislative definitions. First, in 101 years the criteria used by the government to define an Indian changed drastically. Secondly, the changes have been at the expense of any cultural or biological considerations. From an inclusive definition focusing on land, residence, biology and relationships the legislation has moved to a focus upon treaty and legitimacy with a clear bias towards males. The patrilineal bias is as unmistakable as the change from biological and cultural considerations to legal and legislative ones. Section 12 of this same piece of legislation can further illustrate the ever-changing and legislative nature of the Indian definition. Increasingly complex guidelines were presented concerning who was not considered an Indian and who could be "enfranchised" or stripped of their Indian Status.

Enfranchisement:

Enfranchisement is a term given to the process by which an individual may voluntarily give up their Indian Status or have it legally removed. The beginnings of this

process came with the 1850 *Act for the Better Protection of the Lands and Property of the Indians in Lower Canada*; the same document that first attempted to define the Indian. An amendment to this legislation in 1851 was the first to make the distinction between Status and non-Status Indians. Not only were white males excluded from living with Indians, but the provision also excluded white males married to Indian women from obtaining legal status as Indians (Leslie & Maguire, 1978). The 1857 *Act to Encourage the Gradual Civilization of the Indian Tribes in the Canadas* was the first to provide for the voluntary surrender of Indian status and band membership (INAC, 1991). Other amendments to the legislation regarding enfranchisement were made periodically. A few of the most significant changes included:

1876: The *British North American Act* - presented the original incarnation of the modern *Indian Act*. This *Act* detailed the removal of Status from Indian women and their children if they married a non-Status man.

1880: Amendment - allowed the automatic enfranchisement of any individuals that gained a university degree.

1933: Amendment - further empowered the government to order the enfranchisement of individuals as it saw fit (INAC, 1991).

1951: *Indian Act* - involuntary enfranchisement provisions were retained, including those that discriminated against Aboriginal women.

1985: *Bill C-31* Amendment - allowed Aboriginal people who had been voluntarily or involuntarily enfranchised under the discriminatory provisions of the *Indian Act* to apply for reinstatement of their Indian Status.

Enfranchisements reached a peak of 13,760 between the period 1948 and 1968 primarily due to the tabling of the *Indian Act* of 1951 (Frideres, 1998: 25). This large

number was likely a result of two things. First, new provisions allowed for the enfranchisement of more individuals than previously. Secondly, with the establishment of the Indian Register and Office of the Registrar the entire registration process, while becoming exceedingly complex also became more efficient. The Department of Indian Affairs was able to apply a greater number of eligibility rules and other regulations to the incoming applications for Indian Status (INAC, 1991). Some of the enfranchisements were processed voluntarily upon application to Indian Affairs in order that Indians and their minor unmarried children might be privy to certain perceived privileges, for example voting rights. Others were enfranchised as a direct result of the sexually discriminatory provisions in Section 12 of the *Indian Act*. For example, an Indian woman (and her children) could have her Status revoked if she married other than a Status Indian man. The process of enfranchisement further illustrates the difficulty involved in defining the Canadian Indian. Complex legislative guidelines decided who could no longer be called Indian. These guidelines also changed often, allowing for the enfranchisement of more and more individuals, until the passing of *Bill C-31* in 1985.

Bill C-31:

The latest changes to the *Indian Act* were enacted in 1985 with the passing of *Bill C-31*. The changes were introduced for the following reasons: a) the elimination of sexually discriminatory registration criteria; b) provisions for restoration of Status and band membership; c) provision for first time registration of first generation descendents; d) elimination of enfranchisement provisions, and; e) provisions for transfer of control over band membership to band councils (Isfeld, 1997:31).

Summary: Defining the Registered Indian Population:

In summary then, the definition of the Status/Registered Canadian Indian is legislative in nature and has undergone many significant changes. The first definition to be used was based primarily on biological attributes while later definitions became more narrow in scope and legal in context. Isfeld (1997:2) notes "...the term Indian is essentially a legal concept, developed over 100 years ago as a means of regulating the relationship between a colonial and an indigenous population". Therefore the "Indian" category has been and still is, defined and described by the European-Canadian majority and not by Canadian Aboriginals themselves. The resulting Status Indian population therefore may not be a realistic depiction of the Indian population, but rather an attempt by the Euro-Canadian government to define a serviceable population. Similarly Halli, Trovato, and Driedger (1990) note that, "A closer examination of the criteria employed in the legal definition of Indian.... reveals little or no overlap between these and either cultural and biological variables". Researchers carrying out epidemiological and demographic investigations of Canada's Aboriginal population have continued to use this Status Indian population when other data on Aboriginal ancestry is unavailable (Moffat et al., 1988).

It should also be noted here that the definition of an "Indian" might also be different depending on the data source being used. For example, the census tabulates those individuals whom have self-identified as Aboriginal. On the other hand, the Indian Register, which will be discussed in detail below, recognizes as Indians only those that meet the criteria and stipulations set forth by current government legislation. The First Nations and Inuit Health Branch (formerly the Medical Services Branch of Health and

Welfare Canada) also utilizes this definition. Unfortunately, there exists a paucity of literature pertaining to the potential consequences of using such data sources in the evaluation of native health and demography. The importance of recognizing these issues cannot be overstated. As Aboriginal people become more involved in managing their government and health care systems, it is crucial that all parties be able to accurately define those demographic and epidemiological parameters that aid in administrative decision-making.

Problem 2: Describing the Registered Indian Population

Even after one is able to accurately define the Aboriginal population in Canada it is still often difficult to describe this population. This leads us to the second major problem associated with the study of Aboriginal health. Different data sources are often not directly comparable, transposable or mutually transparent. Several authors have noted the importance of accurately characterizing the Aboriginal population (Siggner & Locatelli, 1980:7; Cook, 1980:3). The ramifications of not doing so could be very serious. A study carried out by Frost et al. (1992) indicates that the lower cancer incidence observed in Native Americans compared to Caucasians is partially due to racial misclassification. Similarly, Rosenberg et al. (1999) blame racial misclassification for the understated mortality rates exhibited for American Indians in the United States.

The primary sources of data concerning Canada's Aboriginal population are the Indian Register, the First Nations and Inuit Health Branch, as well as census and post-census surveys conducted by Statistics Canada. Each of these has its own advantages and disadvantages and the data obtained from one is often not comparable to the

corresponding data from another. The following is a brief description of these information sources and how useful or misleading they can be in Aboriginal research.

Census:

The census is carried out every five years by Statistics Canada. Data from the census includes information on age, sex, marital status, as well as cultural, socio-economic, family and household aspects. It is used for many purposes, from calculating population and migration projections to analyzing the impact of social programs. Information on the Aboriginal population of Canada derives from the responses to questions on ethnic origins and/or membership in an Aboriginal Band. Cross-tabulation of Aboriginal origin with demographic, social and economic data represents an important source of information on Registered Indian conditions (Boyd & Rosenberg, 1987:4). A multitude of limitations have been identified in the use of census data for the purpose of demographic and epidemiological analysis. Some of these are purely methodological problems while others are related to the lack of comparability of the census data from year to year and with other data sources. They include the problems of non-response to, and respondent error in the interpretation of, specific questions with consequent over- or under-enumeration, the very nature of the self-reporting process, and other miscellaneous difficulties.

First Nations and Inuit Health Branch:

The First Nations and Inuit Health Branch (FNIHB), previously the Medical Services Branch of the Department of Health and Welfare Canada, is assigned the task of administering the health of Canada's Aboriginal peoples. It is a good source of

information regarding births and deaths, primarily because the reporting takes place locally. It is also not very susceptible to the problem of late reporting (Murray, 1980:81). FNIHB data does have another outstanding advantage. Data are, conditional upon the adequacy of event reporting, subject to continuous updating. For example, if the department in 1979 became aware of a birth that occurred in 1977, then that birth would have been reallocated to the 1977 birth cohort in the database and the numbers amended in subsequent publications. Therefore, vital events data, given the passage of sufficient time for recovery of late-reported births and deaths, are considered to be quite accurate (Rokala, 1999: Personal Communication). Census data and Indian Register data are not continuously updated in this manner.

Still however, this data source is subject to some limitations. The most notable problem is the variation in coverage and collection procedures that one encounters from region to region across Canada. As far as coverage is concerned, in the Atlantic Provinces, Quebec, and Ontario field staff collect information for only those First Nations people living on reserves. On the other hand, for Manitoba, Saskatchewan, Alberta, British Columbia and the Yukon, data are obtained from the respective provincial and territorial databases and includes events that occurred both on the reserves and off (Lemchuk-Favel 1996:2). Other idiosyncrasies exist as well from region to region. For example, those communities in Quebec that are subject to the James Bay Agreement do not provide data to the FNIHB nor do those bands currently involved in the transfer of their own health care management. For the Pacific region data is unavailable for the years 1985 and 1986 (Lemchuk-Favel, 1996:4). Manitoba and Saskatchewan have a unique system. Births occurring among Aboriginals are tracked through the Provincial

Health Insurance Department. Lists of births are sent to the FNIHB to obtain a Medicare number and parents must register new births in order for the child to be covered by Medicare (Ram & Romaniuc, 1985:6).

While the above problems simply make it difficult to make regional comparisons there are other problems inherent in the FNIHB data. Boyd & Rosenberg (1987:26) outline several other problems not directly related to larger demographic and epidemiological analyses. Briefly, these include changes in the International Classification of Diseases (ICD), miscounting of medical resource usage on and off reserve, along with the aggregation of all data to larger regional levels. When all is said and done the database maintained by the FNIHB is a valuable source of information for use in demographic and epidemiological analyses, particularly because of the continuous updating process that they are subject to.

The Indian Register:

The Indian Register is maintained by the Department of Indian and Northern Affairs Canada (INAC). It represents a list of all individuals who have been granted Indian Status through the provisions in the Indian Act. This is quite unlike the self-identification of ethnic origins that characterizes the census. Information recorded within the Register includes name, age, sex, marital status, band status, and occasionally information regarding religion and place of residence (Murray, 1980:72). Events such as births, deaths and marriages are also tracked. It is continuously updated and maintained throughout the year. The Indian Register was established in 1951 for administrative purposes along with the Office of the Registrar and was subsequently computerized in

1965. The Registrar is responsible for determining the eligibility of individuals for Indian Status. The Register is considered by some to be one of the most useful sources of demographic data available to the researcher of native health. It is used by INAC to supply population counts, the denominators in demographic and epidemiological analyses. Like the other information sources mentioned however, the Register has its own inherent limitations. The inconsistent reporting of vital events is the most serious problem associated with using the Indian Register as a source of demographic data. Data are often subject to lengthy reporting delays and in some cases events may never be reported at all. This is evident in the case of both deaths as well as births.

Irregularities in the Reporting of Deaths:

Mortality data is crucial to the examination of population health. One particular report suggests that the late reporting of deaths is the single largest problem associated with Indian Register data (INAC, 1993:6). In some instances it may take up to 3-5 years for a death to be reported (Boyd & Rosenberg, 1987:2; INAC, 1984:9). There are two methods by which INAC adjusts the Indian Register data in order to account for these instances. If both reporting dates and actual event dates are available then the researcher can simply reallocate the deaths to the year in which they occurred, thereby reducing the population count in that year and thereafter. One can also estimate the expected number of late-reported deaths in one year by extrapolating from previous trends. The under-reporting of deaths is also thought to contribute to Indian Register data problems. The procedures used by INAC to correct for this phenomenon are complex.

Irregularities in the Reporting of Births:

The discrepancies in the reporting of vital events can also compromise fertility data. The under-reporting of births can adversely affect Indian Register data. It is quite possible that a child may die before being registered, in which case the birth will go completely unreported. While it is not thought to be as serious a problem as late-reporting, Ram and Romaniuc (1985:13) note that this under-reporting has probably led to an underestimate of Aboriginal fertility rates for most provinces from 1971-1976 and for select provinces from 1976-1978. While not as serious a problem as in the first half of the century the researcher still must address this under-reporting. The adjustment procedures used by INAC for the under-reporting of births are similar to those carried out for the case of deaths and are far too complex to elaborate upon here.

The late reporting of births to INAC is perhaps the largest problem associated with using the Indian Register as a source of demographic data. It is first important to illustrate the magnitude of the problem. This phenomenon was first considered by Graham-Cummings (1968), and since then several authors have recognized the need to address it. Piche & George (1973:381) and Ram & Romaniuc (1985:33) even suggested that some fertility measures might be underestimated for some time periods due to the late reporting of births. They found that for births between 1971 and 1982, between 45 and 92% were not reported in the same year that they occurred. Nault et al (1993:6) illustrate the problem quite well. They note that in 1980 there were 5172 Registered Indian children less than one year of age in Canada. Surprisingly however, in 1981 that cohort (now aged 1 year) was 7215. The size of the cohort therefore increased by 2043 children. This is puzzling because mortality should be the only factor involved in

dictating the size of this segment of the population. The reason for this discrepancy is the inconsistency associated with birth reporting or registration. Most births are reported within 6 years of their occurrence. However, some may continue to be reported even up to 18 years following the event (Nault et al 1993:7). Even more troubling is the fact that the extent of the late reporting has varied markedly from year to year, actually increasing with time (Ram & Romaniuc 1985:6). In 1965, 81% of births were reported in the same year they occurred, 11.8% were reported one year later, 1.5% two years later and the remaining 5.7% were reported three or more years later. In 1971 however the percentages were 69.1, 18.7, 3.2 and 9% respectively. As a further example, for 1990 the end-year Statistics Canada Registered Indian population as measured by the census was reported as 490,178. Once the births were reallocated to the correct year however the national total was 511,382, or 4.3% higher (INAC, 1993). Of course the majority of the impact would be upon the youngest age groups, those under 5 years of age.

The reasons behind the late reporting of births are not well known but some suggestions have been made. The increased out-migration from reserves may make it difficult for Band administrators to keep track of those births occurring off the reserve. Another possible explanation for the apparent late reporting of births is simply the time of year during which a birth occurs. If a birth occurs in November or December for example, it may not be reported to INAC until the following year. Since the Indian Register population totals are end-year then the individual will show up in the following year's total rather than the current. The problem is a very real one and must be addressed by the health researcher.

There are two different methods by which INAC adjusts their numbers for the late reporting of births, depending upon the situation. If the event is registered at some point in time then the birth can be reallocated to the year in which it occurred, as long as the actual birth-date has been recorded. If the event has not yet been registered a different procedure is carried out. For example the researcher may, in the year 2000 wish to know how many births from the year 1999 still have not been reported. The approach is then one of estimation based on previous trends.

Research Objectives:

The objective of this research is to address the problem of describing Manitoba's Registered Indian population. An attempt will be made to accurately define this population for the period of time between 1979 and 1983 and provide more realistic estimates of some demographic and epidemiological indicators within that time period. In so doing I hope to accomplish two things. First, I will address the limitations of data sources, particularly the Indian Register, currently used for these purposes. Secondly, I will attempt to establish an accurate baseline, free of idiosyncrasy, from which long-term trends may be more realistically portrayed in Manitoba.

Research Questions:

1. What is the magnitude of the problem of the inconsistent reporting of vital events for Manitoba's Status Indian population for the period 1979-1983?

2. How do the adjusted population totals for Manitoba compare to those totals presented by INAC?

3. How do the adjusted totals affect the age-sex structure of this population and subsequent fertility and mortality measures?

4. Can the adjusted population totals obtained be used to set a convenient, reliable baseline population from which further trends may be considered?

CHAPTER 2

MATERIALS

DATA SOURCES:

Two primary sources of demographic and epidemiological data were used in this study. Mortality and fertility data were derived from the databases of the First Nations and Inuit Health Branch, as previously reported by Isfeld (1997). During the time period of interest the Medical Services Branch of the Department of National Health and Welfare (the previous form of the FNIHB) was responsible for the collection, collation, and reporting of this data. For this reason the MSB designation will be utilized for the remainder of the analysis. Mortality and fertility events are reported to the MSB via the local health care community, from band reports and also from nursing stations in most communities. Data pertaining to descendents and members are then crosschecked with the Indian Register in order to confirm Indian Status. End-year population counts for this analysis were obtained from Indian Register-based summary reports. These are published on a yearly basis by Indian and Northern Affairs Canada (INAC).

DATA ABSTRACTION:

Data abstraction was undertaken for the years 1979 through 1983 for an aggregate of six bands considered to be among the largest in the province of Manitoba and assumed to be representative of the Manitoba Status Indian population. Separately these populations were too small to allow reliable statistical analyses, but in the aggregate it was assumed that their condition was representative of the larger Manitoba Aboriginal condition as a whole (Isfeld, 1997). MSB birth and death data for the six bands were

aggregated and averaged over the five-year period to produce standard counts of births and deaths (Appendix I). There are both advantages and disadvantages to using MSB data for research purposes. These have been outlined in detail in the introductory section but it is worth repeating that the data are subject to continuous revision when new information becomes available. Therefore one can be reasonably confident of the accuracy of the databases.

INFORMATION SUPPLIED:

MSB: For each mortality record the following information was available from the database: a) year of death; b) band affiliation; c) residence at time of death (on/off reserve); d) sex; and e) age at death. This included those deaths occurring within the afore-mentioned bands only. For each birth record data provided are similar and included: a) band affiliation at time of birth; b) sex; c) date of birth; d) maternal age at time of birth; e) and residential status of mother at time of birth (on/off-reserve).

INAC: Total Registered Indian population counts were obtained from the Indian Register summary reports published by INAC. This data suffers from several limitations, primarily the late- and under-reporting of vital events, but one goal of this research was to analyze and minimize these limitations.

Standard: For comparative purposes the 1992 Manitoba population was used. Post-censal population estimates were taken from publications of the Population Estimates Section of the Demography Division of Statistics Canada. Mortality data for this population was obtained from the Health Statistics Division.

ADJUSTMENTS TO THE DATA:

In order to carry out the intended research it was necessary to make some adjustments to the data supplied. These adjustments took into account: a) residence categories; b) cases in which age was recorded as "unknown"; c) the standard conversion of end-year populations to mid-year; d) and the aggregation of the data into appropriate age categories; e) construction of standard schedules of mortality and fertility.

Residence Categories: INAC differentiates between six primary residence categories based on band administration and location. These are as follows: a) living on a reserve that is administered by the person's own band; b) a reserve administered by a band other than their own; c) living on crown land administered by their own band; d) crown land administered by another band; e) crown land not administered by any specific band; f) and off-reserve. For this research the six categories were collapsed into two, being simply **on**- and **off**-reserve. The former consisted of those individuals falling into the on-reserve own band category and those living on crown land administered by their own band. All others were placed into the off-reserve category. The justification for this grouping procedure was two-fold. If one assumes that each band has its own distinct cultural and geographical characteristics then it can be suggested that the "own" band categories may be combined to represent the on-reserve population. Also, it was still necessary to identify a relatively large off-reserve population in order to make comparison with the on-reserve population more meaningful. For any situation in which the residential status was unknown then the individual was identified as off-reserve. Since this total number was quite small it was unlikely to have any noticeable detrimental effect upon the analyses.

Unknown: In cases where age was recorded as unknown the record was placed in the age 85+ category. It was possible that due to memory loss, the subject simply could not remember their precise age.

Mid-Year Totals: It is standard demographic convention to convert end-year population counts to mid-year counts. This was carried out with the INAC data for the sake of comparison to other research materials.

Age Categories: For the analysis it was necessary to keep the data in single age categories as well as group it into standard demographic age categories (<1, 1-4, 5-9, 10-14...80-84, 85+). One of the foci of this research was an illustration of the problem of the late reporting of births and so it was especially important to keep the data in one-year age strata for the younger ages (i.e. ages <1 through 5). To begin with the birth cohort was referred to as age cohort 0. Subsequently this cohort became the 1980 age 1 cohort, the 1981 age 2 cohort and so on until the termination of the data set at 1983. For the purpose of abridged life table analysis, and for comparison to the Manitoba 1992 population it was necessary to aggregate the data into standard age categories as well.

Organization of the Data:

Fertility Data: The fertility data was organized into a spreadsheet compatible with Excel, Quattro Pro and NCSS and the following extra columns of information were added to that already mentioned. Based upon band affiliation, a code was established to identify each record as either **Northern** or **Southern**. This facilitated the evaluation of any role of inaccessibility in the inconsistent reporting of vital events. This was not a foolproof

method for defining "remoteness". However, if any anomalies presented themselves they may have suggested avenues for possible future research. The birth records were also allocated according to the time of the year in which they occurred, in three-month intervals. These adjustments were made in order to explore the possible effects of seasonality upon vital events reporting.

Mortality Data: The Northern versus Southern distinction was also added to the mortality spreadsheet. While the deaths could not be allocated according to the time of the year in which they occurred, the age-at-death field was rounded to the nearest year.

Inconsistent Reporting of Vital Events: The third and final spreadsheet incorporated both INAC population counts and MSB birth and death data. For each year and single age category, it was possible to compare "expected" population totals in the given year to "actual" population totals suggested by the INAC summary reports.

CHAPTER 3

METHODOLOGY

The methods utilized in this research were similar in many respects to those employed by Isfeld (1997) in an analysis of Manitoba's Registered Indian population, with the primary difference being the emphasis upon delays and other discrepancies in the reporting of vital events. Otherwise, the demographic, statistical and epidemiological procedures used were suitable for the purpose of answering the research questions posed.

THE ERROR OF CLOSURE:

As will be illustrated, births and deaths do not always accurately account for the changes in a population's size from one year to the next. In the case of Manitoba's Aboriginal population certain data quality issues, particularly within the time period of interest in this study, virtually guarantee that mortality and fertility data alone would not account entirely for the changes in population size from year to year. The Error of Closure (E_c) was used to measure this phenomenon. It takes into account factors other than mortality and fertility that may be involved in the population's apparent decrease or increase in size. It may have included the inconsistent reporting of births and deaths. It was calculated by taking one year's population as reported by INAC, subtracting its deaths, adding its births (both as reported by the MSB), and then dividing this result by the following year's population total. This number was then subtracted from 1, giving the proportion of population growth not accounted for by natural increase. Unfortunately this procedure did not allow for the differentiation between the effects of various types of reporting discrepancies and migration. While the E_c may outline the magnitude of the

problem of the inconsistent reporting of vital events, regional (north/south) and residential (on-/off-reserve) migration must be considered as a potential source of error. For this research, E_c calculations were completed for each population of interest (north, south, males, females, on-reserve, off-reserve) for the period of time from 1979-1983. If irregularities in the reporting of vital events were related to the characteristics that differentiated these subpopulations then the respective Ec may have demonstrated it.

IRREGULARITIES IN THE REPORTING OF VITAL EVENTS:

The primary focus of this research was the problem of discrepancies in the reporting of vital events. The MSB data were informative in this regard as a source of demographic and epidemiological data. The problem was analyzed using the following methods.

A Note on Nomenclature: In order to describe the population changes from one year to the next within a cohort the following designation was applied: $YEAR_x$ denoted any year of interest where **x** was the age of the cohort in that particular year. It followed then that the 1979 age 12 cohort, designated 1979_{12} became the 1980_{13} cohort, the 1981_{14} cohort, and so on.

a) Under-reporting of births:

Consider the following example. According to the Indian Register the 1979 total population birth cohort went through the following changes in size:

$1979_0 = 255$
$1980_1 = 379$
$1981_2 = 387$
$1982_3 = 392$
$1983_4 = 393$

The problem is illustrated quite clearly here. The cohort size of 393 in 1983 suggests that at least that many births occurred in 1979. By 1980, 379 of these births were reported, and more were reported in subsequent years. This accounting procedure was carried out in order to illustrate the magnitude of the problem of under-reporting births. The results were presented as "the percentage of births being reported within 1,2,3, and 4 years", with the denominator being the maximum cohort size achieved within the window of time available for the research (1979 through 1983).

Other methodological notes concerning the late reporting of births:

In all instances MSB-reported deaths occurring within each cohort were taken into account. It was hoped that through analyzing the occurrence of under-reported births it would be possible to directly or indirectly adjust the population counts for Manitoba's Status Indian population.

One explanation for the observation of under-reported births may have been a large proportion of births occurring late in the year. For example, if a birth occurred in December it may not have been reported to INAC until the following year. As a result the birth would have shown up in the MSB database as a December birth but would not have been counted in that particular year's Indian Register population total (Rokala, 2000: *pers* comm). In order to assess the potential impact of differential monthly fertility the births were aggregated into three-month intervals for each population of interest. If for some reason there was a substantially large proportion of late-year births off-reserve compared to on-reserve, then it may have explained an apparent excess of late-reported

births. A standard chi-square test was used for this portion of the analysis with the null hypothesis assuming equal proportions of births in each three-month interval.

b) Under-reporting of deaths:

The examination of the problem of death-reporting discrepancies was quite complicated, especially in the short time period being considered within this research. Most deaths are reported within 5 years of their occurrence. The data did not allow a check of monthly mortality intervals but it was possible to get an idea of the magnitude of the problem. The mortality data supplied by the MSB made it possible to follow a cohort through time just as the fertility data did. These numbers were then compared to the corresponding population totals supplied by the INAC summary reports. For example, the age 52 cohort in 1979 (1979_{52}) reported by INAC numbered 58 and apparently remained static through 1983. Interestingly however the MSB mortality data reported three deaths within this cohort in 1980 and one more in 1981. It was very likely therefore that these deaths were not yet reported to INAC or perhaps may never be reported.

Appearance in the Data Tables:

One can gain a better understanding by observing the following example:

Year	IR Count	MSB Deaths
1978	46	0
1979	46	1
1980	45	0

Example: Period 1978-1979: The cohort population, according to INAC, remained unchanged. Peculiarly enough however the MSB reported one death to the cohort in

1979. There is a good reason for this observation. While the death may have occurred in 1979, it was not reported promptly in that year. Consequently, when the death was reported at a later date the record would have been immediately deleted from the Indian Register for the year in which it was finally reported. On the other hand, the MSB would have revised their data to show that a death occurred in 1979. It is quite plausible therefore that a situation could exist in which the INAC population count remained unchanged even while the MSB reported one or more death events.

Other methodological notes concerning late reported deaths:

The discrepancies observed were divided into two types. If the MSB reported a death within a specific cohort without a corresponding decrease occurring in the corresponding Indian Register population it was classified as a type 1 discrepancy. If however the MSB did not report a death while a decrease was noted in the Indian Register then it was classified as a type 2 discrepancy.

This accounting procedure was completed for every cohort of every population starting from age 10 to age 84, followed by a 5-year age stratum summary. The age 10 minimum was set because the majority of late births would have been accounted for by age 10 and therefore should not confound the analysis of death-reporting irregularities. It was assumed therefore that the only process affecting the size of this age 10+ population was mortality. The age 85+ category was disregarded for this portion of the analysis. The all-inclusive nature of the category did not allow the same accounting procedure to be carried out. In cases where there was an apparent increase in cohort size from one year to the next this change was disregarded and a situation of "no late-reported deaths"

was noted. It was also important to note the potential confounding effects of migration in this portion of the analysis. If an individual moved from a reserve to an off-reserve location and died then the record may have shown an on-reserve death while the Indian Register may have counted the person as off-reserve. Unfortunately it was not feasible within this study to track the migration of individuals.

ADJUSTING THE POPULATION COUNTS:

Two sets of data were available for comparison. The first constituted the unadjusted data set and consisted of the aggregated data taken directly from the Indian Register summary reports. The adjusted data set was obtained through the replacement of births and deaths into the appropriate year according to the MSB data. These adjustments were performed under the following guidelines.

Age 0 Cohort: This consisted of the maximum cohort size exhibited for this particular cohort over the available time-span minus the deaths reported up to that particular maximum cohort size.

Ages 1-10: Any apparent additions to the cohort throughout the period of interest were reallocated to the respective 1979 cohort. Deaths occurring over the period of analysis were accounted for. In each year after 1979 the cohort size was then reduced according to the number of MSB-reported deaths taking place within that cohort.

Ages 10-85+: After age 10 it was assumed that all births had been reported. Therefore any apparent population increases were disregarded. Using the 1979 population as a base the population counts for each cohort in each year were reduced according to the number of deaths reported by the MSB.

The adjusted and unadjusted population counts were then subjected to the analyses described below. The values obtained using both sets of data were then compared in order to assess the impact of vital event-reporting discrepancies upon the epidemiological and demographic analysis of the Manitoba Registered Indian population. The unadjusted counts used in this analysis represented the respective population and cohort sizes that resulted from reporting discrepancies. The adjusted counts represented the more accurate and realistic population sizes that could be expected had the effect of reporting discrepancies been minimized.

MORTALITY ANALYSIS:

In order to analyze the effect of reporting irregularities upon the demography and epidemiology of the Registered Indian population some commonly used mortality and fertility calculations were carried out. Each process is described below. In every case a standard schedule of vital events was used. It was then possible to isolate the effect of the changing denominators resulting from the adjustment procedures, and therefore the effect of reporting discrepancies upon these calculations. The resulting parameters do not reflect the actual demographic and epidemiological experience of each population in question. They do however provide a means by which the relative affect of reporting discrepancies upon the populations can be compared.

Three types of mortality rates were calculated for each population of interest, both adjusted and unadjusted. This included the crude mortality rate (CMR), indirectly standardized rate and directly standardized rate. In addition, a decomposition of the crude mortality rates based upon the direct standardization procedure was also completed.

Crude Mortality Rate (CMR): The CMR is simply a measure of the average death rate calculated over all age categories.

Indirectly Standardized Mortality Rates (ISMR): The adjustment procedures described above were carried out upon the Indian Register-based population counts, which served as the denominators in the mortality analysis. It was preferable to observe the effect of these adjustment procedures and hence, changing denominators, upon the mortality measures for each age category and population of interest. For this reason indirectly standardized mortality rates were calculated. This procedure was carried out using both the gross and age <1 to 9 populations using both adjusted and unadjusted counts. The 1992 Manitoba population was used as the standard, and the standard schedule of deaths described in Appendix I was also employed in this portion of the analysis. The methodology followed that described by Rothman (1986).

Directly Standardized Mortality Rates (DSMR): If the age distributions of two populations are relatively different then a simple comparison of crude rates can be very misleading. The seemingly lower mortality rate for one population may be a product of the greater proportion of one population being in younger age categories. Investigators generally make it a point to use "standardized" rates (Pollard et al.,1974:64). The choice of a standard population for this procedure is completely arbitrary. The resulting mortality rates are simply for comparison purposes. For this procedure the standard population was the 1992 Manitoba population.

Several standardization procedures were carried out in this research with the 1992 Manitoba population being used as the standard. In each case the calculations were completed for both the gross populations and for the age <1 to 9 population. Mortality

rate comparisons included north versus south populations, on- versus off- reserve populations, and male versus female populations. The adjustment procedures described above impacted the population totals, the denominators in the mortality analysis.

Further calculations were carried out upon the standardized rates, including the binomial variance, standard error and 95% confidence intervals. The variation was estimated by calculating the binomial variance via the method of Armitage (1971). The standard error then followed as the square root of this variance. This is a measure of the average amount of variation exhibited in the data set and is depicted in standard units. Finally, 95% confidence intervals were computed.

This standardized rate was essential for making meaningful comparisons. It did not however give any indication of the principal contributor to the difference in the crude rate. For this reason a decomposition of the mortality differences was also carried out. Of the difference in the crude rates of two populations some is a result of the difference in their age distributions while some was due to real differences in the death rates. The composition component reflects the effect of age structure on the difference in crude rates. It is a weighted average of the difference in the two age distributions. The rates component is the actual difference in mortality and it is a weighted average of the differences in age-specific death rates. The direct standardization and decomposition techniques were based upon the formulae and procedures presented by Das Gupta (1993).

LIFE TABLE CONSTRUCTION AND ANALYSIS:

The life table provides the investigator with an invaluable tool for studying the mortality experience of the population of interest. It portrays the progress of a cohort of individuals as it is reduced by mortality until every individual has died. The final table

consists of a record of mortality rates, the probabilities associated with dying, the actual number of deaths and survivors, and the life expectancies experienced by each age category of the given population (McVey Jr. & Kalbach, 1995:427).

As with many demographic modeling procedures some assumptions are necessary: a) The life table is closed to in- and out- migration; b) each age category is subject to a fixed schedule of age-specific mortality rates; c) the cohort originates from a standard number of births (100 000 is generally used in order to aid in comparison); d) deaths are distributed evenly within the year for each age category; e) the life table is constructed for only one sex at a time (due to the small population sizes in this analysis it was necessary to circumvent this assumption for the sake of the fertility analysis); f) and finally, these are expected numbers. There will of course be some variation and this will generally depend on the size of the population. Statistics show that the smaller the population the greater the potential for variations and consequently deviations from the expected values. The following is a brief summary of the variables required for the construction of the life table.

$\mathbf{q_x}$: probability of dying for an individual of exact age **x**, before reaching age **x + n**.
$\mathbf{S_x}$: number surviving to exact age **x** out of 100,000 born.
$\mathbf{d_x}$: number dying between age **x** and **x + n** out of 100,000 born.
$\mathbf{L_x}$: total years lived in the interval between age **x** and **x + n** per 100,000 born; also the life table stationary population.
$\mathbf{T_x}$: total years lived beyond age x, per 100,000 born.
$\mathbf{a_x}$: average number of years lived within the interval by those $\mathbf{d_x}$ who died within it. For the sake of consistency with Isfeld (1997) **a** will equal 0.07 for the <1 age category. This small value reflects the fact that most deaths in this category occur very early in the first

year. For the other age categories (excluding 85+), the individuals dying have lived, on average, half of the year, hence the **a** value of 0.50.

$\mathbf{e_x}$: expectation of life at age **x**.

The life table calculations were carried out for both the adjusted and unadjusted populations. Standard schedules of mortality were utilized so that differences in the probabilities associated with mortality became a function only of cohort size. It was hoped that this would better illustrate the impact of the adjustment procedures, and therefore the impact of reporting discrepancies, upon the mortality measures. In a few circumstances the number of deaths in the standard schedule of mortality exceeded the actual population total for the corresponding age category, thereby compromising the resulting survivorship and expectation of life calculations. This was the case for the south male (1981 & 1982), off-reserve female (1981), and off-reserve male (1980-1982) populations. In order to carry out some portions of the fertility analysis it was necessary to have viable survivorship data. Therefore unisex life tables were produced for each of the total, and overall north, south, on- and off-reserve populations. The methodology used was based upon that described by McVey Jr. & Kalbach (1995).

REPRODUCTION AND FERTILITY ANALYSIS:

The final analyses and comparisons carried out upon both the adjusted and unadjusted populations consisted of a detailed analysis of fertility and reproduction. All calculations were carried out upon the gross populations, using a standard schedule of fertility. The following measures were obtained.

Crude Birth Rate (CBR): This value was calculated by dividing the total number of births by the total mid-year population. This measure was of limited use since the denominator included those segments of the population that were not "at risk" of giving birth, for example females outside the childbearing ages and males.

General Fertility Rate (GFR): This was a more meaningful measure of fertility than the CBR as it divided the total number of births by the mid-year female population within the childbearing years. For the fertility analysis this population included all females from the age of 15 to 49. Births occurring for females aged less than 15 were included into the 15-19 age category. Those occurring for females over the age of 49 were allocated to the 45-49 age category.

Total Fertility Rate (TFR): This was used to express the total number of births a woman would have within her childbearing years if the age-specific fertility rates were to remain constant. It was calculated by summing the female age-specific fertility rates and multiplying by five (for the number of years represented in each age group).

Gross Reproductive Rate (GRR): This measure was derived from the TFR. It represented the average number of daughters that would be born to a hypothetical female if she experienced the characteristic age-specific fertility rates. The GRR was a useful indication of the replacement of females in the childbearing segment of the population (McVey & Kalbach, 1995).

Net Maternity Function: This value was a product of the age-specific fertility rates for female births, and the corresponding survivorship probabilities associated with females surviving to that particular age obtained from the life table.

Mean Age at Childbearing (MAC): This value was calculated by weighting the net maternity function by the average age within each category and then dividing the total of weighted values by the un-weighted ones (Keyfitz & Flieger, 1971).

Net Reproductive Rate (NRR): This measure was similar to the GRR in that it also considered female births only. In this case however further consideration was given to the effect of mortality. The NRR was calculated by summing the measures obtained for net maternity function for each age stratum and then dividing this by five in order to obtain the average number of daughters produced by a woman during her complete lifetime.

Intrinsic Rate of Natural Increase (r): This measure represented an estimate of the growth rate experience of the populations of interest, based upon a stable population model.

CHAPTER 4

RESULTS

The Populations:

The total study population was divided into six sub-populations for analysis: male, female, north, south, on-reserve and off-reserve. End-year age-specific population counts for 1979 through 1983 were adjusted for reporting discrepancies using the methods described to obtain end-year adjusted population counts for the same years. These data sets were then converted to mid-year adjusted and unadjusted age-specific population counts. The complete data set therefore, disaggregated by sex, consisted of 15 end-year adjusted and 15 end-year unadjusted populations for the years 1979 through 1983, as well as 15 mid-year adjusted and 15 mid-year unadjusted populations for 1980 through 1983. These are all available in standard age categories (Appendix II). In some cases population totals were too small to carry out meaningful analyses, particularly in the case of life table calculations and fertility measures. These will be noted, although not discussed, where appropriate.

The average percentage difference between adjusted and unadjusted end-year age-specific population counts for each population from 1980 through 1982 are presented in Table 1. Positive values were produced when the adjustment procedures increased the size of an age stratum while negative values resulted from decreases. In all populations the youngest age strata experienced the most significant increases in size. After the age of 4 the values indicated a general decrease in the proportions.

Table 1: Average % Difference Between Adjusted and Unadjusted Population Counts for All Populations, 1980-1982.

Age	male	female	total	north	south	on-res	off-res	north male	north female	south male	south female	on-res male	on-res female	off-res male	off-res female
<1	0.69	0.67	0.68	0.58	0.76	0.58	0.87	0.62	0.54	0.76	0.77	0.59	0.57	0.91	0.83
1-4	0.20	0.24	0.22	0.16	0.23	0.10	1.03	0.21	0.11	0.16	0.31	0.07	0.12	1.05	1.00
5-9	-0.03	-0.01	-0.02	0.01	-0.06	0.04	0.43	0.02	-0.01	-0.05	-0.08	0.12	-0.05	0.22	0.62
10-14	-0.21	-0.15	-0.18	-0.16	-0.24	-0.15	-0.32	-0.20	-0.11	-0.22	-0.26	-0.15	-0.16	-0.39	-0.25
15-19	-0.22	-0.18	-0.20	-0.15	-0.29	-0.32	-0.09	-0.22	-0.08	-0.24	-0.35	-0.30	-0.35	-0.20	0.00
20-24	-0.11	-0.12	-0.11	-0.04	-0.21	0.21	-0.96	-0.08	0.00	-0.14	-0.29	0.18	0.25	-0.87	-1.06
25-29	-0.08	-0.22	-0.15	-0.10	-0.23	0.10	-0.81	-0.01	-0.18	-0.16	-0.30	0.13	0.06	-0.66	-0.95
30-34	-0.08	-0.10	-0.09	-0.11	0.04	-0.09	-0.15	-0.09	-0.13	-0.08	0.18	-0.13	-0.04	0.01	-0.30
35-39	-0.08	-0.04	-0.06	-0.08	0.09	-0.18	0.10	-0.09	-0.07	-0.05	0.23	-0.18	-0.18	-0.01	0.21
40-44	-0.06	-0.02	-0.04	-0.05	-0.03	-0.11	0.01	-0.07	-0.04	-0.04	-0.02	-0.13	-0.09	-0.08	0.09
45-49	-0.03	-0.04	-0.03	-0.02	-0.05	-0.07	-0.03	-0.03	-0.02	-0.03	-0.07	-0.09	-0.04	0.00	-0.06
50-54	-0.01	-0.02	-0.01	-0.03	0.00	-0.01	-0.07	-0.02	-0.05	0.00	0.00	-0.02	0.01	-0.04	-0.10
55-59	-0.03	-0.01	-0.02	-0.02	-0.02	-0.03	-0.04	-0.04	0.00	-0.01	-0.03	-0.06	0.01	-0.01	-0.08
60-64	0.00	0.00	0.00	-0.02	0.03	-0.02	0.04	-0.04	0.00	0.06	0.00	0.01	-0.05	-0.02	0.09
65-69	0.06	-0.05	0.01	0.01	0.00	-0.02	0.01	0.07	-0.04	0.07	-0.07	0.05	-0.09	0.00	0.02
70-74	-0.01	0.03	0.01	0.00	0.01	0.03	-0.05	-0.06	0.05	0.02	0.00	-0.01	0.07	-0.02	-0.08
75-79	0.00	-0.01	0.00	0.02	-0.03	-0.02	0.02	0.03	0.01	-0.04	-0.03	-0.04	0.00	0.08	-0.03
80-84	-0.01	0.04	0.01	0.01	0.02	0.00	0.04	0.00	0.01	-0.02	0.07	-0.04	0.04	0.05	0.04
85+	-0.01	-0.02	-0.01	-0.01	-0.02	-0.03	-0.01	-0.03	0.01	0.02	-0.06	0.00	-0.07	-0.03	0.02

Figure 1: Average Percentage Difference Between Adjusted and Unadjusted Total, Male and Female Population Counts.

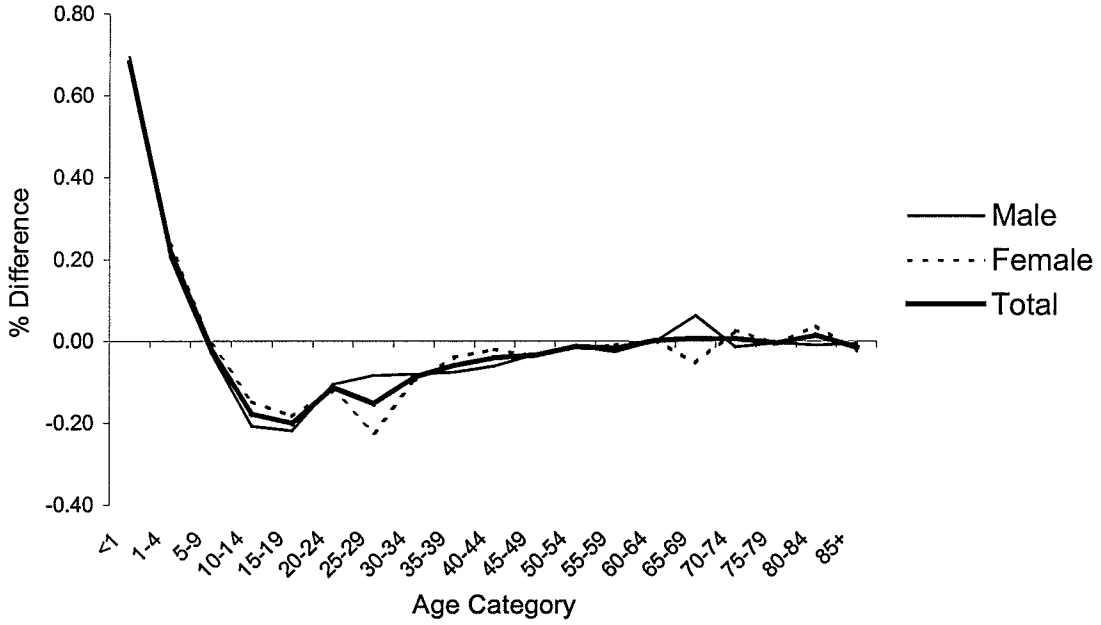

Figure 2: Average Percentage Difference Between Adjusted and Unadjusted On-Reserve and Off-Reserve Population Counts.

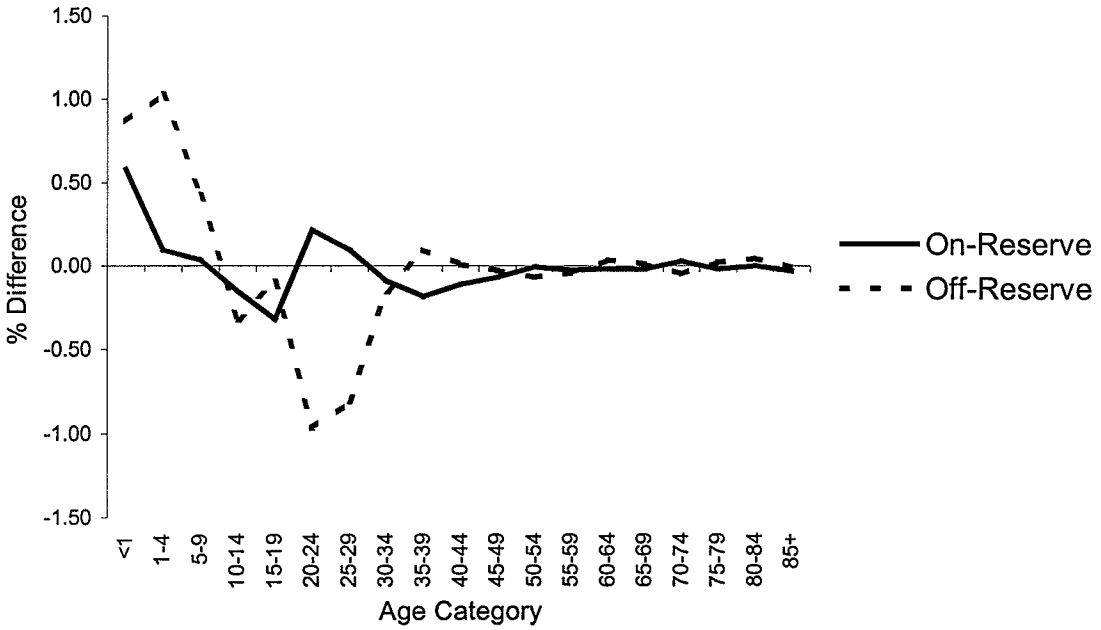

Table 1 shows that for males under the age of 1 the adjustments resulted in this cohort constituting 0.69% more of the population than in the unadjusted case. For ages 1-4 this proportion was increased by 0.20%. The same age categories within the female population averaged approximately 0.67% and 0.24% respectively. Noteworthy patterns were not observed at other ages. After plotting the average difference between the adjusted and unadjusted population counts the patterns became clearer (Figure 1). An increase in size was associated with the youngest cohorts while in most cases older cohorts, particularly those from age 10 to 34 experienced decreases as a result of the adjustment procedures. In this case the plots run along a nearly identical path. The increases and decreases in cohort sizes associated with the adjustments were similar for the male, female and total populations.

There appeared to be no significant differential impact of the adjustments upon the total north population compared to the south. This could also be said after separate analysis of males and females within these groups.

The most notable differential effects of the adjustment procedures were upon the overall on- and off-reserve populations (Figure 2). The average proportion difference between adjusted and unadjusted end-year populations for the on-reserve population aged <1 was relatively small at 0.58%. For the off-reserve population the adjusted proportion for the age category was 0.87%%. Differences in the proportion were also observed within separate analyses of males and females. They were much larger for both off-reserve populations (0.91% for males, 0.83% for females) than they were on-reserve (0.59% for females, 0.57% for females). The average differences between adjusted and unadjusted on- and off-reserve counts associated with the adjustment procedures are

plotted in Figure 2. As in the male, female and total comparison the youngest age strata experienced the most significant increases in size. Older strata experienced both increases and decreases in size, including one very notable observation. From age 15 to 39 the off-reserve population experienced a marked decrease in size. The corresponding on-reserve population was actually increased in size. A similar pattern, albeit to a lesser degree was noted in older age strata as well. This speaks to the potential role of residential mobility in the late- and under-reporting of vital events.

Error of Closure:

Errors of closure (E_c) for end-year unadjusted populations are presented in Table 2. These assess the ability or inability of natural increase to account for overall population growth. Normally the calculation of E_c would also entail a consideration of in- and out-migration. It was not possible to isolate the effect of regional and residential migration. Therefore, any inability of natural increase to account for population growth was a reflection of both reporting discrepancies and migration effects. E_c calculations must be considered cautiously, especially upon separate consideration of males and females within residential and regional sub-categories and the relatively small accompanying populations. Positive E_c values indicated that more population growth occurred than would have been expected through natural increase. Negative values were produced if population growth was less than would have been expected by natural increase.

From 1979-1980 and 1980-1981 the E_c averaged approximately one half of a percent. E_c's for the male population were 0.37% for the 1979-1980 time period and

Table 2: Annual Increase/Decrease of End-Year Populations by Natural Increase and Error of Closure.

A. Total:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	13787	14216	429	423	55	368	**0.43%**
1980-81	14216	14635	419	444	104	340	**0.54%**
1981-82	14635	14953	318	434	74	360	**-0.28%**
1982-83	14953	15391	438	533	76	457	**-0.12%**

B. Males:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	7112	7320	208	218	37	181	**0.37%**
1980-81	7320	7517	197	245	63	182	**0.20%**
1981-82	7517	7676	159	221	48	173	**-0.18%**
1982-83	7676	7885	209	280	50	230	**-0.27%**

C. Females:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	6675	6896	221	205	18	187	**0.49%**
1980-81	6896	7118	222	199	41	158	**0.90%**
1981-82	7118	7277	159	213	26	187	**-0.38%**
1982-83	7277	7506	229	253	26	227	**0.03%**

D. Northern:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	6616	6811	195	207	28	179	**0.23%**
1980-81	6811	7024	213	217	41	176	**0.53%**
1981-82	7024	7177	153	190	37	153	**0.00%**
1982-83	7177	7387	210	263	40	223	**-0.18%**

E. Southern:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	7171	7405	234	216	27	189	**0.61%**
1980-81	7405	7611	206	227	63	164	**0.55%**
1981-82	7611	7776	165	244	37	207	**-0.54%**
1982-83	7776	8004	228	270	36	234	**-0.07%**

F. On Reserve:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	9641	9967	326	266	45	221	**1.05%**
1980-81	9967	10185	218	295	78	217	**0.01%**
1981-82	10185	10259	74	285	63	222	**-1.44%**
1982-83	10259	10588	329	361	65	296	**0.31%**

G. Off Reserve:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	4146	4249	103	155	10	145	**-0.99%**
1980-81	4249	4450	201	148	26	122	**1.78%**
1981-82	4450	4694	244	149	11	138	**2.26%**
1982-83	4694	4803	109	172	11	161	**-1.08%**

H. North Males:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	3357	3446	89	99	21	78	**0.32%**
1980-81	3446	3556	110	117	23	94	**0.45%**
1981-82	3556	3637	81	105	25	80	**0.03%**
1982-83	3637	3736	99	136	24	112	**-0.35%**

I. North Females:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	3259	3365	106	108	7	101	**0.15%**
1980-81	3365	3468	103	100	8	92	**0.32%**
1981-82	3468	3540	72	85	12	73	**-0.03%**
1982-83	3540	3651	111	127	16	111	**0.00%**

J. South Males:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	3755	3874	119	119	16	103	**0.41%**
1980-81	3874	3961	87	128	40	88	**-0.03%**
1981-82	3961	4039	78	116	23	93	**-0.37%**
1982-83	4039	4149	110	144	26	118	**-0.19%**

K. South Females:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	3416	3531	115	97	11	86	**0.82%**
1980-81	3531	3650	119	99	23	76	**1.18%**
1981-82	3650	3737	87	128	14	114	**-0.72%**
1982-83	3737	3855	118	126	10	116	**0.05%**

N. On Reserve Males:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	5034	5191	157	141	30	111	**0.89%**
1980-81	5191	5290	99	160	47	113	**-0.26%**
1981-82	5290	5358	68	150	42	108	**-0.75%**
1982-83	5358	5509	151	186	43	143	**0.15%**

O. On Reserve Females:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	4607	4776	169	125	15	110	**1.24%**
1980-81	4776	4895	119	135	31	104	**0.31%**
1981-82	4895	4901	6	135	21	114	**-2.20%**
1982-83	4901	5079	178	175	22	153	**0.49%**

L. Off Reserve Males:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	2078	2129	51	77	7	70	**-0.89%**
1980-81	2129	2227	98	85	16	69	**1.30%**
1981-82	2227	2318	91	71	6	65	**1.12%**
1982-83	2318	2376	58	94	7	87	**-1.22%**

M. Off Reserve Females:

Period	P(0)	P(1)	P(1)-P(0)	Births	Deaths	Nat. Inc.	E_c
1979-80	2068	2120	52	80	3	77	**-1.18%**
1980-81	2120	2223	103	64	10	54	**2.20%**
1981-82	2223	2376	153	78	5	73	**3.37%**
1982-83	2376	2427	51	78	4	74	**-0.95%**

0.20% for 1980-1981. The corresponding female values were 0.49% and 0.90% respectively. In most cases the E_c's were negatively signed for the 1981-1982 and 1982-1983 periods.

E_c's for the first two years were slightly larger for the overall south population compared to the north. For the south, from 1979-1980 natural increase failed to account for approximately 0.60% of the growth. No difference was observed upon comparison of the north and south male populations but the same could not be said for the females. Substantial differences were observed in both the 1979-1980 and 1980-1981 periods. In fact, for 1980-1981 well over 1.00% of population increase could not be attributed to natural increase. As in the overall male and female comparison the E_c's were either negative or close to zero for the latter two years.

The largest values, both negative and positive, occurred in the on- and off-reserve categories. The total, male and female on-reserve E_c's for the 1979-1980 period were all positive. For females specifically, 1.24% of the population growth could not be accounted for by natural increase. For the periods 1980-1981 and 1982-1983 the E_c's were less significant. From 1981-1982, especially for females the E_c's were considerably

larger and negative in value, indicating that less growth occurred than would have been expected by natural increase. This was especially true for females. The off-reserve values were very different from those for the on-reserve population. In most cases off-reserve E_c's for each time period were the opposite of those for the corresponding on-reserve population. For example, the 1979-1980 E_c for the off-reserve females was -1.18% while for on-reserve females the it was +1.24%; for the off-reserve total population it was -0.99% and for the on-reserve total population it was +1.05%. The highest E_c in the analysis was obtained for off-reserve females from 1981-1982 when 3.37% of the growth could not be accounted for by natural increase.

Irregularities in the Reporting of Births:

Table 3 displays the cumulative average percentage of births reported within one to five years of their occurrence throughout the time period. The percentages varied widely, especially for births reported within the 1st year, being as low as 50% and as high as 70%. In each reporting year the percentage reported for males was approximately 1-2% lower than the total and female populations.

Nearly 66% of births in the north population were reported within the first year but for the south populations it was just under 63%. The situation was less clear upon separate consideration of males and females. Inter-regional comparison revealed that the percentages in each category were slightly higher for south males compared to north males. In addition, the percentage reported in the first year for south females was also slightly lower than for north females. A comparison of on- and off-reserve populations was equally interesting. For the first and second reporting years the percentage-reported

Table 3: Average Cumulative Percentage of Births Reported Within One to Five Years, 1979-1983.

Population	% Reported 1st Year	% Reported 2nd Year	% Reported 3rd Year	% Reported 4th Year	% Reported 5th Year
Total	64.56	96.19	98.22	99.49	100.00
Male	65.05	96.59	99.02	100.00	-
Female	64.02	95.77	97.35	98.94	100.00
North	66.13	95.14	98.92	100.00	-
South	63.16	97.13	97.61	99.04	100.00
On-Reserve	67.38	100.00	-	-	-
Off-Reserve	51.18	77.17	86.61	99.21	100.00
North Male	61.96	94.51	98.90	100.00	-
South Male	67.54	98.25	99.12	100.00	-
North Female	70.21	95.74	98.94	100.00	-
South Female	57.89	95.79	95.79	97.89	100.00
On-Res Male	69.18	100.00	-	-	-
Off-Res Male	50.00	80.30	90.91	98.48	100.00
On-Res Female	65.44	100.00	-	-	-
Off-Res Female	52.46	73.77	81.97	100.00	-

for on-reserve populations greatly exceeded those of the corresponding off-reserve populations. These were as high as 65% for on-reserve females and as low as 52% for off-reserve females.

Seasonality of Births: Chi-square values were calculated in order to compare the seasonal distribution of births throughout the year. The values for each population are presented in Table 4. Those that exceeded the critical value of 7.81 (p=0.05, 3 degrees of freedom) have been highlighted. Statistically significant differences in three-month interval fertility existed for the male, off-reserve, north, north male, and off-reserve male populations for 1982, as well as for the 1980 on-reserve population. The excess births were primarily concentrated within the periods from January to March and October to December.

Table 4: Chi-square Calculations: Seasonality of Births, 1979-1983.

Population	1979	1980	1981	1982	1983
Total	3.496	1.444	4.450	7.180	3.218
Male	0.955	5.339	4.878	8.484*	6.029
Female	4.557	1.498	2.226	2.455	0.107
On-Reserve	2.212	2.331	2.125	2.144	5.416
Off-Reserve	6.712	3.076	2.919	7.913*	0.558
North	2.660	1.599	2.594	9.874*	4.118
South	1.353	0.852	2.022	1.803	6.207
North Male	2.333	7.061	5.222	9.400*	4.294
South Male	0.664	0.765	1.813	1.862	3.667
North Female	6.571	0.889	0.880	1.824	2.354
South Female	1.417	0.856	2.455	2.313	3.905
On-Res Male	2.371	9.213*	2.250	2.693	7.161
On-Res Female	3.587	5.080	2.807	1.622	1.251
Off-Res Male	7.641	7.000	4.271	7.930*	2.170
Off-Res Female	1.176	1.100	1.625	5.179	3.436

* denotes statistical significance at $p<0.05$, 3 degrees of freedom.

Irregularities in the Reporting of Deaths:

Table 5 provides a summary of MSB-reported deaths for each population of interest during the time period as well as the total number of reporting discrepancies observed. The latter included two types of situations; those in which the Indian Register cohort size did not decrease although a death was reported by the MSB; and those in which a decrease in the Indian Register cohort size was noted in the absence of a corresponding MSB-reported death. For the sake of comparison a ratio of reporting irregularities to reported deaths is also included for each population in the table. A higher ratio suggested a more serious problem of death-reporting discrepancies. A comparison of female and male populations showed a consistently higher ratio for the former. In each year the ratios for the north population were also slightly higher than for the south. Upon separate analysis of males and females however no obvious patterns presented

Table 5: Irregularities in the Reporting of Deaths.

Population	Period	Deaths	Discrepancies			Ratio
			Type 1	Type 2	Total	Total/Deaths
Total	1979-80	41	18	42	60	**1.46**
	1980-81	69	43	25	68	**0.99**
	1981-82	58	30	41	71	**1.22**
	1982-83	54	21	42	63	**1.17**
Male	1979-80	28	17	30	47	**1.68**
	1980-81	47	31	24	55	**1.17**
	1981-82	39	22	26	48	**1.23**
	1982-83	41	18	30	48	**1.17**
Female	1979-80	13	9	28	37	**2.85**
	1980-81	22	14	16	30	**1.36**
	1981-82	19	8	28	36	**1.89**
	1982-83	13	7	32	39	**3.00**
North	1979-80	21	11	31	42	**2.00**
	1980-81	23	18	20	38	**1.65**
	1981-82	27	17	31	48	**1.78**
	1982-83	26	16	27	43	**1.65**
South	1979-80	20	11	28	39	**1.95**
	1980-81	46	33	23	56	**1.22**
	1981-82	31	17	26	43	**1.39**
	1982-83	28	11	29	40	**1.43**
On-Reserve	1979-80	35	17	58	75	**2.14**
	1980-81	51	30	60	90	**1.76**
	1981-82	48	23	105	128	**2.67**
	1982-83	46	21	27	48	**1.04**
Off-Reserve	1979-80	6	2	71	73	**12.17**
	1980-81	18	14	19	33	**1.83**
	1981-82	10	8	41	49	**4.90**
	1982-83	8	6	33	39	**4.88**
North Male	1979-80	16	11	19	30	**1.88**
	1980-81	14	13	13	26	**1.86**
	1981-82	19	13	14	27	**1.42**
	1982-83	19	10	22	32	**1.68**

North	1979-80	5	3	18	21	**4.20**
Female	1980-81	9	7	10	17	**1.89**
	1981-82	8	6	22	28	**3.50**
	1982-83	7	7	13	20	**2.86**
South	1979-80	12	7	18	25	**2.08**
Male	1980-81	33	24	18	42	**1.27**
	1981-82	20	12	18	30	**1.50**
	1982-83	22	12	16	28	**1.27**
South	1979-80	8	7	20	27	**3.38**
Female	1980-81	13	10	15	25	**1.92**
	1981-82	11	5	15	20	**1.82**
	1982-83	6	3	23	26	**4.33**
On-Reserve	1979-80	23	14	38	52	**2.26**
Male	1980-81	36	20	38	58	**1.61**
	1981-82	33	18	45	63	**1.91**
	1982-83	12	9	39	48	**4.00**
On-Reserve	1979-80	14	11	39	50	**3.57**
Female	1980-81	15	11	35	46	**3.07**
	1981-82	15	7	88	95	**6.33**
	1982-83	11	7	20	27	**2.45**
Off-Reserve	1979-80	5	2	42	44	**8.80**
Male	1980-81	11	8	22	30	**2.73**
	1981-82	6	5	40	45	**7.50**
	1982-83	6	5	20	25	**4.17**
Off-Reserve	1979-80	1	1	43	44	**44.00**
Female	1980-81	7	5	11	16	**2.29**
	1981-82	4	2	18	20	**5.00**
	1982-83	2	2	18	20	**10.00**

themselves. The ratios were quite high for the off-reserve population compared to on-reserve, and this was also true in most cases for males and females within these categories. For example, from 1979 to 1980 there were six deaths reported to the MSB. For the same time period there were two instances whereupon these deaths were not recorded in the Indian Register and 71 instances when the Indian Register decreased

without any apparent death being reported by the MSB. In the most extreme case one death was recorded by the MSB for off-reserve females 1979-1980 while in 44 cases the changes in Indian Register cohort size did not correspond to the reported deaths.

Mortality Analysis I. Crude Mortality Rates (CMR):

All calculations in the mortality analysis have been summarized in Appendix III. Crude Mortality Rates for the gross populations and the populations aged <1 to 9 have been summarized in tables 6 and 7 respectively.

Gross Population: In nearly every case the CMR's were decreased as a result of the adjustment procedures. Males and females did not differ markedly in this respect. Both were decreased by less than two percent in each year.

The situation was very similar for the north and south comparison. Upon disaggregation however CMR's for the north male population were more strongly and consistently affected by the adjustments than their south counterparts. The opposite was true for females. Changes in the south population were more significant for males.

The on-reserve population CMR's were only minimally affected by the adjustments. Total, male and female on-reserve CMR's were decreased by 0.62% to 1.72%. Off-reserve rates on the other hand were markedly affected by the adjustments. For example, after adjustment the off-reserve 1980 CMR was reduced from 18.32 to 17.41 deaths per thousand people. This represented a decrease of nearly 5%. Similar changes were observed upon separate consideration of males and females.

Ages <1 to 9: The adjustment procedures greatly affected the CMR's for the population aged <1 to 9. This was a reflection of the significant increases in population size associated with the adjustments to these particular age groups. As in the case of the gross

Table 6: Crude Mortality Rates per 1000 Population, Adjusted* and Unadjusted Population Counts, 1980-1982.

Population	1980	1980*	%Diff	1981	1981*	%Diff	1982	1982*	% Diff
Total	5.50	5.40	**-1.81**	5.34	5.28	**-1.12**	5.20	5.17	**-0.72**
Male	10.66	10.47	**-1.82**	10.37	10.25	**-1.17**	10.13	10.05	**-0.82**
Female	11.34	11.13	**-1.85**	10.98	10.86	**-1.07**	10.69	10.63	**-0.58**
North	11.46	11.23	**-1.97**	11.12	10.97	**-1.35**	10.84	10.74	**-0.91**
South	10.56	10.37	**-1.71**	10.25	10.12	**-1.21**	10.00	9.90	**-1.07**
On-Reserve	7.85	7.76	**-1.18**	7.64	7.59	**-0.69**	7.53	7.43	**-1.26**
Off-Reserve	18.32	17.41	**-4.95**	17.68	17.03	**-3.69**	16.82	16.70	**-0.74**
North Male	22.62	22.10	**-2.30**	21.96	21.64	**-1.43**	21.39	21.16	**-1.07**
South Male	20.16	19.87	**-1.47**	19.63	19.42	**-1.11**	19.23	19.06	**-0.87**
North Female	23.22	22.81	**-1.75**	22.50	22.24	**-1.18**	21.94	21.77	**-0.76**
South Female	22.14	21.68	**-2.06**	21.41	21.13	**-1.32**	20.82	20.56	**-1.28**
On-Reserve Male	15.05	14.88	**-1.08**	14.68	14.59	**-0.64**	14.45	14.33	**-0.82**
Off-Reserve Male	36.53	34.64	**-5.17**	35.29	33.85	**-4.09**	33.82	33.22	**-1.77**
On-Reserve Female	16.40	16.19	**-1.26**	15.91	15.81	**-0.62**	15.71	15.44	**-1.72**
Off-Reserve Female	36.67	34.95	**-4.68**	35.37	34.19	**-3.33**	33.41	33.49	**0.26**

populations the effect was not very different for males compared to females.

South population CMR's were decreased to a larger extent than those for the north as a result of adjustments. Intra-regional comparison for the population aged <1 to 9 revealed a pattern similar to the gross analysis. CMR's for the north population were more noticeably affected than females. In the south population females were affected to a greater degree than males.

Overall, male and female off-reserve CMR's were dramatically affected by the adjustment procedures. For example the 1980 rate was decreased from 19.86 to 16.87 deaths per thousand people which represented a decrease of approximately 15%. Corresponding on-reserve CMR's did not change appreciably. Intra-residential comparison showed no significant differences between males and females.

Table 7: Crude Mortality Rates per 1000 Population, Adjusted* and Unadjusted Population Counts, Ages <1 to 9, 1980-1982.

Population	1980	1980*	%Diff	1981	1981*	%Diff	1982	1982*	%Diff
Total	2.88	2.70	**-6.25**	2.85	2.72	**-4.40**	2.85	2.75	**-3.70**
Male	5.60	5.26	**-6.17**	5.50	5.26	**-4.45**	5.49	5.29	**-3.70**
Female	5.91	5.54	**-6.30**	5.89	5.63	**-4.35**	5.95	5.73	**-3.65**
North	5.71	5.35	**-6.18**	5.64	5.40	**-4.22**	5.64	5.46	**-3.08**
South	5.80	5.43	**-6.37**	5.74	5.48	**-4.68**	5.78	5.53	**-4.37**
On-Reserve	4.10	3.91	**-4.45**	4.06	3.94	**-2.97**	4.12	3.96	**-3.81**
Off-Reserve	9.67	8.22	**-15.02**	9.53	8.35	**-12.38**	9.31	8.55	**-8.16**
North Male	11.24	10.46	**-6.94**	11.01	10.51	**-4.58**	10.93	10.56	**-3.45**
South Male	11.17	10.55	**-5.56**	10.99	10.52	**-4.30**	11.01	10.56	**-4.13**
North Female	11.59	10.96	**-5.48**	11.54	11.10	**-3.83**	11.63	11.32	**-2.67**
South Female	12.07	11.19	**-7.32**	12.02	11.42	**-4.98**	12.15	11.60	**-4.54**
On-Reserve Male	7.97	7.63	**-4.30**	7.87	7.64	**-2.99**	7.97	7.67	**-3.76**
Off-Reserve Male	18.87	16.01	**-15.14**	18.24	16.06	**-11.97**	17.60	16.15	**-8.22**
On-Reserve Female	8.42	8.04	**-4.53**	8.35	8.12	**-2.80**	8.51	8.18	**-3.87**
Off-Reserve Female	19.86	16.87	**-15.03**	19.93	17.41	**-12.66**	19.71	18.12	**-8.07**

Mortality Analysis II. Indirectly standardized mortality rates (ISMR):

Indirectly standardized rates were calculated in order to illustrate the effect of the adjustment procedures upon mortality measures. In most cases the adjusted population rates were lower than those for the unadjusted population counts. This was not surprising because the adjustments generally resulted in an increase in population size. These rates are summarized in Tables 8 and 9.

Gross Population: Male and female rates were affected equally by the adjustment procedures. The same was true for the overall north and south populations. Upon disaggregation the indirectly standardized rates for the south male population were decreased to a larger extent than their north counterparts as a result of the adjustments. In addition, intra-regional comparison showed that the adjustments more strongly affected

the north female and south male rates compared to the north males and south females respectively.

Large differentials were exhibited between the indirectly standardized rates for the on- and off-reserve populations. Off-reserve rates were substantially reduced compared to those for the on-reserve population. Upon separate consideration of

Table 8: Indirectly Standardized Mortality Rates, Adjusted* and Unadjusted Gross Population Counts (deaths per thousand people).

Population	1980	1980*	%Diff	1981	1981*	%Diff	1982	1982*	%Diff
Total	15.97	15.44	**-3.30**	15.44	15.14	**-1.93**	15.06	14.90	**-1.05**
Male	31.96	30.63	**-4.14**	31.00	30.48	**-1.69**	30.41	30.27	**-0.45**
Female	31.91	30.89	**-3.20**	30.72	30.02	**-2.25**	29.63	29.35	**-0.97**
North	30.31	29.44	**-2.87**	29.15	28.39	**-2.59**	28.32	27.80	**-1.84**
South	33.60	32.37	**-3.69**	32.71	32.26	**-1.36**	32.05	31.91	**-0.44**
On-Reserve	21.12	20.47	**-3.06**	20.40	20.17	**-1.12**	19.99	20.20	**1.08**
Off-Reserve	65.01	61.34	**-5.64**	63.06	60.21	**-4.53**	60.95	58.54	**-3.96**
North Male	62.45	60.36	**-3.35**	59.59	58.91	**-1.13**	58.02	57.69	**-0.56**
South Male	64.93	62.04	**-4.45**	64.49	61.94	**-3.94**	63.12	61.66	**-2.32**
North Female	58.87	56.58	**-3.88**	56.18	54.74	**-2.56**	54.25	53.22	**-1.90**
South Female	69.50	66.79	**-3.90**	65.77	66.17	**0.60**	65.10	64.31	**-1.20**
On-Reserve Male	40.67	39.66	**-2.48**	39.97	39.67	**-0.75**	39.41	39.94	**1.35**
Off-Reserve Male	144.40	133.06	**-7.85**	136.62	128.35	**-6.05**	129.51	124.95	**-3.52**
On-Reserve Female	43.37	41.88	**-3.43**	41.22	40.86	**-0.89**	39.97	40.67	**1.74**
Off-Reserve Female	116.93	113.54	**-2.90**	115.00	111.58	**-2.97**	114.56	107.79	**-5.91**

males and females the pattern was similar to the overall on- and off-reserve population comparison. Off-reserve male and female rates were generally reduced more noticeably than their on-reserve counterparts. Within the on-reserve population female rates were slightly more affected than their male counterparts. Off-reserve male rates for 1980 and 1981 were decreased to a larger extent than females after adjustment.

Ages <1 to 9: Male and female rates were again equally affected by the adjustment procedures. The same could not be said for the north and south comparison. In each year the south indirectly standardized rates were more strongly affected than the north. South female rates were more markedly affected by the adjustment procedures than their north counterparts but the opposite was true for males. Intra-regional comparison showed that

Table 9: Indirectly Standardized Mortality Rates, Adjusted* and Unadjusted Population Counts, Age <1 to 9 (deaths per thousand people).

Population	1980	1980*	%Diff	1981	1981*	%Diff	1982	1982*	%Diff
Total	3.68	2.75	**-25.33**	3.47	2.77	**-20.18**	3.41	2.79	**-18.14**
Male	7.22	5.37	**-25.63**	6.79	5.35	**-21.14**	6.59	5.39	**-18.21**
Female	7.49	5.64	**-24.64**	7.08	5.72	**-19.14**	7.09	5.81	**-18.05**
North	7.49	5.70	**-23.87**	6.98	5.66	**-18.91**	6.80	5.81	**-14.50**
South	7.21	5.31	**-26.35**	6.88	5.41	**-21.39**	6.86	5.38	**-21.52**
On-Reserve	5.00	3.88	**-22.38**	4.74	3.94	**-16.93**	4.72	4.00	**-15.36**
Off-Reserve	14.05	8.93	**-36.45**	12.88	9.14	**-29.03**	12.33	9.16	**-25.71**
North Male	15.97	11.53	**-27.80**	14.25	8.97	**-37.06**	12.93	8.83	**-31.70**
South Male	13.17	10.04	**-23.76**	12.97	10.23	**-21.14**	13.42	10.44	**-22.18**
North Female	14.12	11.29	**-20.04**	13.68	11.40	**-16.66**	14.32	12.17	**-15.01**
South Female	15.95	11.28	**-29.28**	14.67	11.49	**-21.66**	14.03	11.11	**-20.78**
On-Reserve Male	9.69	7.57	**-21.85**	9.41	7.73	**-17.87**	9.34	7.90	**-15.43**
Off-Reserve Male	28.30	17.47	**-38.25**	24.41	17.19	**-29.59**	21.97	16.50	**-24.91**
On-Reserve Female	10.23	7.94	**-22.39**	9.50	8.03	**-15.40**	9.54	8.08	**-15.28**
Off-Reserve Female	27.89	18.03	**-35.37**	27.27	19.54	**-28.34**	27.54	20.29	**-26.32**

the adjustments more strongly affected the male rates within the north population while in the south population both sexes were affected equally.

As in the gross population analysis the largest differentials were exhibited between the on- and off-reserve populations. Off-reserve rates were reduced to a larger extent compared to those for the on-reserve population as a result of the adjustments. Upon separate consideration of males and females the pattern was not unlike the overall

on- and off-reserve population comparison. Off-reserve male and female rates were more strongly affected than their on-reserve counterparts. Within the on-reserve population female and male rates were similarly affected, and the same was true for the corresponding off-reserve populations.

Mortality Analysis III. Directly standardized mortality rates (DSMR):

Tables 10 and 11 provide a summary of the directly standardized rates along with the percentage difference between the age-standardized mortality rates (DSMR's) for adjusted and unadjusted population counts. These differences were an indication of the effect of vital event reporting inconsistencies. Positive values resulted if the adjustment procedures led to a higher standardized rate while negative values indicated a decrease in the rate.

A. Gross Population: In each year the adjustments led to decreases in the directly standardized mortality rate of the total population, from as large as 2.15% in 1980 to a negligible 0.15% in 1982. A similar effect was observed for the female population with the exception of 1982 when a more notable decrease was observed. The male population showed increases in the DSMR for 1981 and 1982, and a decrease in 1980.

The north population also experienced a decrease in DSMR's for each year while in two years the south rates were increased as a result of adjustments. The south male rates were decreased significantly, as much as 5.99% in 1981, while for two years the corresponding north male rates actually increased. A comparison of the north and south female populations showed slightly more significant increases in mortality rates for the latter in 1981 and 1982.

The differential effect of the adjustments upon directly standardized mortality rates was illustrated by the on- and off-reserve comparison. In each year the off-reserve rates decreased by no less than 3.37% while on-reserve rates decreased in 1980 but increased thereafter. After plotting the adjusted and unadjusted gross on- and off-reserve rates this differential effect became clearer (Figure 3, pg. 63). In the on-reserve case the plots were nearly identical. On the other hand the DSMR's were consistently lower after adjustment for the off-reserve population. Large changes, both increases and decreases, were associated with the off-reserve males and females compared to their on-reserve counterparts.

Table 10: Directly Standardized Mortality Rates, Adjusted* and Unadjusted Gross Population Counts (deaths per thousand people).

Population	1980	1980*	%Diff	1981	1981*	%Diff	1982	1982*	%Diff
Total	12.68	12.41	**-2.15**	12.26	12.15	**-0.84**	11.88	11.90	**0.15**
Male	26.25	25.26	**-3.77**	25.62	25.74	**0.45**	25.50	26.41	**3.53**
Female	25.82	25.34	**-1.83**	24.79	24.49	**-1.22**	23.69	23.51	**-0.79**
North	24.08	23.62	**-1.94**	23.14	22.72	**-1.80**	22.43	22.10	**-1.45**
South	27.18	26.47	**-2.63**	26.72	27.10	**1.43**	26.17	27.33	**4.47**
On-Reserve	16.91	16.56	**-2.08**	16.27	16.29	**0.11**	15.81	16.36	**3.45**
Off-Reserve	55.24	52.82	**-4.39**	53.59	51.47	**-3.96**	51.45	49.71	**-3.37**
North Male	51.70	50.58	**-2.16**	48.08	48.56	**0.98**	47.23	47.73	**1.07**
South Male	54.02	51.59	**-4.50**	56.92	53.51	**-5.99**	58.68	58.15	**-0.91**
North Female	48.88	47.69	**-2.43**	46.46	45.60	**-1.86**	44.59	43.83	**-1.71**
South Female	56.25	55.35	**-1.60**	53.53	55.69	**4.04**	52.18	52.93	**1.44**
On-Reserve Male	33.26	32.45	**-2.43**	32.86	32.83	**-0.11**	32.87	34.03	**3.52**
Off-Reserve Male	127.97	120.51	**-5.83**	121.77	132.41	**8.74**	118.21	131.78	**11.47**
On-Reserve Female	34.91	34.15	**-2.17**	33.18	33.17	**-0.03**	31.98	32.61	**1.98**
Off-Reserve Female	112.62	115.02	**2.13**	110.50	112.92	**2.19**	104.07	100.03	**-3.88**