

**EPIDEMIOLOGIC AND COST TRENDS
IN DIABETES IN SASKATCHEWAN,
1991 TO 2001**

Working Paper 05-06

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GLOSSARY OF TERMS:

NDSS Criteria: The National Diabetes Surveillance System (NDSS) provides a case definition to identify individuals with diabetes through utilization of health care services. Using this definition, individuals are considered to have diabetes if they have two physician visits with a diagnosis of diabetes (ICD-9 code of 250) on two different days within any contiguous 730-day period or one hospitalization with a discharge diagnosis of diabetes (ICD-9 code of 250 from the first three diagnostic fields.

Pre-diabetes: the period of follow-up for diabetes cases before they satisfy the NDSS criteria.

Registered Indian: An individual who is registered according to *The Indian Act*.

General Population: Those individuals who are not registered according to *The Indian Act*.

SUMMARY

Objective

The purpose of this study was to analyze epidemiologic and cost trends from 1991 to 2001 in the province of Saskatchewan for a cohort of individuals identified as having diabetes and for a randomly selected control cohort.

Methods

Health care resource utilization and cost data were identified in the Saskatchewan Health administrative databases (1991-2001) and grouped by calendar year. Subjects in the diabetes cohort (n=64,079) were considered to be 'pre-diabetes' in the years prior to meeting the National Diabetes Surveillance System (NDSS) definition of diabetes and to have 'active diabetes' once the NDSS criteria were satisfied. The control cohort (n=128,158) consisted of a random sample from the non-diabetes population. Two individuals who did not meet the NDSS definition of diabetes during the study period were randomly selected for every individual with diabetes. Control selection was matched on year of diabetes index date, registered Indian status. Health care utilization and costs were determined for five categories of expenditures, namely physician services, prescriptions, hospitalizations, day surgeries and dialysis. With the control group as a reference, the cost (in 2001 dollars) and annual utilization ratios were calculated for the 'active diabetes' and 'pre-diabetes' cohorts for each expenditure category and for overall expenditures. Total costs and rates for prevalence, incidence and mortality were estimated and age-standardized to the 2001 Canadian population using the direct method. Data were analyzed according to registered Indian status where possible.

Results

The overall aged-standardized prevalence of diabetes rose from 2.65% (95% CI: 2.61% – 2.68%) in 1991 to 4.71% (95% CI: 4.67% - 4.75%) in 2001. In 2001, the age-standardized prevalence was 11.09% (95% CI: 10.75% - 11.42%) in the registered Indian population and 4.35% (95% CI: 4.31% - 4.39%) in the general population. The age-standardized mortality rates for individuals with diabetes were approximately 1.3 to 1.9 times higher than controls, each year. Physician costs, in each year, were 1.5 to 1.6 times higher for the pre-diabetes and 2.5 to 2.9 times higher

for the active diabetes subgroups compared to control. Hospital costs, in each year, were 1.3 to 1.8 and 4.0 to 5.5 times higher for the pre-diabetes and active diabetes subgroups, respectively. Day surgery cost ratios ranged from 1.6 to 1.8 for the pre-diabetes subgroup and 2.0 to 2.5 for the active diabetes subgroup. Prescription costs (excluding the registered Indian population) were 2.5 to 2.6 times higher for the pre-diabetes subgroup and 4.6 to 6.1 times higher for the active diabetes subgroup. Utilization ratios were similar to cost ratios. Total health care expenditures (excluding prescriptions) rose from \$140 million in 1991 to \$154 million in 2001; they averaged \$3253 for the general population and \$3295 for the registered Indian population. The average annual total health care expenditure per active diabetes case decreased from 1991 to 2001. After age-standardization, health care expenditures for the registered Indian population were 40% higher than the general population. Crude total expenditure ratios ranged from 3.6 to 4.8 for the active diabetes subgroup and 1.4 to 1.8 for the pre-diabetes subgroup. Age-standardized ratios were somewhat smaller in magnitude but, in most years, remained 2.5 times higher than controls for the active diabetes subgroups.

Conclusions

Costs and utilization were higher for both pre-diabetes and active diabetes subgroup compared to the control groups, although costs in many categories were considerably higher for the active diabetes subgroup than for the pre-diabetes subgroup. Total health care expenditures for diabetes increased considerably from 1991 to 2001. The increased number of individuals with diabetes over the study period appears to be responsible for this trend, rather than increased average expenditures per individual with diabetes.

INTRODUCTION

Diabetes affects approximately five per cent of all Canadians aged 20 years or older, with the prevalence rising with age (Health Canada 2003). Type 2 diabetes accounts for 90% of the diagnosed cases of diabetes in Canada, while approximately 10% of diabetes cases are attributed to type 1 diabetes (Health Canada 2003). Both type 1 and type 2 diabetes can be associated with a substantial burden for individuals with the disease, their families and society as a whole. The societal impact of diabetes can be captured in various ways. Prevalence, incidence, mortality and morbidity data help to capture the social burden of diabetes, as do direct and indirect cost estimates (i.e., estimates of resources used and potentially lost as a result of the disease) (Ettaro 2004).

The National Diabetes Surveillance System (NDSS) monitors epidemiologic trends in diabetes in Canada and recently reported on the prevalence of the disease and mortality in individuals with diabetes (Health Canada 2003). It was estimated that approximately 5.2% of the Saskatchewan population over the age of 20 had diabetes (4.9% of females and 5.5% of males) (Health Canada 2003). At the time of reporting, the epidemiologic trends were not explored according to Aboriginal status. Important differences may exist between the general and registered Indian populations. In fact, a recent report on epidemiologic trends in diabetes in the Manitoba First Nations population (i.e., individuals registered under Canada's *Indian Act* and hereinafter referred to as the registered Indian population) demonstrated that the registered Indian population had incidence and prevalence rates of diabetes that were 4.5 times that of the non-registered Indian population (Green 2003). Exploring these epidemiologic trends Canada-wide, or in other provinces, would help to better assess the generalizability of these findings and characterize the disproportionate burden of diabetes in the registered Indian population.

Over the past decade, numerous studies have provided insight into the financial costs of diabetes (Ettaro 2004). While these studies are informative, the majority have been conducted in patient groups outside of Canada. Further, the various studies have produced quite disparate results due to differences in the cost components included (e.g., different categories of direct and indirect costs), methods of determining costs and data sources used (e.g., administrative claim data, survey data or projected data from previous research studies). These differences may relate, in part, to the underlying approach taken to capturing the economic burden of diabetes. One

approach to estimating the costs of diabetes focuses on only those costs attributable to diabetes itself (Ettaro 2004). The alternate approach estimates health care costs of individuals with the disease, regardless of whether these costs are directly or indirectly attributable to the disease (Ettaro 2004). These are fundamentally different research questions and, hence, produce considerably different results.

Regardless of the approach used, previous research has demonstrated that the economic costs of diabetes are growing (Ettaro 2004). This trend could be attributed to increased disease prevalence, but may also relate to inflation and increased health care resource utilization (Ettaro 2004). A recently published review explored this issue and found that after controlling for inflation, increases in overall health care costs persisted, suggesting that inflation was not the sole cause of the increased health care costs (Ettaro 2004). Increased disease prevalence was also thought to contribute, but the role of health care utilization as a cost driver was not explored. Despite the growing costs to care for an increasing number of individuals with diabetes, it is possible that more efficient use of health care resources could decrease overall health care expenditures per diabetes case.

In order to better understand the magnitude of health care costs associated with the management of diabetes, two recent Canadian studies estimated these costs. We previously estimated health care costs of a cohort of 45,716 individuals in Saskatchewan identified as having diabetes during 1991 to 1996 (Johnson 2002; Simpson 2003). During the six-year observation period, the cost for hospitalizations, day surgeries, physician services, dialysis services and prescription drugs was estimated to be \$748.3 million, valued in 1996 dollars (\$833.1 million in 2001 dollars) (Johnson 2002). In this study, all health care expenditures for the cohort were included, not only those costs specifically for diabetes care. Costs for hospitalizations and day surgeries accounted for over 60% of diabetes health care expenditures, with prescription drugs accounting for 20%, physician services accounting for 16% and dialysis services accounting for 4% (Johnson 2002). In a study that explored only those health care expenditures attributable to diabetes itself and its complications, national expenditures were estimated to be between US \$4.76 and US \$5.23 billion, of which \$2.6 billion were direct medical costs (Dawson 2002). Of the direct medical costs, 50% were attributable to hospital costs, 31% to prescriptions and 19% to physician services (Dawson 2002).

While these studies are informative, the direct costs of diabetes in Canada warrant further investigation. In particular, the excess health care costs of individuals with diabetes in comparison to individuals without diabetes were not determined in either of these studies. It does not appear that this question has been addressed using Canadian data. As well, since more recent data are now available, more current estimates can be obtained and trends can be analyzed over a longer follow-up period. Thus, the objectives of this project were:

1. To explore epidemiologic trends (i.e., prevalence, incidence and mortality) in diabetes from 1991 to 2001, overall and according to registered Indians and non-registered Indian status.
2. To estimate the direct medical costs of health care for individuals with and without diabetes each year in five categories: physician services, prescriptions, hospitalizations, day surgeries and dialysis.
3. To estimate the total annual medical expenditures across the resource categories for people with diabetes in the province of Saskatchewan for the years 1991 to 2001.
4. To compare patterns of resource utilization in Saskatchewan from 1991 to 2001 between individuals with and without diabetes, identified as registered Indians and non-registered Indians.
5. To compare health care costs and utilization patterns before and after identification of diabetes each year.

METHODS

Data Sources

The linkable administrative databases from Saskatchewan Health containing information on prescription drug use, hospitalizations, physician services and dialysis for all eligible residents of Saskatchewan were used in the analyses (Appendix A) (Downey 2000). These databases have been used in numerous epidemiologic studies (Downey 2000). Data pertaining to the age, sex and registered Indian distribution of all Saskatchewan Health beneficiaries from 1991 to 2001 were obtained from Saskatchewan Health (Saskatchewan Health 2005a).

Study Population

Diabetes Cohort

The National Diabetes Surveillance System (NDSS) criteria (Health Canada 2003) were applied to Saskatchewan Health's administrative databases to identify individuals with diabetes between 1991 and 2001. The NDSS provides a case definition to identify individuals with diabetes through utilization of health care services (i.e., physician visits and hospitalizations for diabetes). Individuals are considered to have diabetes if they have two physician visits with a diagnosis of diabetes (ICD-9 code of 250) on two different days within any contiguous 730-day period or one hospitalization with a discharge diagnosis of diabetes (ICD-9 code of 250 from the first three diagnostic fields) (Health Canada 2003). Individuals who met the NDSS criteria for diabetes in the years 1989 or 1990 were also identified and were considered prevalent diabetes cases in 1991. The remaining individuals were considered incident cases in the year in which they first met the NDSS definition of diabetes. Incident cases were then considered to be prevalent cases in the subsequent years until their study exit date (i.e., termination of Saskatchewan Health coverage or death) (Table 1).

Diabetes status was further defined within each calendar year from 1991 through to 2001. Individuals were considered "pre-diabetes" in the calendar years prior to the year they met the NDSS definition for diabetes. Individuals contributed utilization and cost information to the "pre-diabetes" subgroup during the study period between January 1, 1991 and their index year as long as they had active Saskatchewan Health coverage. Incident cases and prevalent cases of

diabetes who had not exited the study prior to the beginning of the year were considered “active diabetes” in that calendar year. For example, consider an individual who moves to Saskatchewan in 1993, fulfills the NDSS criteria in 1996 and moves out of the province in 2000. This individual would be in the “pre-diabetes” subgroup during 1991-1995; however, we would only consider the individual’s utilization and cost information during 1993-1995, because there was no Saskatchewan Health coverage in 1991 and 1992. Furthermore, this individual would be in the “active diabetes” subgroup from 1996 to 2000 because he or she would be considered an incident case in 1996 and a prevalent case for 1997 to 2000.

Control Cohort

Each diabetes case had two controls randomly selected from the non-diabetes Saskatchewan population. This sampling pool was made up of Saskatchewan residents who did not meet the NDSS case definition for diabetes throughout the entire observation period (i.e., from January 1, 1991 through December 31, 2001). Cases and controls were matched on registered Indian status and active Saskatchewan Health coverage during the index year. For comparison purposes, the control cohort in each calendar year was comprised of control subjects with active Saskatchewan Health coverage in that year and who had not exited the study prior to the beginning of the year.

Estimation of Epidemiologic Trends in Diabetes (Prevalence, Incidence and Mortality)

Epidemiologic trends of diabetes in each year were determined for the general (i.e., non-registered Indian), registered Indian and combined populations. For the purpose of these analyses, registered Indians were defined as those individuals who are registered as an Indian according to *The Indian Act* (Revised Statutes of Canada c.1-5 1985). The numerator in each prevalence calculation was the total number of active cases of diabetes (prevalent = incident plus existing cases) in a given year for a particular population, while the denominator was the total number of Saskatchewan Health beneficiaries at June 30th of a given year for the respective populations. Annual diabetes incidence rates were determined from the number of new cases meeting the NDSS definition of diabetes each year divided by the population at risk (i.e., the total population without diabetes in the same year). The incidence rate was expressed as the number of new cases per 1000 population at risk.

Mortality rates were determined for control and diabetes cohorts. For each mortality calculation, the numerator was the annual number of deaths in a particular population (i.e., either diabetes or control). The denominator was the number of individuals with active diabetes or the number of controls for that year. Mortality was expressed as a rate of deaths per 1000 population.

Estimation of Health Care Resource Utilization and Costs

Health care service use was identified from service records in the linkable administrative databases of Saskatchewan Health. These data were collected for each individual and grouped according to status within each calendar year (pre-diabetes, active diabetes, control).

Physician Visits

Physician service records were used to estimate utilization and costs of physician services. The information available in this database included date of services, ICD-9 diagnostic code associated with the claim, type of physician and fee paid (Appendix A). Fee- for-service claims were collapsed to create physician visits. A physician visit was a single record for services received by a patient from a single physician for the same diagnosis on the same day at the same clinic and same location. Physician visits included visits to general practitioners, specialists and out-of-province physicians, as well as visits to other practitioners who provided insured services, such as optometrists. Capture of visits to salaried and contract physicians was incomplete. Visits to Saskatchewan Cancer Agency salaried physicians are not captured. The amount paid for each visit was used to determine the cost for physician services. These values were then converted to 2001 dollars using the Consumer Price Index for Health Care Services basket, which was obtained from Statistics Canada (See Appendix B).

Hospitalizations and Day Surgeries

The number of hospitalizations and day surgeries for each year were obtained from Saskatchewan Health's hospital services file, which includes data on all hospital discharges for Saskatchewan Health beneficiaries (including out-of-province hospitalizations). Each inpatient record contained a resource intensity weight (RIW), calculated by the Canadian Institute of Health Information, admission and discharge dates, diagnostics codes and discharge type (alive, dead or transferred). The discharge date was used to determine the year in which a

hospitalization occurred. The cost per hospitalization in 2001 dollars was determined by multiplying the RIW by the funding per weighted case for 2001 (Johnson 2002) and was estimated to be \$3369.77 (personal communication, M. R. Stang; March 4, 2004). Missing RIWs and DPG weights were estimated using an algorithm provided by Saskatchewan Health (based, in part, on length of stay) and mean imputation, respectively. (See Appendix C).

Hospital separation records for day surgery procedures were identified from the hospital services file. A cost per day surgery was assigned based on the day procedure group (DPG) weight multiplied by the estimated funding per weighted case for 2001 (\$3369.77). Actual DPG weights were unavailable for three fiscal years: 1991/92 through 1993/94. Although 1993/94 was the introductory year for DPGs and DPG weights, the reported values for this fiscal year were considered unreliable. Therefore, we used the fiscal annual average DPG weight calculated and provided by Saskatchewan Health (W. Downey, personal communication, October 11, 2001) for all day surgery records for the calendar years 1991 through 1993. For the 1994 to 1998 calendar years, a mean imputation method was used to estimate missing DPG weights. Using this approach, missing weights were replaced with the mean DPG weight for individuals within the respective cohort (i.e., diabetes cases or controls) within each calendar year (1994 to 1998). After 1998, there were no records with missing DPG weights (See Appendix D).

Prescriptions

The number of prescriptions per year was determined from the Saskatchewan Drug Plan (DP) database. The database contains out-of-hospital medication claims for all beneficiaries eligible for DP benefits. Beneficiaries whose prescription drug benefits are provided by a federal government agency (e.g., First Nations & Inuit Health, Health Canada) are not included in the database (Saskatchewan Health 2005b). Therefore, it is important to note that prescription use for registered Indians was not available. Treatment patterns with antidiabetic agents and use of testing supplies for the 2001 calendar year were explored.

Prescription drug expenditures were compiled from the same database. This database contains the total approved, total submitted and program portions of the prescription cost. The total amount approved was used to estimate prescription expenditures. Total prescription expenditures were determined each year for active and pre-diabetes cases and controls. The total for each year

was then converted to 2001 dollars using the Consumer Price Index Prescribed Medicines basket (Appendix B).

Dialysis

The physician services file was used to identify individuals who were on dialysis, based on three fee-for-service billing codes (initiation of hemodialysis, ongoing hemodialysis, and peritoneal dialysis). Duration, frequency and patterns of dialysis were used to estimate the duration of time each year that individuals were on hemodialysis or peritoneal dialysis. Duration of hemodialysis was determined for each year by subtracting the earliest hemodialysis code (either 11 or 12) from the last hemodialysis code within a given year. The duration of time between the last hemodialysis code in one year and the first hemodialysis code in the subsequent year was determined. If this period of time was less than 14 days, individuals were assumed to be on hemodialysis until the end of the calendar year and from the beginning of the next calendar year. It is recognized that hemodialysis less than three times weekly is associated with increased mortality (Churchill 1999). Thus, it is likely that individuals on hemodialysis would receive the procedure three times per week, but not all of these events would have a fee-for-service billing code. It was felt that individuals on ongoing dialysis would have a fee-for-service code at least every two weeks. Thus, throughout a calendar year, hemodialysis was assumed to be ongoing if the average number of days between hemodialysis codes within that year was less than or equal to 14 days. If the duration of time between hemodialysis codes exceeded 14 days on average, the duration of hemodialysis within a given year was estimated from individual dialysis codes. The same algorithm was used to determine the duration of peritoneal dialysis based upon procedure code 13.

Annual dialysis costs were calculated by multiplying the proportion of each calendar year on either hemodialysis or peritoneal dialysis by the estimated annual cost of each dialysis modality. The cost estimate we used came from a prospective observational study of patients attending dialysis clinics in Calgary, Alberta (Lee 2002). We used the annual cost of either hemodialysis or peritoneal dialysis excluding physician services (as these costs were captured in the physician visits costs). This value was converted to Canadian dollars (one U.S. dollar = 1.45 Canadian dollars) in 2001 (estimated from the Consumer Price Index Health Services basket) (Appendix

B) and was found to be \$52,719 dollars per year of hemodialysis or \$37, 431 dollars per year of peritoneal dialysis (Appendix E).

Analysis

Epidemiologic Trends - Incidence, Prevalence and Mortality

Crude and adjusted incidence, prevalence and mortality rates were calculated overall and for the general and registered Indian populations for each calendar year. Prevalence, incidence and mortality estimates were directly age-standardized (Rothman 1986) to the Canadian population based on the 2001 Census (Statistics Canada 2002). Confidence intervals (95%) were computed based on an assumed normal distribution. Annual crude and age-standardized mortality rate ratios were calculated by dividing the mortality rate for individuals with active diabetes by the mortality rate for controls within each year.

Health Care Utilization and Costs

Health care resource utilization was determined per calendar year for diabetes cases (prevalent, incident and pre-diabetes) and controls according to registered Indians status. For prescription medication utilization, however, data were only available for the general population. For specific anti-diabetic agents and testing supplies, individuals with active diabetes who had one or more dispensations were categorized as being on the medication or having used strips in 2001. Individuals without a dispensation were categorized as not on the medication or not a user of testing supplies. Only individuals with active Saskatchewan Health coverage were considered within a calendar year (i.e., individuals were excluded from the analysis for those years prior to commencement of Saskatchewan Health coverage). Including individuals without active coverage would have underestimated average utilization and costs because they would not have any insured health care services recorded (i.e., no contribution to the numerator) and would dilute the average by increasing the denominator. For each category of health care resource utilization (other than dialysis) the average number of encounters was determined. For the purpose of comparing utilization to controls, incident and prevalent diabetes cases were combined. Utilization ratios (i.e., average utilization for active diabetes or pre-diabetes divided by average utilization for controls) were calculated for each calendar year. For dialysis, the

average number of days each year on each dialysis modality was determined for those individuals on dialysis and for the cohorts as a whole.

Average health care expenditures (in 2001 dollars) for each resource category were calculated for active and pre-diabetes cases and controls, for each year, according to registered Indian status (with the exception of prescription medication utilization as these data were not available for the registered Indian population). Again, only those individuals with active Saskatchewan Health coverage during the calendar year were included in the analysis for that year. Comparisons that included the pre-diabetes group were based upon 2000 data (i.e., the latest year with data available for this group). For the calculation of average costs, the active diabetes cases were divided into incident and prevalent cases. For cost ratios, incident and prevalent cases were grouped together as active diabetes cohorts. Cost ratios for active diabetes or pre-diabetes compared to controls were determined for each utilization category as described for utilization ratios. For individuals with active diabetes in 2001, total prescription expenditures were also determined specifically for anti-diabetic agents.

Average annual overall health care expenditures were determined for active diabetes, pre-diabetes and control cohorts according to registered Indian status, for each year, based on physician services, hospitalizations, day surgeries and dialysis. Crude and directly age-standardized average total cost ratios were calculated for the registered Indian and general populations combined. Crude and directly age-standardized total cost ratios were then calculated to compare costs for the registered Indian population to the general population. Total health care expenditures from 1991 to 2001 were also determined for the active diabetes cohorts. For the general population only, average overall health care expenditures, including prescriptions, were determined for the active diabetes, pre-diabetes and control cohorts. This value was used to calculate the proportion of overall expenditures accounted for by each of the five health care resource categories.

RESULTS

Cohort Characteristics

Over the 11-year period, 64,079 individuals met the NDSS criteria for diabetes (Tables 1 and 2). Overall, 90.3% of these individuals met the NDSS criteria based upon physician claims; however, the percentage was lower for the registered Indian population than for the general population (87.9% versus 90.5%, $p < 0.001$). Diabetes cases were significantly older than their controls, were more likely to be male, live in rural areas, have a shorter duration of follow-up and more likely to die in the 11-year period than were the controls (Table 1). Within both the diabetes and control cohorts, the registered Indian population differed from the general population in terms of age, sex distribution, duration of follow-up, mortality and rural residence (Table 2).

Epidemiologic Trends

In the initial year of the study (1991), 25,399 individuals had met the NDSS criteria for diabetes, of whom 79.6% ($n=20,227$) were prevalent cases (Table 3). The sample size of each control cohort is shown in Table 4. By 2001, the total number of active diabetes cases had almost doubled to 46,914, the majority of whom (92.5%) were prevalent cases. During this time period, the overall age-standardized population prevalence rose from 2.65 (95% CI: 2.61% to 2.68%) to 4.71% (95% CI: 4.67% to 4.75%) (Figure 1). Throughout the 11-year period, the age-standardized prevalence of diabetes in the registered Indian population was more than double that in the general population (Figure 1). The crude population prevalence of diabetes in the general and registered Indian populations were similar in 2001 (Figure 2), but was significantly higher in the registered Indian population after age-standardization of the estimate (Figure 2). Age-specific prevalence rates of diabetes for 2001 in the registered Indian population and the general population demonstrated that the excess prevalence in the registered Indian population was apparent in most age groups over 20, but were not significantly different for those over age 80 (Figure 3).

The overall age-standardized incidence rate per year in Saskatchewan decreased somewhat from 1992 to 2001, at 4.63 (95% CI: 4.49 to 4.78) and 3.82 (95% CI: 3.70 to 3.96) cases per 1000 population at risk, respectively (Figure 4). (The year 1991 was the inception year of the cohort

and, as such, had an inflated incidence rate despite using 1989 and 1990 data to identify prevalent cases.) The age-standardized incidence rate of diabetes in the registered Indian population was higher than in the general population for the years 1991 to 2001 (Figure 4). Crude incidence rates were similar for the registered Indian and the general population; it is apparent that age-standardization had a dramatic effect on the estimated incidence rate in the registered Indian population (Figure 5).

Individuals with active diabetes (general and registered Indian populations combined) had higher age-standardized mortality rates relative to controls each year, although these differences were not statistically significant in all years (Figure 6). Although crude mortality rates were approximately 4.2 to 5.2 times higher in the diabetes cohorts each year, age-standardized mortality rates were approximately 1.3 to 1.9 times higher (Figure 7). Overall, individuals with diabetes experienced excess mortality relative to controls later in life (i.e., after age 55), but these differences were not significant after age 85 (Figure 8). When analyzing the general and registered Indian populations separately, age-specific mortality in registered Indians with diabetes was similar to that in the general population (Figure 9).

Health Care Utilization and Costs

Physician Visits

The average number of physician visits for the registered Indian population was higher in each year than for the general population for all groups (i.e., active diabetes, pre-diabetes and controls) (Figures 10a and 10b). For the general population with diabetes, incident diabetes cases had higher utilization of physician services than prevalent cases (Figure 10b). In the registered Indian population, however, this trend was reversed, with prevalent cases having more visits annually than incident cases (Figure 10a). The pre-diabetes and active diabetes cohorts had crude utilization rates that were approximately 1.5 and 2.5 times higher, respectively, than the control cohort for most years (Figure 11).

As with utilization, per capita costs were slightly higher for prevalent diabetes cases than incident cases in the registered Indian population, but were higher for incident cases in the general population (Figures 12a and 12b). Across the 11-year period, per capita physician costs

were approximately 2.5 to 2.9 times higher for the active diabetes cohorts relative to controls and approximately 1.5 to 1.6 times higher for pre-diabetes (Figure 13). The total costs of physician services increased from 1991 to 2001, reaching \$34.4 million in 2001 and totalling \$293.1 million over the 11-year period (Table 5).

Prescriptions

For the general population, the average number of prescriptions dispensed per year was substantially higher in the prevalent, incident and pre-diabetes cohorts than in the control cohorts (Figure 14). Prescription utilization declined from 1991 to 1993, after which time a trend of increasing utilization was observed. By 2000, the average number of prescriptions dispensed annually was 33.5 ± 30.1 for prevalent diabetes cases, 24.9 ± 24.5 for incident cases, 17.8 ± 22.7 for pre-diabetes and 7.3 ± 13.9 for controls (Figure 14). Each year, individuals with active diabetes had approximately 4.9 to 5.6 times the number of prescriptions dispensed than the control group, while the pre-diabetes cohort had approximately 2.4 to 2.8 times the number of prescriptions dispensed (Figure 15). Crude utilization ratios decreased from 1991 to 2001 for diabetes, but ratios for the pre-diabetes cohort increased over this time period (Figure 15).

The use of an oral agent without insulin (45.4% of the cohort) was the most common means of managing blood sugars in 2001 (Table 6). Metformin alone (13.9%) or in combination with sulfonylurea (16.2%) was the most commonly used medication within this utilization category. Approximately one-third of individuals in the 2001 active diabetes cohort were managed without the use of insulin or oral anti-diabetic agents (i.e., they may have been managed with diet alone) (Table 6). Over one-half of individuals with active diabetes had one or more prescriptions for testing supplies (Table 6).

Annual per capita prescription expenditures in 2000 reached an average of $\$1126 \pm \1328 for individuals with prevalent diabetes, $\$865 \pm \1324 for incident diabetes, $\$607 \pm \1294 for pre-diabetes and $\$234 \pm \718 for controls (Figure 16). As with utilization ratios, crude cost ratios declined over the 11-year period for the active diabetes cohorts, but increased slightly for the pre-diabetes cohort (Figure 17). Total annual prescription expenditures nearly tripled from 1991 to 2001 for individuals with active diabetes, reaching \$50.5 million by 2001 and totalling \$329.5 million (Table 7). After 1992, total annual prescription medication expenditures exceeded

physician services each year (Table 7). Medications other than anti-diabetic agents or testing supplies accounted for the majority of prescription expenditures for individuals with diabetes (\$37.4 million (74%) in 2001) (Figure 18a). Among prescription categories directly related to diabetes, testing supplies accounted for the largest proportion of prescription expenditures at 13%, followed by insulins at 7%. Without including testing supplies, anti-diabetic agents only accounted for 15% of medication expenditures for individuals with diabetes in 2001 (Figure 18b).

Hospitalizations

There was little difference in the average number of hospitalizations for prevalent and incident cases of diabetes for the registered Indian population (Figure 19a); however, incident cases of diabetes had a higher average number of hospitalizations than prevalent cases each year for the general population (Figure 19b). For both the registered Indian and general populations, the average number of hospitalizations was considerably higher in the incident and prevalent diabetes cohorts compared to controls (Figures 19a and 19b). Generally, the registered Indian population had a higher average number of hospitalizations than the general population (Figures 19a and 19b), for each year. The average number of hospitalizations decreased from 1991 to 2001 for prevalent and incident diabetes cases, but remained relatively stable for both pre-diabetes and control cohorts. Crude hospital utilization ratios for individuals with active diabetes decreased over the 11-year period (Figure 20).

As with utilization, annual per capita hospital costs declined considerably in the prevalent and incident diabetes cohorts from 1991 to 2001, but remained relatively stable for the control and pre-diabetes cohorts (Figure 21a and Figure 21b). Per capita hospital costs were similar for the registered Indian and general populations. Hospital costs were approximately 4.0 to 5.5 and 1.3 to 1.8 times higher for the active diabetes and pre-diabetes cohorts, respectively, than for controls (Figure 22). Total hospital costs for individuals with diabetes declined from approximately \$113.2 million in 1991 to \$102.1 million in 2001 despite the increasing number of beneficiaries with diabetes (Table 5). Hospital costs were the largest category expenditure each year and totalled over \$1.2 billion from 1991 to 2001 (Table 5).

Day Surgeries

The average number of day surgeries was lower for the registered Indian population than for the general population over the follow-up period in all cohorts (Figures 23a and 23b). From 1991 to 2001, the average number of day surgeries increased considerably in both populations. For the general population, the average number of day surgeries reached 0.23 ± 1.2 for prevalent and 0.23 ± 0.96 for incident diabetes cases, 0.16 ± 0.50 for the pre-diabetes cohort and 0.10 ± 0.52 for the control cohort in 2000 (Figure 23b). Crude utilization ratios ranged from 2.0 to 2.5 for the active diabetes cohorts and 1.6 to 1.8 for the pre-diabetes cohorts (Figure 24).

Annual per capita day surgery costs were higher for the general population than for the registered Indian population (Figure 25a and 25b). Per capita day surgery costs were similar in the incident and prevalent diabetes cohorts for the general population. For the registered Indian population, the prevalent diabetes cohorts had higher average costs than the incident diabetes cohorts in a number of years (Figures 25a and 25b). Crude day surgery costs were approximately 2.5 times higher for the active diabetes cohorts compared to controls and approximately 1.5 times higher for the pre-diabetes cohorts (Figure 26). Day surgeries constituted the smallest expenditure category for individuals with active diabetes (Table 5), but they more than doubled from 1991 to 2001.

Dialysis

There were 1070 (1.7%) individuals with diabetes and 226 (0.2%) control subjects with one or more fee-for-service codes for either hemodialysis or peritoneal dialysis. Of the individuals with diabetes on dialysis, 250 (4.0%) were from the registered Indian population and 820 (1.4%, $p < 0.001$) were individuals from the general population. The average duration of either hemodialysis or peritoneal dialysis each year varied with cohort and dialysis modality, with no clear pattern emerging (Figure 27). Small numbers precluded the analysis of data according to registered Indian status for those on dialysis.

Annual per capita dialysis costs were highest for prevalent diabetes cases for both the registered Indian and general populations (Figures 28a and 28b). Per capita dialysis costs were considerably higher for the registered Indian population with prevalent diabetes compared to the general

population (e.g., $\$582 \pm \5075 vs $\$192 \pm \2914 in 2000) (Figures 28a and 28b). The cost ratios (active diabetes or pre-diabetes compared to controls) for dialysis were relatively large in magnitude (Figure 29). For those individuals on dialysis, annual dialysis costs were highly variable over the 11-year period, but in 2000, they were $\$30,349 \pm \$20,821$ for prevalent diabetes, $\$23,436 \pm \$20,343$ for incident diabetes, $\$27,993 \pm \$21,384$ for pre-diabetes and $\$25,496 \pm \$20,272$ for controls (Figure 30). Total dialysis costs for individuals with diabetes increased from \$2.9 million in 1991 to \$11.4 million in 2001 (Table 5).

Total Health Care Costs Excluding Prescriptions

From 1991 to 2001, \$1.7 billion were spent on physician services, hospitalizations, day surgeries and dialysis for individuals with diabetes (Table 5). Total per capita health care expenditures (excluding prescriptions) decreased from \$5499 in 1991 to \$3295 in 2001 for individuals with active diabetes (Table 5 and Figure 31); however, overall expenditures rose with the increasing number of diabetes cases (Table 5). While total per capita expenditures also decreased in the control groups over this time period, they remained relatively stable for the pre-diabetes cohorts (Figure 30). Crude total expenditure ratios ranged from 3.6 to 4.8 for the active diabetes cohorts and 1.4 to 1.8 for the pre-diabetes cohorts (Figure 32a). Age-standardized ratios were somewhat smaller in magnitude but, in most years, remained 2.5 times higher than controls for active diabetes cohorts (Figure 32b).

Throughout the follow-up period, annual per capita expenditures for individuals with diabetes in the registered Indian population exceeded expenditures in the general population (Figures 33a and 33b, Table 8). In both groups, total per capita expenditures decreased for the active diabetes cohorts over the follow-up period, falling to \$3622 and \$3253, respectively, in 2001 (Table 8). Total per capita expenditures also decreased in both the registered Indian and general population control cohorts from 1991 to 2001 (Figures 33a and 33b). Annual total per capita expenditures were 35% to 85% higher for the registered Indian population (Figure 34). Health care expenditures for registered Indians with active diabetes did not exceed those for the general population for all age categories, but did so for those older than approximately 45 (Figure 35).

Total Health Care Expenditures Including Prescriptions – General Population

Over the 11-year follow-up period, health care expenditures across the five categories totalled \$1.8 billion for the general population with diabetes (Table 7). During this time, total expenditures rose from \$145 million in 1991 to \$186 million in 2001. As a percentage of the five expenditure categories, hospital costs fell from 70% in 1991 to 50% in 2001 (Figures 36a and 36b). At the same time, prescription medication expenditures more than doubled as a percentage of the five categories, increasing from 13% in 1991 to 27% in 2001 (Figures 36a and 36b). In 2001, dialysis costs were nearly four times higher than in 1991 and doubled as a component of total costs.

While total health care expenditures increased over the 11-year period, per capita health care expenditures decreased from \$6298 in 1991 to \$4167 in 2001 for individuals with active diabetes in the general population (Figure 37 and Table 7). At the same time, total per capita health care expenditures remained relatively constant for the control and pre-diabetes cohorts (Figure 37). From 1991 to 2001, crude total cost ratios ranged from approximately 3.8 to 5.0 for active diabetes and 1.5 to 1.9 times for the pre-diabetes cohorts (Figure 38a). Age-standardized ratios decreased in magnitude for the diabetes cohorts, but overall expenditures for individuals with diabetes were approximately three times higher than for the controls (Figure 38b). Age-standardization had little effect on cost ratios in the pre-diabetes cohorts (Figure 38b).

DISCUSSION

Diabetes is a chronic condition clearly associated with a substantial burden. To capture this burden, we analyzed epidemiologic trends and estimated health care expenditures across five categories (physician services, prescriptions, hospitalizations, day surgeries and dialysis) for individuals with diabetes in the province of Saskatchewan from 1991 to 2001. We included all health care services eligible for coverage by Saskatchewan Health within each category for people with diabetes and compared these to a random sample of the population without diabetes to better understand the excess disease burden. The social and individual burden of the disease increased over the 11-year period as reflected by trends of increasing prevalence of diabetes, mortality rates and health care expenditures. Health care expenditures of individuals with diabetes were more than 2.5 times those of individuals without the disease in 2001, while mortality rates were almost twice that of the population without diabetes that year. It is anticipated that the burden of diabetes in Canada will continue to rise in the next decade, with the number of individuals with diabetes reaching 2.4 million and health care expenditures reaching \$8.14 billion nationally by 2016 (Ohinmaa 2004).

Total Expenditures

With the number of individuals with diabetes nearly doubling from 1991 to 2001, it is not surprising that total health care costs increased accordingly over the time period. Interestingly, after adjusting for inflation, the total per capita expenditures for active diabetes case decreased from 1991 to 2001. Thus, increased total expenditures in the active diabetes cohorts seemed to relate mainly to increases in the number of diabetes cases. The decrease in per capita costs appeared to relate to substantial decreases in hospital expenditures, driven, in part, by a decreasing number of hospitalizations for both incident and prevalent diabetes cases over the follow-up period. Counter to this trend, per capita physician, prescription, day surgery and dialysis expenditures rose, with each of these categories becoming an increasing proportion of overall expenditures. With hospitalizations being so costly, the decrease in hospital costs outweighed increases in the other expenditure categories, resulting in a net decrease in overall average costs per active diabetes case. This trend, of course, only considers the five expenditure categories that we captured. It is possible that costs were shifted to health care expenditure

categories not included in the analysis. Home care costs, for example, may have increased with decreasing hospital costs, but these data were not included in this analysis.

Prescriptions

The increases in prescription expenditures over the study period deserve some attention. From 1991 to 2001, the average number of prescriptions dispensed per prevalent or incident diabetes case increased by approximately 30%. After 1992, annual total prescription medication expenditures exceeded what was spent on physician services. The average increase in prescription expenditures over this time period was more than \$300 per active diabetes case. Given that the number of individuals with diabetes nearly doubled from 1991 to 2001, it is not surprising that total prescription expenditures had almost tripled over the follow-up period. There are a number of points to consider, however, in interpreting these observations. First, given the decrease in hospitalizations and hospital expenditures, it is possible that a portion of prescription expenditures was simply shifted from inpatient medication expenditures to outpatient expenditures. Further, while the increase in prescription expenditures was large, this increase should not necessarily be viewed as unacceptable. More appropriate management of diabetes, itself, and cardiovascular risk may require increased utilization of prescription medications (Brown 2004) and could result in a net cost savings in terms of diabetes-related complications despite increased medication expenditures (Padwal 2005). Further, some medications (e.g., metformin, orlistat and acarbose) delay the onset of diabetes (Padwal 2005). Increased spending on such medications is likely justified as they have the potential to reduce overall expenditures over the long-term by extending the pre-diabetes phase. Prescription expenditures included diabetes-testing supplies, in addition to medications. Thus, increased expenditures could, in part, reflect increased blood glucose monitoring.

Utilization Patterns

The excess utilization and costs associated with diabetes appear to have begun prior to the date upon which the NDSS criteria for diabetes was met (i.e., in the pre-diabetes cohorts each year). Depending on the year and category of expenditure, utilization and costs of the pre-diabetes cohorts were approximately 1.5 to 7.0 times those of controls. Overall age-standardized expenditures were 80% higher in 2000 for the pre-diabetes cohort compared to the control

cohort. Age-standardized expenditures for the active diabetes cohort, however, were considerably higher than the pre-diabetes cohort for the same year. Thus, costs of the pre-diabetes cohorts were intermediate between the active diabetes and control cohorts. Coupled with evidence from clinical trials demonstrating the benefits of delaying the onset of diabetes (Pan 1997; Tuomilehto 2001; Chiasson 2002; Knowler 2002), this observation may enhance the argument for preventive strategies in health care.

Without considering differences in age distribution of the registered Indian and general populations, the higher health care costs of the registered Indian population compared to the general population were relatively small in magnitude. This difference was more pronounced, however, after age standardization given the larger proportion of the registered Indian population in the younger age bands. After adjusting for age, total per capita costs for the registered Indian population were approximately 30% to 80% higher each year than for the general population. In a study of excess costs of diabetes in the Manitoba First Nations population (defined as those individuals registered under Canada's *Indian Act*), average total health care costs in 1995-96 were 69% higher across four categories of expenditures (hospitalizations, home care, professional services and dialysis) (Jacobs 2000). In the Manitoba study, the excess costs were mainly attributable to higher hospitalization rates in the First Nations population. Using our 1995 data for the purposes of comparison, age-standardized costs in the registered Indian population were 57% higher than the general population. In our study, excess costs in the registered Indian population appeared to be related to the larger proportion of the registered Indian population on dialysis rather than to hospital costs. We found that hospital costs were similar in both populations despite the higher average number of hospitalizations in the registered Indian population. This likely reflects a shorter length of stay, on average, for individuals in the registered Indian population.

Epidemiologic Trends

In 2001, the overall age-standardized prevalence of diabetes in Saskatchewan was 4.7%. After considering differences in the age distribution of the registered Indian and general populations, the disproportionate burden of diabetes in the registered Indian population was quite apparent in terms of prevalence and incidence rates of diabetes. Age-standardized prevalence and incidence

rates of diabetes in the registered Indian population were several times higher than the general population. These estimates are similar to those obtained from the Manitoba First Nations (i.e., registered Indian) population (Green 2003). The Manitoba study explored trends according to sex and found that age-standardized prevalence rates among First Nations females in 1998 were 4.6 times higher compared to the general female population, whereas they were 3.7 times higher for males. Age-standardized incidence rates in the Manitoba study were approximately three times higher in the First Nations male population and 3.7 times higher in the female population. We did not consider the differences in prevalence and incidence according to sex, but plan to do so in the future.

The high incidence and prevalence rates of diabetes in the registered Indian population have major health policy implications. Culturally appropriate primary prevention programs targeting this segment of the population may be needed in order to reduce the excess burden of diabetes experienced by this group. We anticipate that as the Aboriginal population with diabetes continues to age, the rates of comorbidities in this population will also increase (Green 2003). Given that a significant proportion of the costs of care for individuals with diabetes is attributable to comorbidities and complications (Dawson 2002; Ettaro 2004; Norlund 2001), efforts to prevent complications in the Aboriginal population are needed. It is anticipated that the prevalence and diabetes-related costs will increase more rapidly in the Aboriginal population than in the general population (Blanchard 2000).

Age-standardized mortality in the diabetes cohorts was approximately twice that of the control cohort, a finding similar to that of the NDSS (Health Canada 2003). We also determined the 95% confidence intervals around these mortality rates and found, in every year, that the age-standardized mortality rates in individuals with diabetes were not statistically significantly higher than their controls. Nonetheless, it is still alarming that in the last four years of data capture, mortality rates were statistically significantly higher for individuals with diabetes. Excess mortality in the 2001 diabetes cohort was not apparent in all age groups, but was significantly higher between 55 and 85 years old. It has been estimated that life expectancy for individuals with diabetes is approximately 12 to 13 years shorter than for individuals without the disease (Manuel 2004) and that more than 50% of deaths in individuals with diabetes are attributable to cardiovascular disease (Gerstein 2001; King 1999). From a health policy perspective, this

emphasizes the need for primary and secondary prevention of cardiovascular disease in individuals with diabetes to help reduce the excess mortality experienced by those with the disease.

Limitations

While these analyses revealed some interesting trends in the epidemiology and costs of diabetes from 1991 to 2001, these trends should be considered in light of a number of limitations. First, despite there being good evidence of validity of the NDSS criteria for identifying diabetes cases, it can potentially miss some diabetes cases and underestimate the prevalence (Hux 2002). Individuals whose physicians do not bill fee-for-service and do not shadow bill, for example, may not meet the NDSS criteria for diabetes unless they are hospitalized for diabetes. Further, some settlements in Saskatchewan's northern health districts are served by nurse practitioners (NPs). Although some NPs shadow bill, the records are kept on a separate file and were not included in the compilation of the dataset for this project. Despite this, the NDSS algorithm is useful for identifying diabetes cases for the purposes of surveillance and of analyzing trends over time. One potential issue that remains, however, is that we applied the NDSS criteria to the entire population, not just those over the age of 20. The evidence of validity of the NDSS criteria may not be generalizable to those under 20 years old, nor to the registered Indian population.

For our comparisons of utilization by the registered Indian and general population, we did not have access to prescription data for the registered Indian population, and thus we based our comparisons on only four expenditure categories. It is not clear what the impact of excluding prescription expenditures would be on the ratio of costs between the two groups if they had different patterns of utilization. This may be more of a problem in later years of the follow-up period given that prescriptions became a larger component of health care expenditures over the study period.

Total cost estimates and comparisons between cohorts in this study were limited to the direct costs of medical care, of which five expenditure categories were included. We were unable to capture resource utilization and costs managed under global budgets with health regions in Saskatchewan. This would include resources such as diabetes educators, dietitians, podiatrists and auxiliary costs of transplants (e.g., transplant coordinators and costs for living donors). As

well, we were unable to capture other expenditures such as emergency department services. Despite excluding such expenditure categories, costs were still approximately 2.5 times those of individuals without the disease. This estimate is very similar to that obtained from a study of the cost of diabetes in the United States in 2002, where the costs of individuals with diabetes were approximately 2.4 times the costs for individuals without the disease when emergency room visits and home care were included (Hogan 2003). By excluding some outpatient costs and emergency department services, however, the total and average direct medical costs of care would be underestimated for all cohorts.

For some cost categories, data were not directly available from Saskatchewan Health, and external sources were used to generate cost estimates. Dialysis costs, for example, were based on costs estimated in an Alberta study (Lee 2002). It is not clear to what extent dialysis costs in Alberta are generalizable to Saskatchewan. As well, hospital and day surgery costs were based on resource intensity or DPG weights and the estimated funding per weighted case for the year 2001. We would have preferred to use the estimated funding per weighted case for each year inflated to 2001 dollars, but an estimated funding per weighted case was not available for 1991 to 1994. Thus, costs in early years may have been overestimated. Further, weights were not calculated in early years and some were missing in later years. Since April 1, 1998, however, weights were missing only if the hospitalization was in an out-of-province hospital that does not report to CIHI. Consequently, we had to use imputation methods to estimate missing weights.

Expenditures for each resource category were not age-standardized and, as such, some caution should be taken in comparing diabetes cases to controls for the five individual components. Further, because other differences existed between diabetes cases and controls (sex and rural residence, for example), caution should be taken in attributing differences in costs and utilization solely to diabetes.

Health policy changes in the province of Saskatchewan from 1991 to 2001 have implications for the interpretation of health care utilization and cost trends. A number of changes in co-payments and deductibles for the Saskatchewan Drug Plan occurred during the study period resulting in increased out-of-pocket costs for certain beneficiaries (Johnson 2002). Increased cost-sharing in the early 1990s likely impacted overall utilization and expenditures during this time. For day

surgeries, the calculation of DPG weights was inconsistent in the early 1990s, which could impact cost estimates (Johnson 2002). There have also been several changes to the definition of day surgery over time and the application of the definition was quite inconsistent. As well, a number of RIWs and DPG weights were missing during the early 1990s, requiring imputation. There have also been changes in the intensity weight methodology over time. Funding of some services, such as laboratory services, changed over the study period and were no longer reflected in fee-for-service physician billings after 1993 (Johnson 2002). Thus, estimates of costs and utilization of physician services may appear higher in the earlier years of the follow-up period simply due to this change in policy.

CONCLUSION

Our analyses revealed some important epidemiologic and cost trends over the study period. Total health care expenditures for individuals with diabetes rose from \$140 million in 1991 to \$154 million in 2001. An increased number of individuals with diabetes over the study period, rather than increased costs per beneficiary, appeared to be responsible for this trend. Costs of health care for individuals with diabetes were approximately 2.5 times greater and mortality rates were almost twice that for individuals without the disease in 2001. Despite increased resource utilization by those with diabetes, mortality remained high relative to their controls. Costs appeared to increase prior to meeting the NDSS criteria for diabetes (i.e., during the “pre-diabetes” stage), suggesting that delay or prevention of type 2 diabetes could result in significant cost savings. Registered Indians had health care costs that were approximately 60% higher than the general population, which, in part, related to the larger proportion of registered Indians who received dialysis services. These findings emphasize the importance of primary and secondary prevention of diabetes and its complications in the registered Indian and general populations.

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Table 1: Comparison of Diabetes and Control Cohorts

	Diabetes Cohort	Control Cohort
N	64,079	128,158
Age – Mean (SD) years	60.31 (17.15)**	37.22 (21.73)
Sex – n (%) Male	33,862 (52.8)**	63,779 (49.8)
Residence – n (%) Rural	31,161 (48.6)**	56,691 (44.2)
Follow-Up – Mean (S.D.) years	5.64 (3.51)**	6.32 (3.66)
Deaths 1991-2001 – n (%)	16,164 (25.2)**	7 289 (5.7)
Registered Indian – n (%)	6 305 (9.8)	12,610 (9.8)

** P value< 0.001

Table 2: Characteristics According To Registered Indian Status

	Diabetes Cohort¹		Control Cohort²	
	Registered Indian	General Population	Registered Indian	General Population
N (%)	6 305 (9.8)	57,774 (90.2)	12,610 (9.8)	115,548 (90.2)
Age – Mean (S.D.) years	47.94 (15.33)**	61.66 (16.80)	24.82 (15.68)**	38.57 (21.73)
Sex – n (%) Male	2 708 (43.0)**	31,154 (53.9)	6 405 (50.8)*	57,374 (49.7)
Residence – n (%) Rural	4 505 (71.5)**	26,656 (46.1)	7 612 (60.4)**	49,079 (42.5)
Follow-Up – Mean (S.D.) years	6.03 (3.53)**	5.60 (3.51)	6.49 (3.64)**	6.31 (3.66)
Deaths 1991-2001 – n (%)	998 (15.8)**	15,166 (26.3)	376 (3.0)**	6 913 (6.0)

1 Tests of statistical significance reflect comparisons between the registered Indian and general populations within the diabetes cohort

2 Tests of statistical significance reflect comparisons between the registered Indian and general populations within the control cohort

** P value < 0.001

* P value < 0.05

Table 3: Prevalent, Incident and Pre-Diabetes According To Registered Indian Status (1991 – 2001)

		Incident	Prevalent	Active Diabetes Cohort	Pre-Diagnosis	Follow-Up ¹ Terminated
1991	General Population	4731	18,338	23,069	34,705	---
	Registered Indians	441	1889	2330	3975	---
	Total	5172	20,227	25,399	38,680	---
1992	General Population	3783	22,276	26,059	30,922	793
	Registered Indians	357	2287	2644	3618	43
	Total	4140	24,563	28,703	34,540	836
1993	General Population	3451	24,860	28,311	27,471	1992
	Registered Indians	363	2583	2946	3255	104
	Total	3814	27,443	31,257	30,726	2096
1994	General Population	3119	26,944	30,063	24,352	3359
	Registered Indians	379	2866	3245	2876	184
	Total	3498	29,810	33,308	27,228	3543
1995	General Population	3192	28,502	31,694	21,160	4920
	Registered Indians	377	3159	3536	2499	270
	Total	3569	31,661	35,230	23,659	5190
1996	General Population	3235	30,149	33,384	17,925	6465
	Registered Indians	363	3437	3800	2136	369
	Total	3598	33,586	37,184	20,061	6834
1997	General Population	3691	31,630	35,321	14,234	8219
	Registered Indians	381	3695	4076	1755	474
	Total	4072	35,325	39,397	15,989	8693
1998	General Population	3698	33,472	37,170	10,536	10,068
	Registered Indians	445	3969	4414	1310	581
	Total	4143	37,441	41,584	11,846	10,649
1999	General Population	3765	35,280	39,045	6771	11,958
	Registered Indians	468	4290	4758	842	705
	Total	4233	39,570	43,803	7613	12,663
2000	General Population	3663	37,026	40,689	3108	13,977
	Registered Indians	426	4594	5020	416	869
	Total	4089	41,620	45,709	3524	14,846
2001	General Population	3108	38,522	41,630	--	16,144
	Registered Indians	416	4868	5284	--	1021
	Total	3524	43,390	46,914	--	17,165

¹ Total number of diabetes cases whose follow-up was terminated at the beginning of each year (i.e., January 1st)

Table 4: Control Cohorts According To Registered Indian Status (1991 – 2001)

		Active Control Cohort	Follow-Up ¹ Terminated
1991	General Population	38,862	---
	Registered Indians	3976	---
	Total	42,838	---
1992	General Population	48,299	1251
	Registered Indians	4948	46
	Total	53,247	1297
1993	General Population	55,441	2443
	Registered Indians	5747	99
	Total	61,188	2542
1994	General Population	61,076	3908
	Registered Indians	6519	165
	Total	67,595	4073
1995	General Population	66,302	5608
	Registered Indians	7237	243
	Total	73,539	5851
1996	General Population	71,939	6797
	Registered Indians	7961	305
	Total	79,900	7102
1997	General Population	77,838	8598
	Registered Indians	8656	398
	Total	86,494	8996
1998	General Population	83,542	10524
	Registered Indians	9456	502
	Total	92,998	11026
1999	General Population	89,598	12192
	Registered Indians	10,334	572
	Total	99,932	12764
2000	General Population	95,146	14092
	Registered Indians	11,103	665
	Total	106,249	14757
2001	General Population	98,680	16868
	Registered Indians	11,692	918
	Total	110,372	17786

¹ Total number of diabetes cases whose follow-up was terminated at the beginning of each year (i.e., January 1st)

Table 5: Total Health Care Costs By Component: 1991 – 2001 (Registered Indians and General Population)

Year	N ¹	Physician Services	Hospital	Day Surgery	Dialysis	Total	Average per Capita ²
1991	25,399	21,078,505	113,175,135	2,548,225	2,878,863	139,680,728	5499
1992	28,703	23,114,888	127,827,826	2,447,706	3,867,471	157,257,891	5479
1993	31,257	23,196,891	123,393,198	3,265,105	4,333,707	154,188,902	4933
1994	33,308	23,029,000	118,035,869	4,673,481	5,338,635	151,076,985	4536
1995	35,230	23,960,433	119,287,340	4,701,403	5,827,100	153,776,276	4365
1996	37,184	25,413,342	114,800,597	5,469,178	6,232,106	151,915,224	4085
1997	39,397	26,954,748	112,510,518	6,134,030	6,755,847	152,355,142	3867
1998	41,584	29,022,665	105,034,475	7,482,470	7,292,524	148,832,134	3579
1999	43,803	30,812,071	99,043,857	6,693,521	8,469,607	145,019,055	3311
2000	45,709	32,169,340	104,730,789	6,954,633	9,959,708	153,814,469	3365
2001	46,914	34,364,144	102,051,236	6,795,322	11,370,175	154,580,877	3295
Total		293,116,026	1,239,890,840	57,165,074	72,325,744	1,662,497,683	

1 N= Number of active diabetes cases (prevalent and incident) in each year

2 total expenditures/active diabetes cases

Table 6: Utilization of Antidiabetic Agents (2001)

	Percentage of 2001 Active Diabetes Cohort (N=41630)
No Medications	34.0
Insulin Alone	14.9
Oral Agents With Insulin	5.6
Metformin and Insulin	2.9
Sulfonylurea and Insulin	0.3
Metformin, Sulfonylurea, Insulin	1.3
Other Combination, With Insulin	1.1
Oral Agents Without Insulin	45.4
Metformin Alone	13.9
Sulfonylurea Alone	11.5
Other Oral Agent Alone	0.4
Metformin and Sulfonylurea	16.2
Other Combination, Without Insulin	3.4
Testing Supplies	
Blood and urine testing supplies	52.6

Table 7: Total Health Care Costs by Component (Including Prescriptions) for the General Population (1991 – 2001)

Year	N ¹	Physician Services	Prescriptions	Hospital	Day Surgery	Dialysis	Total	Crude Average ²	Age-Adjusted Average ³
1991	23,069	19,088,093	18,606,886	102,879,012	2,408,044	2,302,638	145,284,673	6298	4096
1992	26,059	20,890,440	21,113,110	114,287,143	2,286,722	3,047,313	161,624,728	6202	3936
1993	28,311	20,829,334	19,741,048	110,462,514	3,062,979	3,247,198	157,343,073	5558	3466
1994	30,063	20,393,450	21,136,285	103,169,844	4,295,833	3,822,370	152,817,782	5083	3207
1995	31,694	21,339,381	23,168,024	106,871,430	4,324,107	4,219,850	159,922,792	5046	3256
1996	33,384	22,609,414	26,024,624	101,319,094	5,052,118	4,394,169	159,399,420	4775	3229
1997	35,321	23,945,035	31,034,400	98,918,067	5,685,941	4,707,524	164,290,967	4651	3194
1998	37,170	25,698,450	34,160,078	92,122,860	6,997,543	4,859,282	163,838,213	4408	3142
1999	39,045	27,322,333	38,956,868	87,020,790	6,202,953	5,978,440	165,481,384	4238	3095
2000	40,689	28,529,700	44,854,783	92,469,971	6,391,821	7,268,058	179,514,333	4412	3288
2001	41,630	30,417,294	50,514,785	90,565,032	6,256,637	8,202,175	185,955,923	4467	3372
Total		261,062,926	329,310,890	1,100,085,757	52,964,698	52,049,016	1,795,473,288		

1 N=total number of general population active diabetes cases (prevalent and incident) in each year

2 total expenditures/active diabetes cases

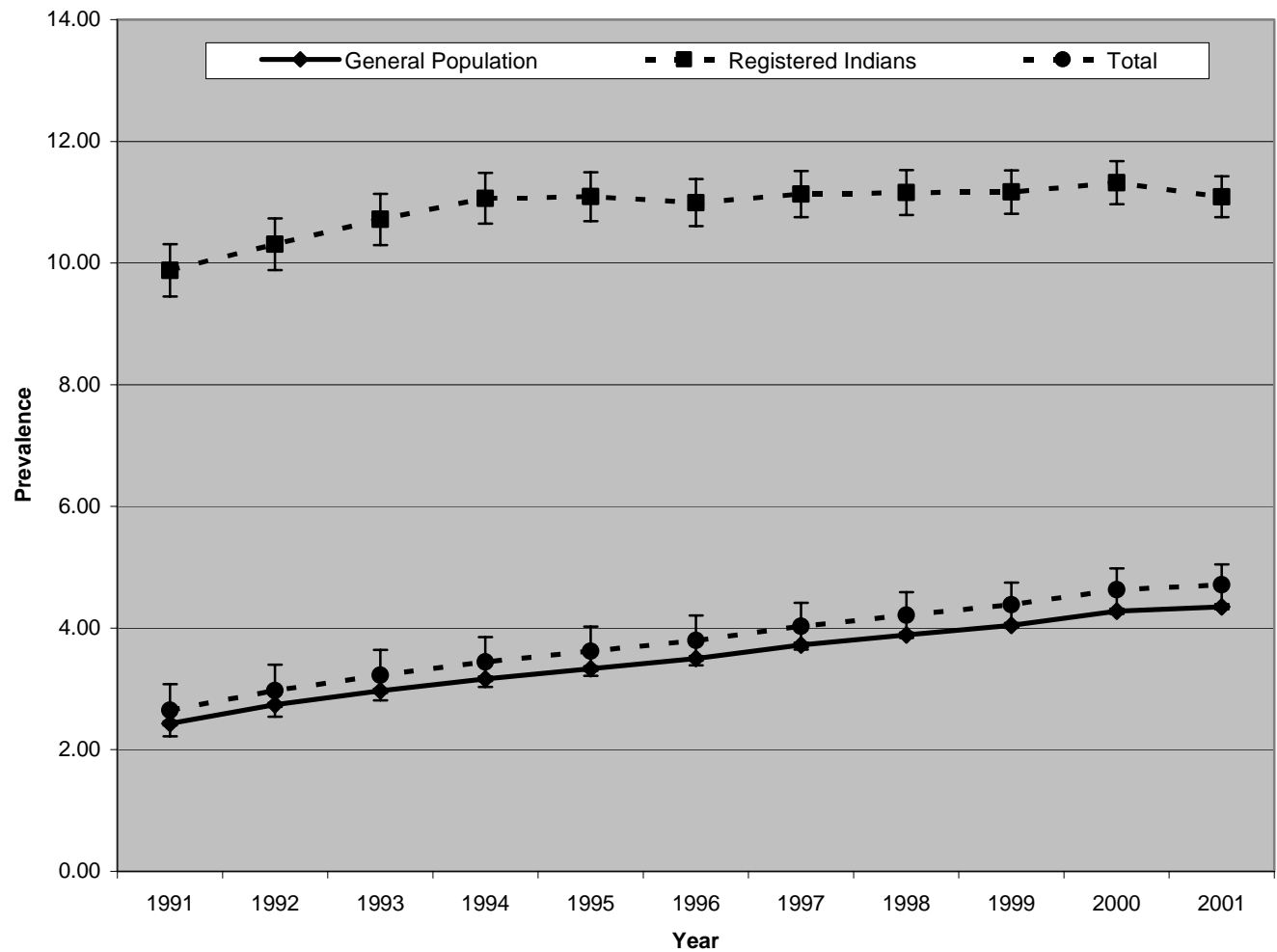
3 Directly age standardized to the 2001 Canadian population

Table 8: Total Health Care Costs (Excluding Prescriptions) (1991 - 2001)

	Total Costs Excluding Medications								
	General Population			Registered Indians			Overall		
	Total	Crude Average	Age-Adjusted Average¹	Total	Crude Average	Age-Adjusted Average¹	Total	Crude Average	Age-Adjusted Average¹
1991	126,677,787	5491	3294	13,002,941	5581	4411	139,680,728	5499	3428
1992	140,511,619	5392	3124	16,746,272	6334	5181	157,257,891	5479	3286
1993	137,602,025	4860	2842	16,586,877	5630	4528	154,188,902	4933	3074
1994	131,681,497	4380	2563	19,395,488	5977	4733	151,076,985	4536	2855
1995	136,754,768	4315	2593	17,021,508	4814	4081	153,776,275	4365	2768
1996	133,374,795	3995	2527	18,540,429	4879	3969	151,915,224	4085	2700
1997	133,256,567	3773	2390	19,098,575	4686	4341	152,355,142	3867	2623
1998	129,678,135	3489	2299	19,153,999	4339	3765	148,832,134	3579	2476
1999	126,524,516	3240	2171	18,494,539	3887	3501	145,019,055	3311	2342
2000	134,659,549	3309	2284	19,154,920	3816	3531	153,814,469	3365	2410
2001	135,441,138	3253	2256	19,139,739	3622	3204	154,580,877	3295	2376

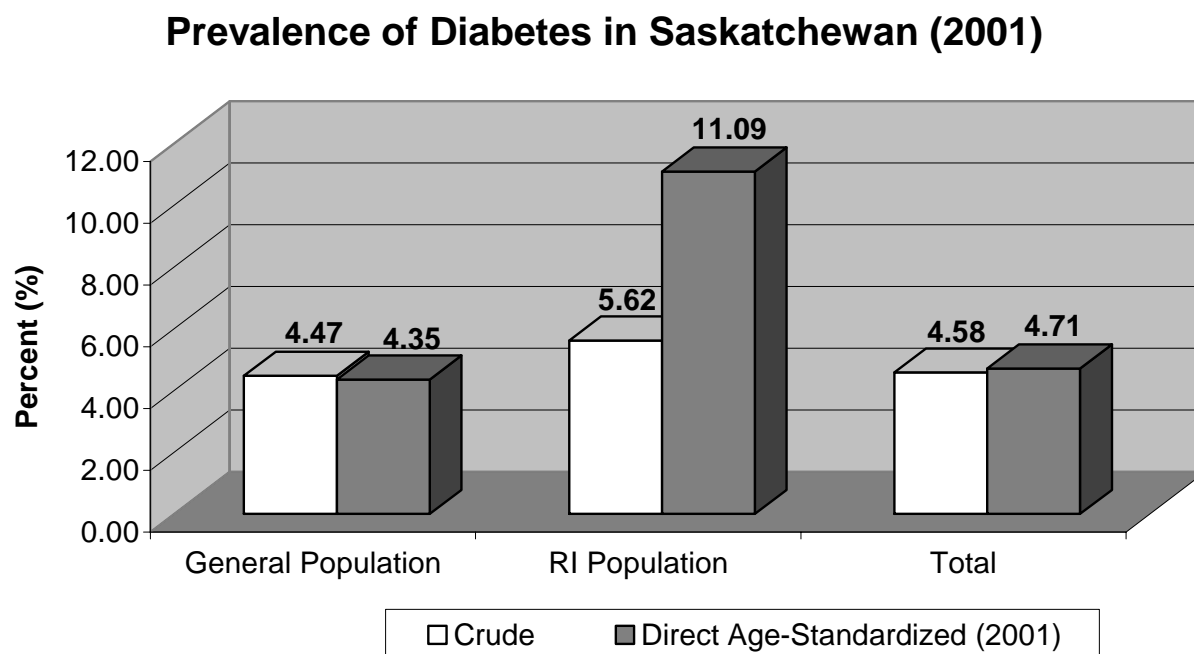
1 Directly age standardized to the 2001 Canadian population

Figure 1: Age-Standardized¹ Prevalence of Diabetes (1991 to 2001)



1 Directly Age-Standardized to the 2001 Canadian Population

Figure 2: Crude and Age-Standardized¹ Prevalence of Diabetes, 2001



1 Directly Age-Standardized to the 2001 Canadian Population

Figure 3: Age-Specific Prevalence of Diabetes (2001)

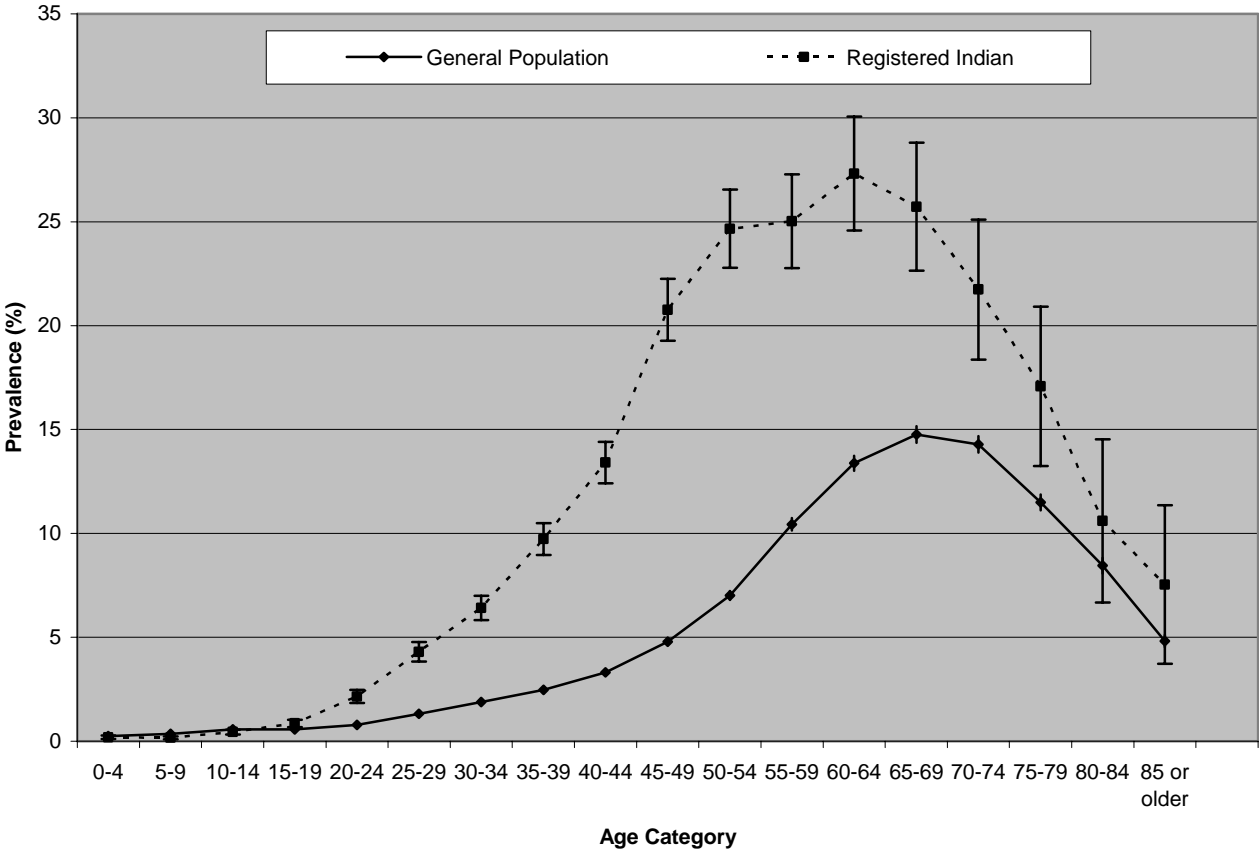
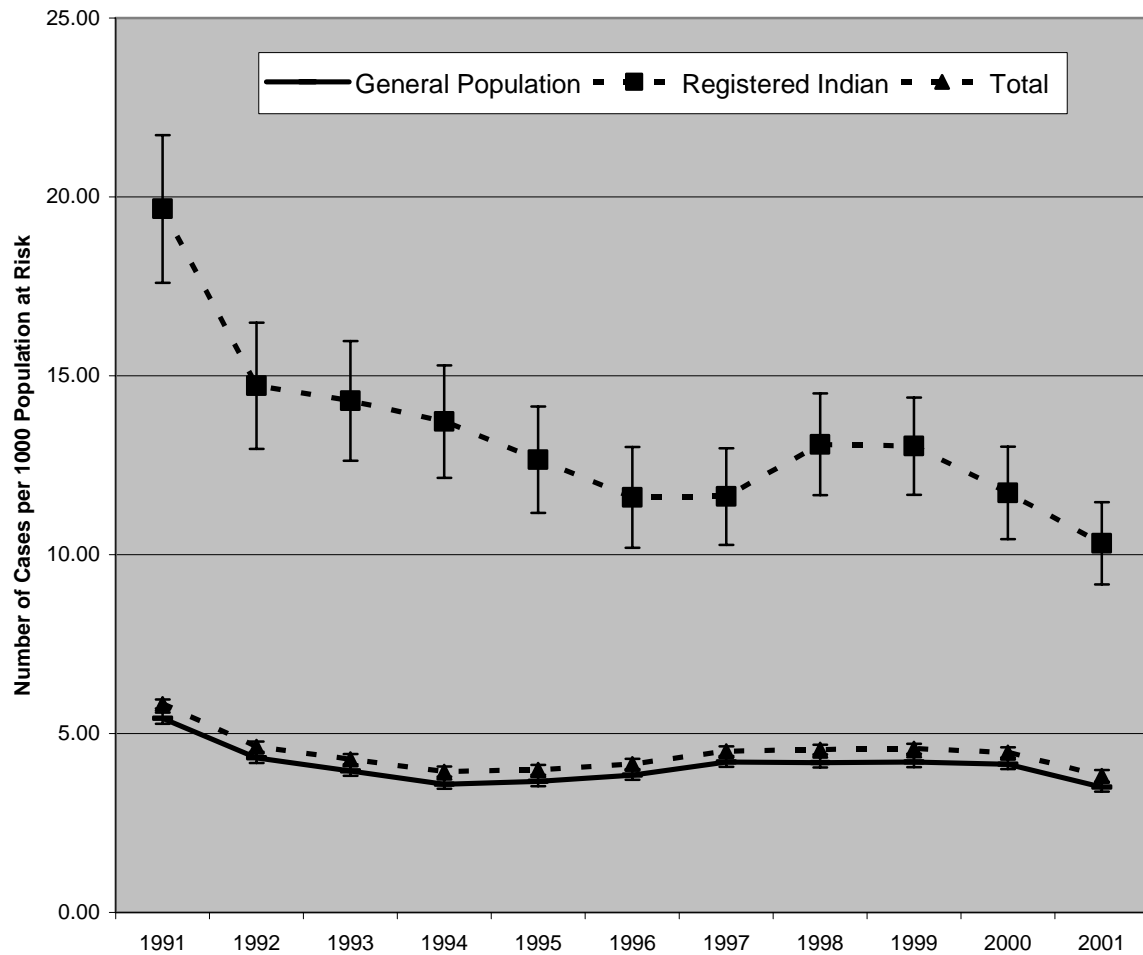
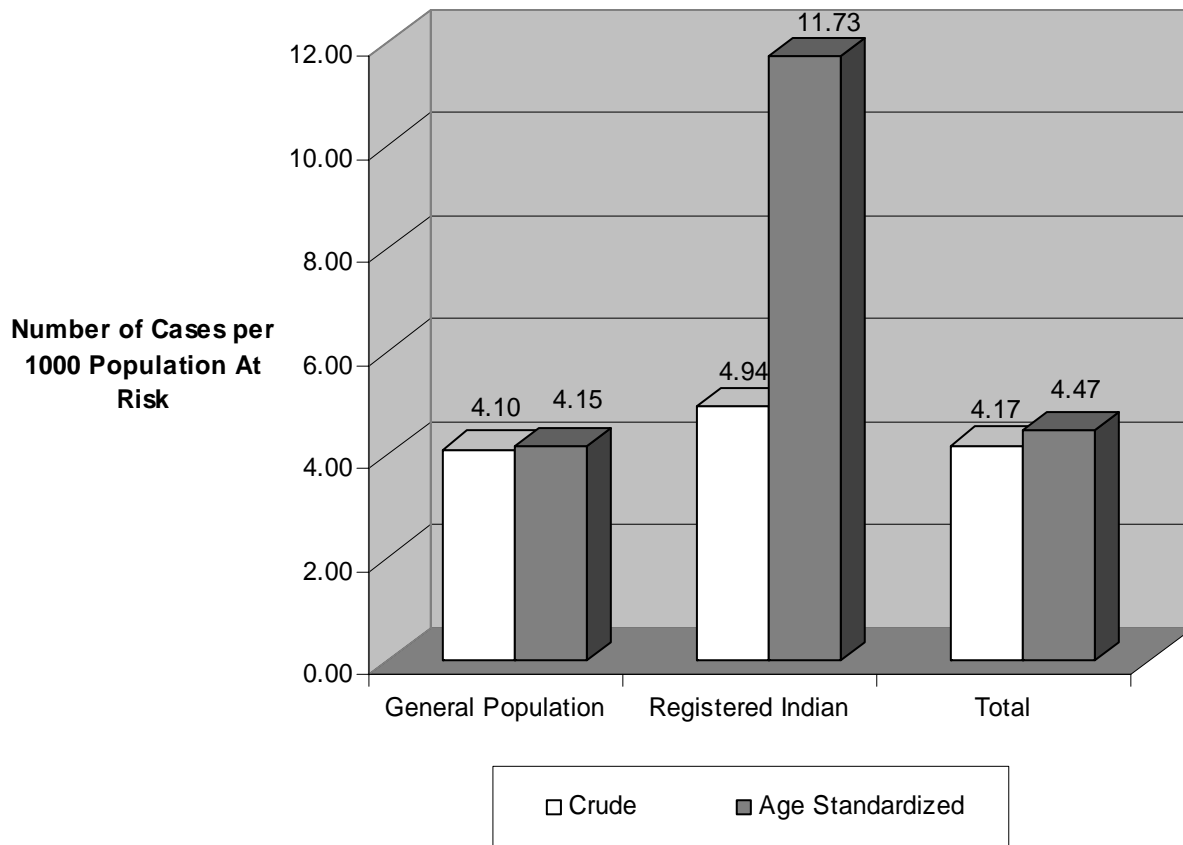


Figure 4: Age-Standardized¹ Incidence of Diabetes (1991 to 2001)



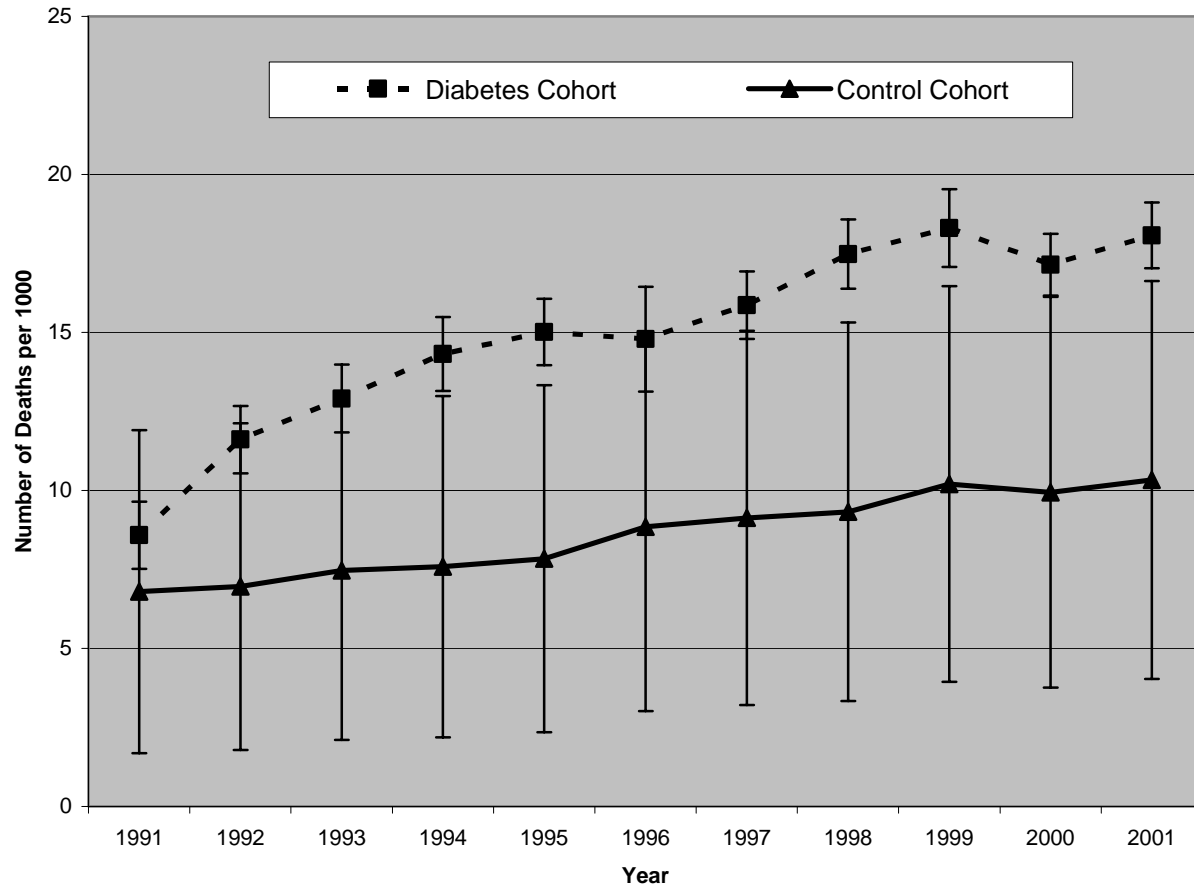
1 Directly Age-Standardized to the 2001 Canadian Population

Figure 5: Crude and Age-Standardized¹ Incidence of Diabetes, 2000



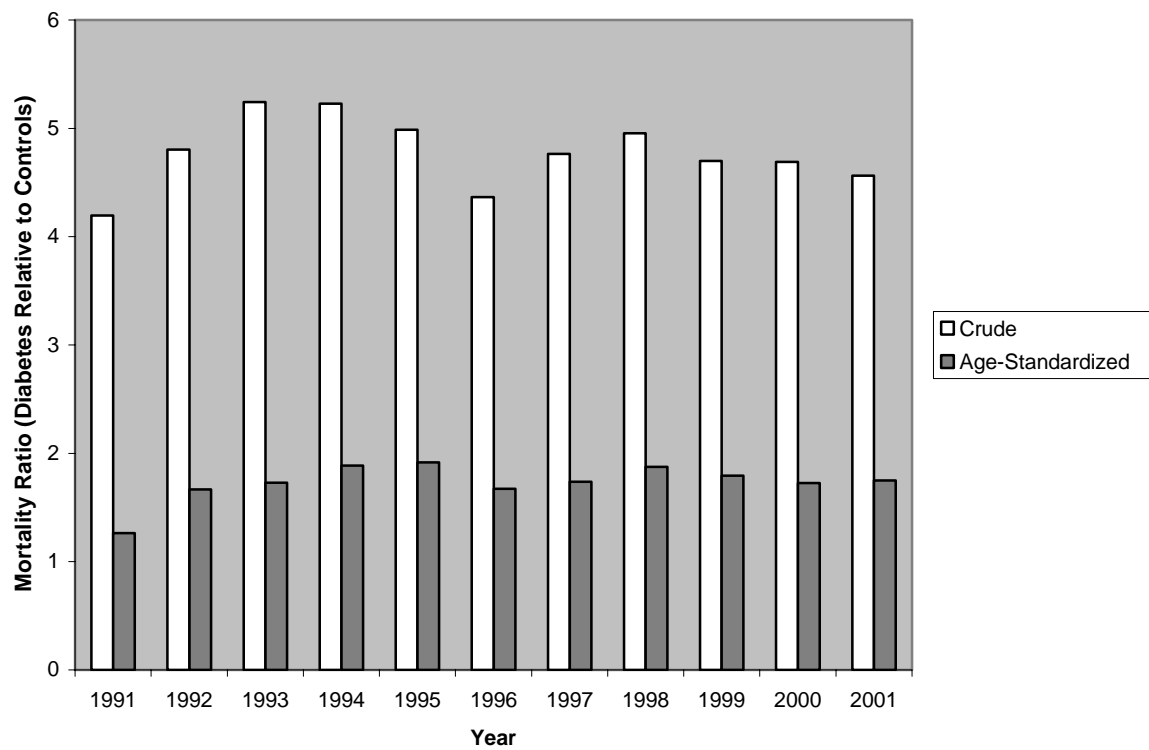
1 Directly Age-Standardized to the 2001 Canadian Population

Figure 6: Age-Standardized¹ Mortality Rates (1991 to 2001) –Registered Indian and General Populations Combined



1 Directly Age-Standardized to the 2001 Canadian Population

Figure 7: Crude and Age-Standardized¹ Mortality Ratios (1991 to 2001) – Registered Indian and General Populations Combined



1 Directly Age-Standardized to the 2001 Canadian Population

Figure 8: Age-Specific Mortality (2001) in Diabetes and Controls – Registered Indian and General Populations Combined

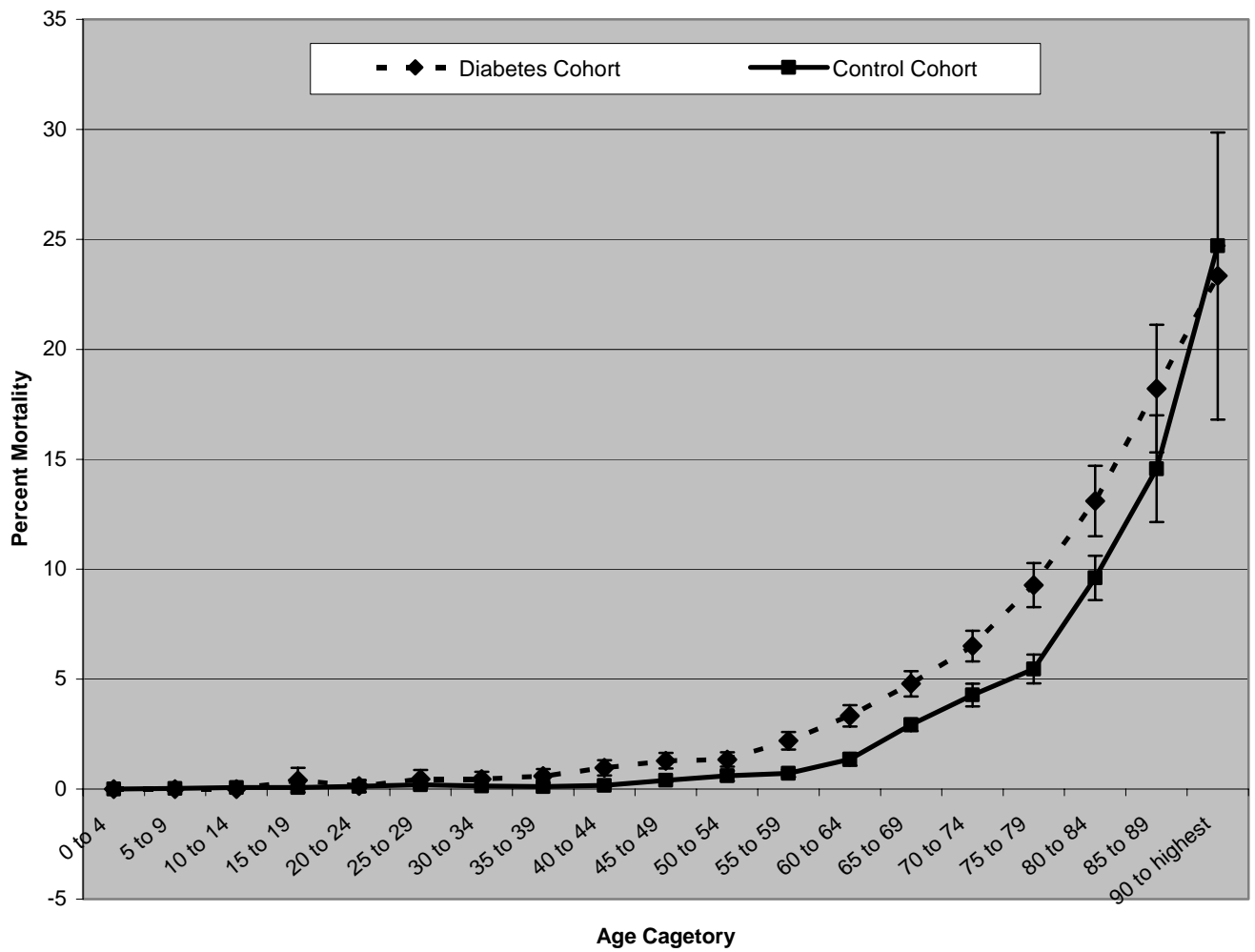


Figure 9: Age-Specific Mortality (2001) - Registered Indian and General Populations

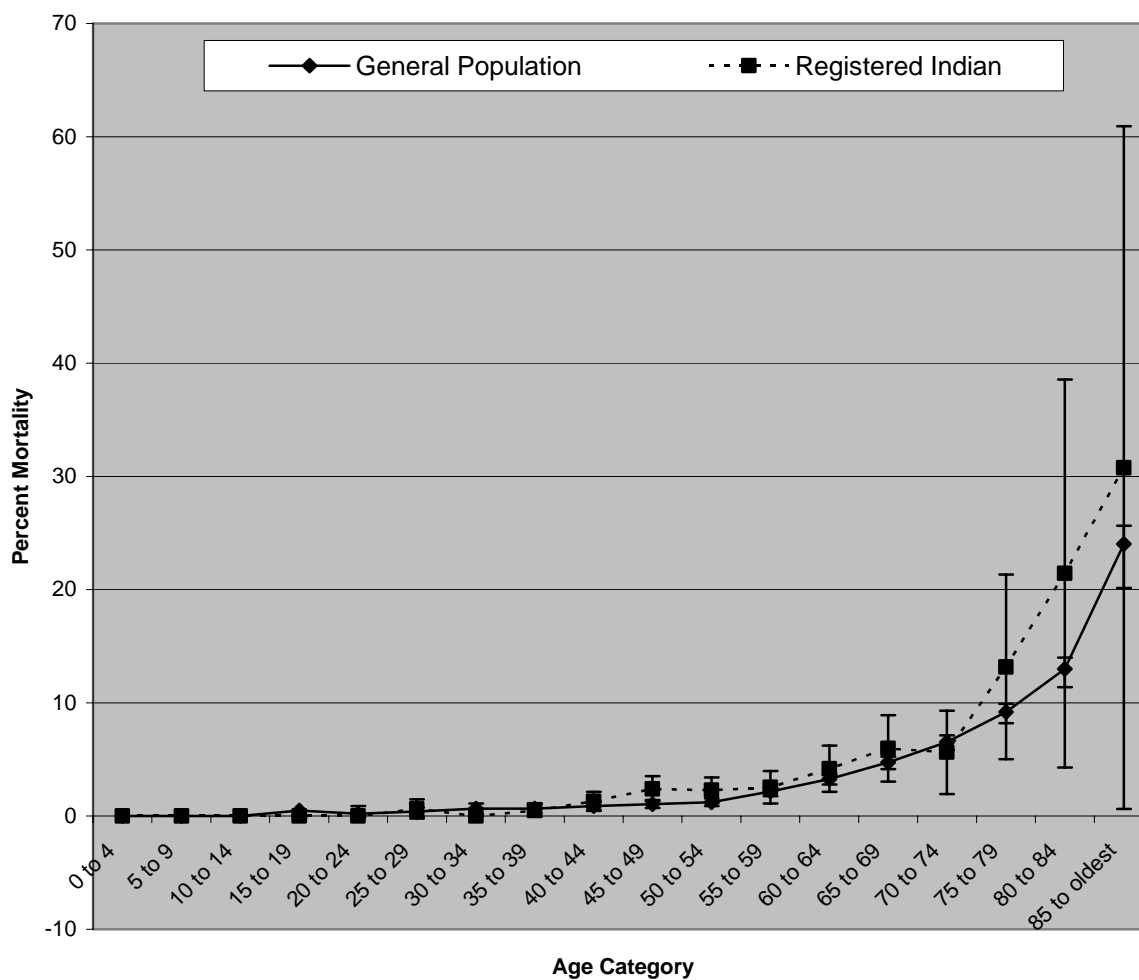


Figure 10a: Average Number of Physician Visits (1991 to 2001) – Registered Indians

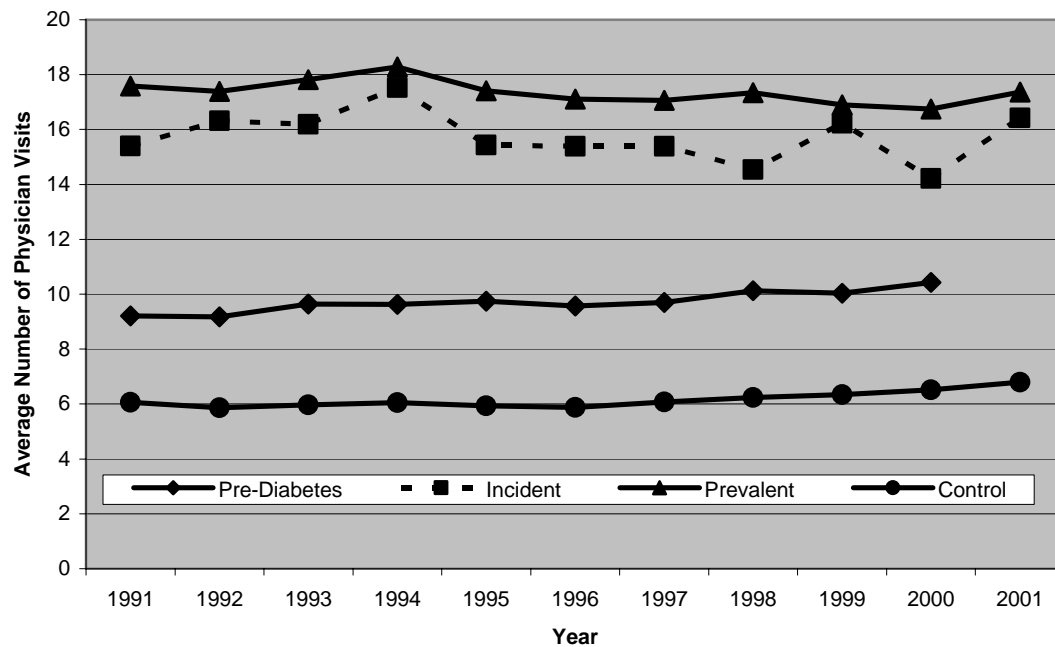


Figure 10b: Average Number of Physician Visits (1991 to 2001) – General Population

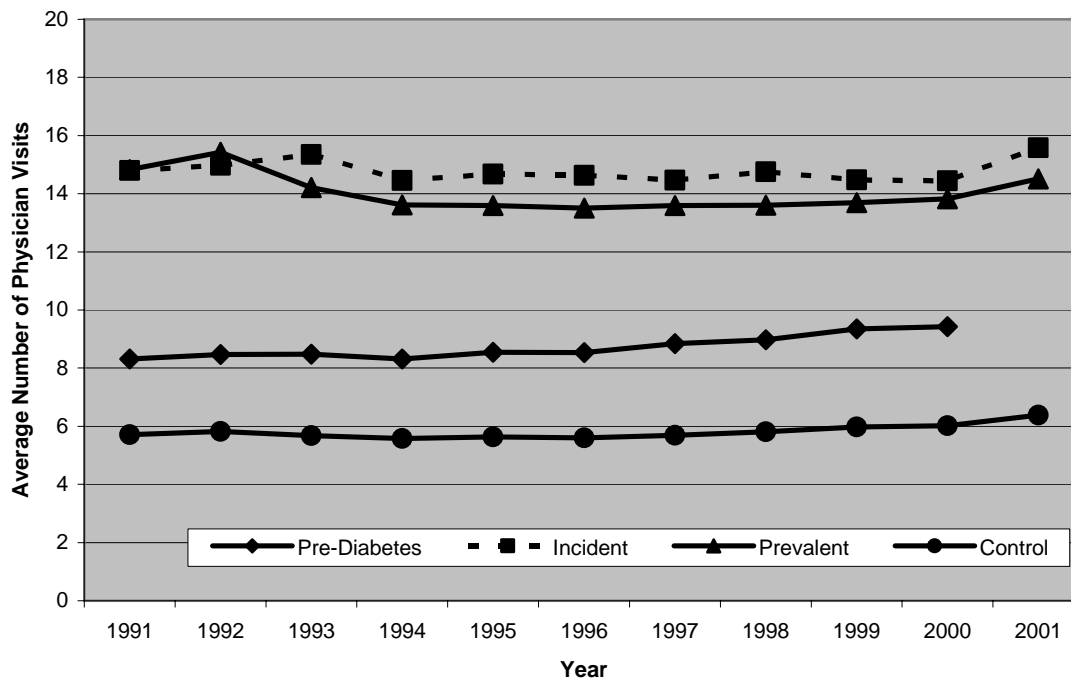


Figure 11: Crude Overall Utilization Ratios for Physician Visits (1991 to 2001) – Registered Indian and General Populations Combined

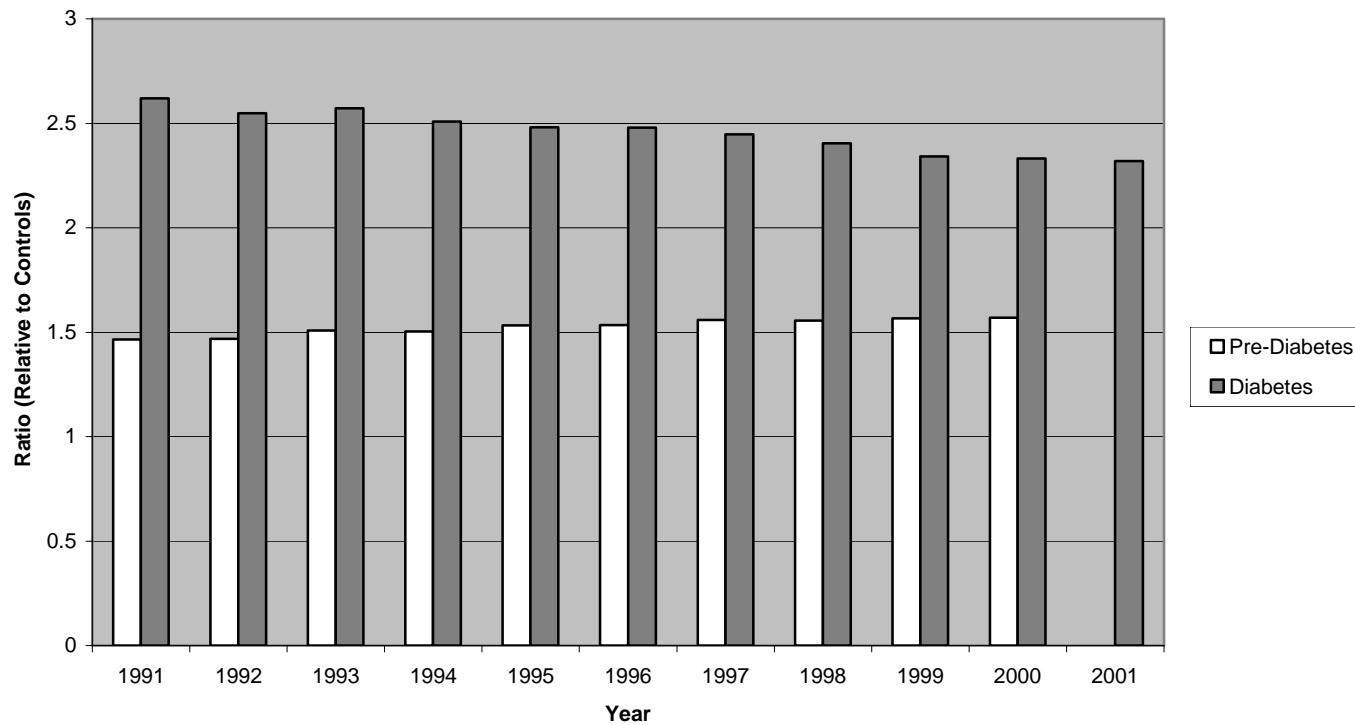


Figure 12a: Average Physician Costs (1991 to 2001) – Registered Indians

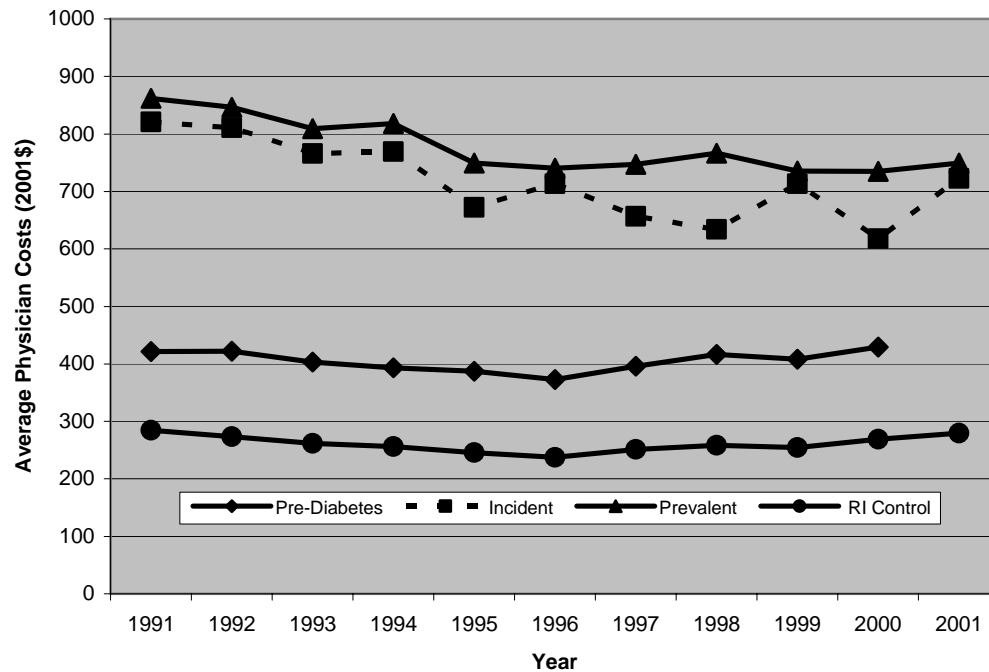


Figure 12b: Average Physician Costs (1991 to 2001) – General Population

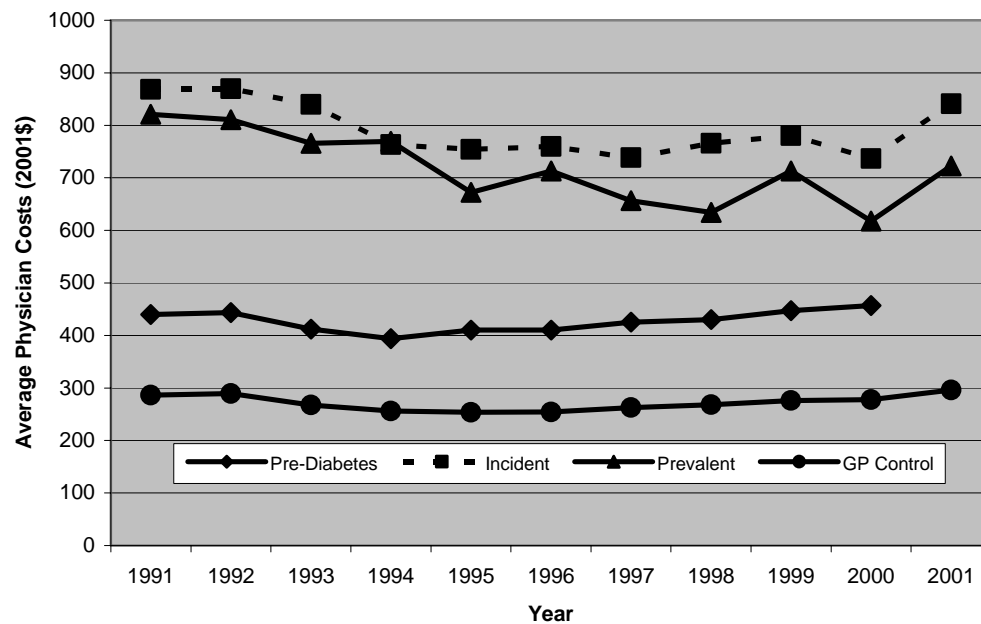


Figure 13: Crude Overall Cost Ratios for Physician Visits (1991 to 2001) – Registered Indian and General Populations Combined

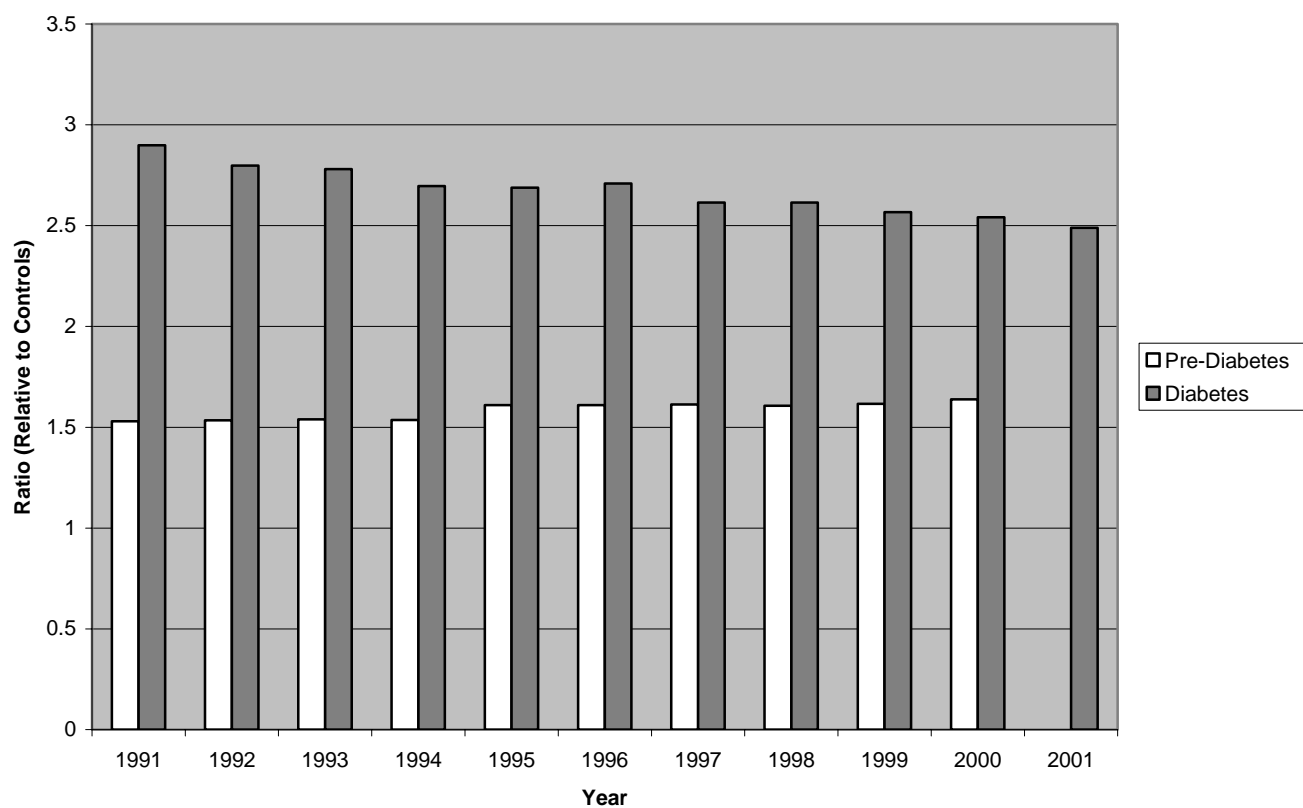


Figure 14: Average Number of Prescription Dispensations (1991 to 2001) – General Population

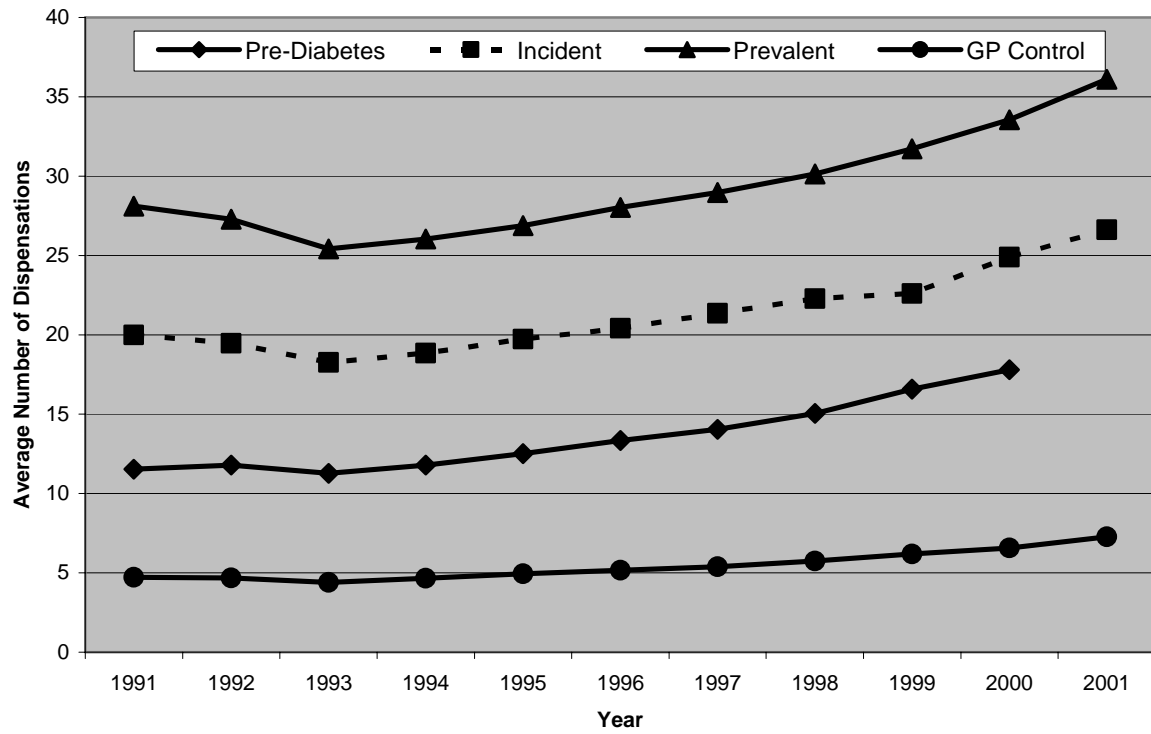


Figure 15: Crude Utilization Ratios for Prescription Dispensations (1991 to 2001) – General Population

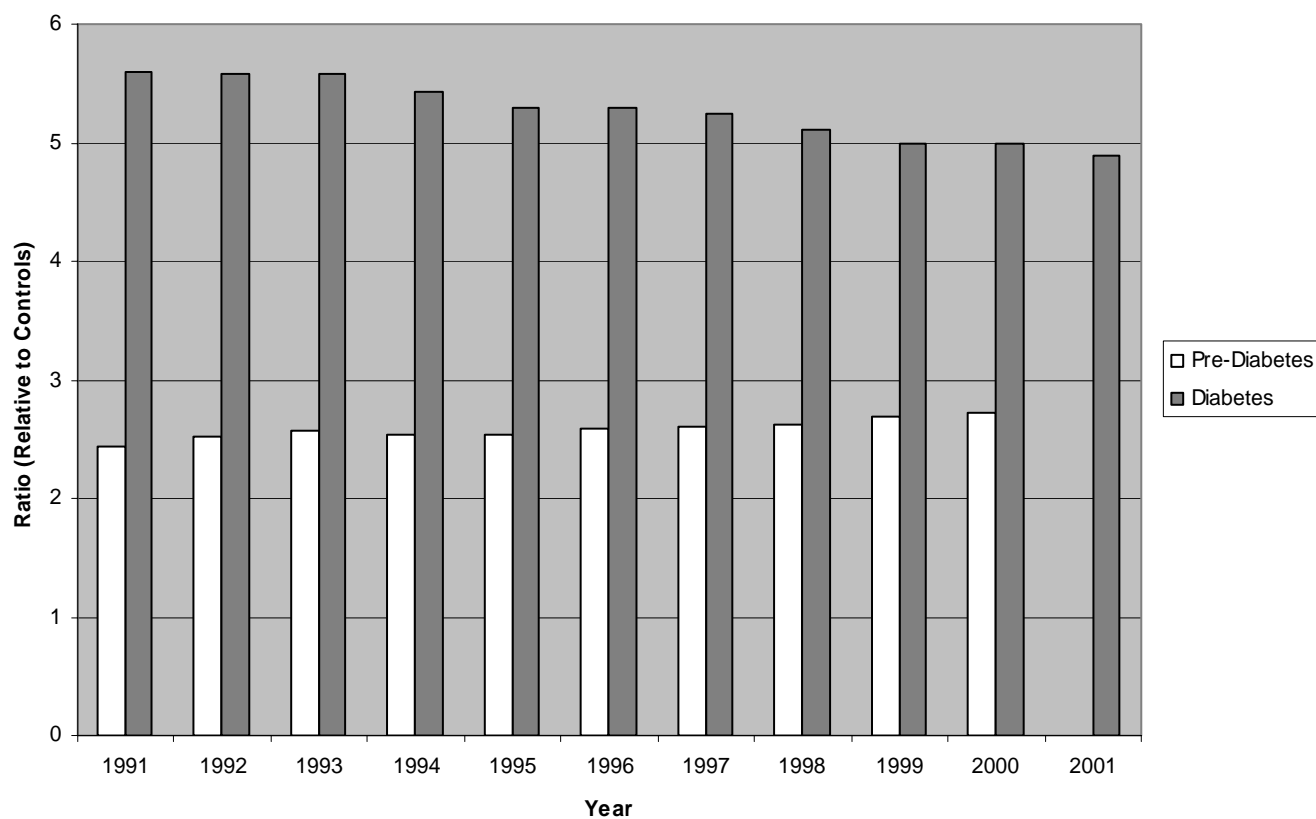


Figure 16: Average Prescription Costs (1991 to 2001) – General Population

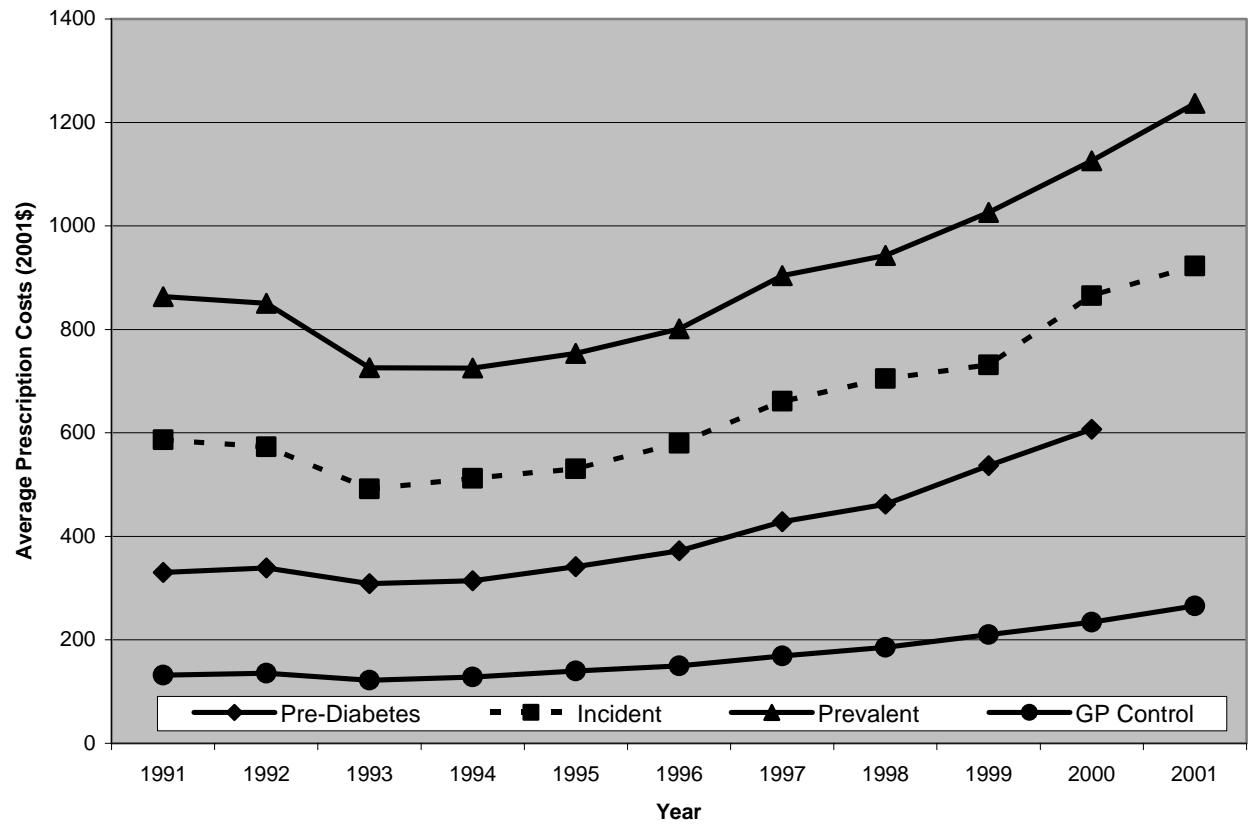


Figure 17: Crude Prescription Cost Ratios (1991 to 2001) – General Population

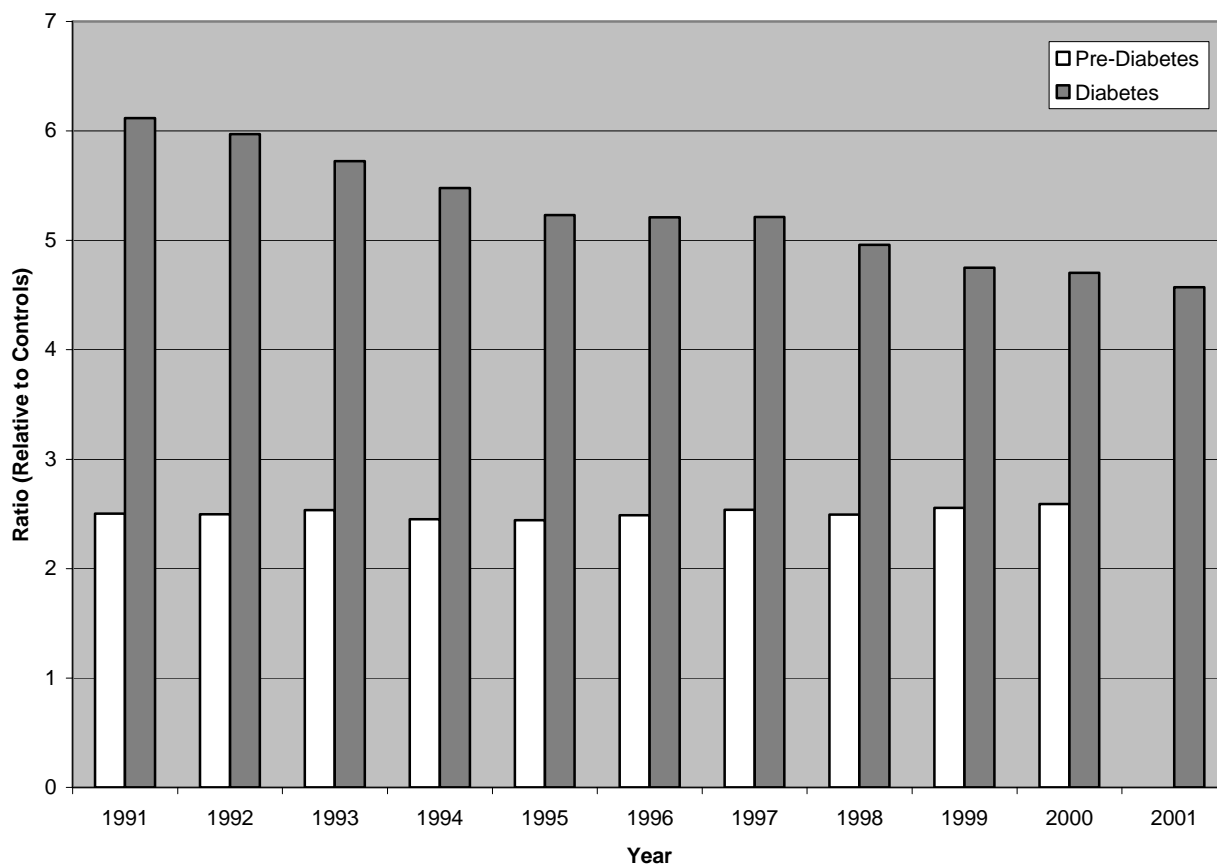


Figure 18a: Expenditures According to Prescription Category (2001) – Including Testing Supplies

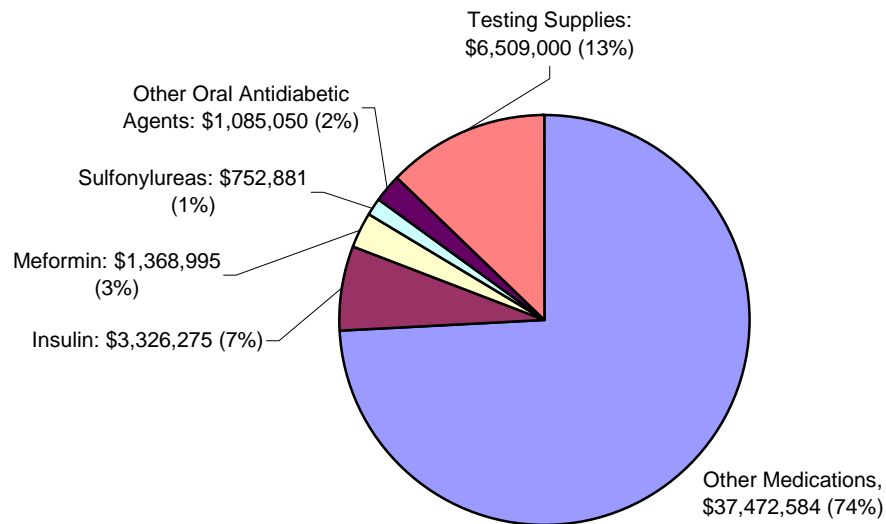


Figure 18b: Expenditures According to Prescription Category (2001) – Excluding Testing Supplies

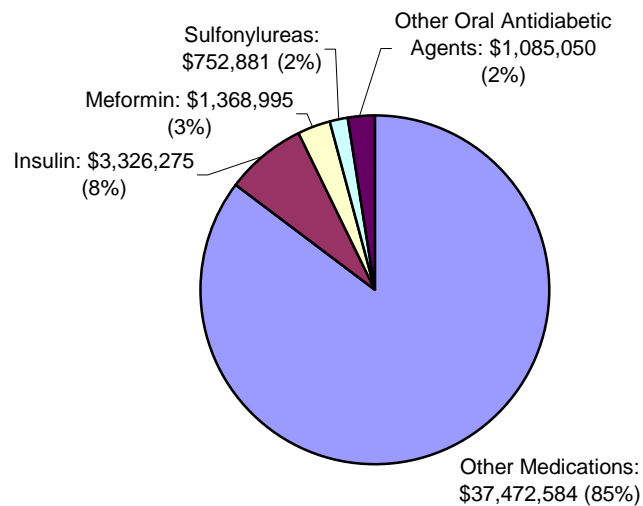


Figure 19a: Average Number of Hospitalizations (1991 to 2001) – Registered Indian Population

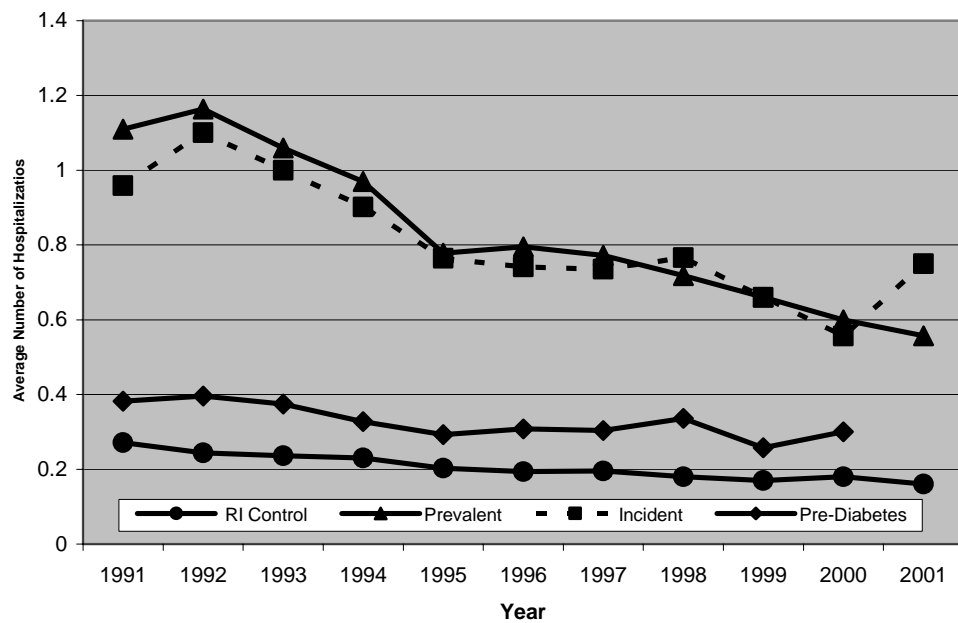


Figure 19b: Average Number of Hospitalizations (1991 to 2001) – General Population

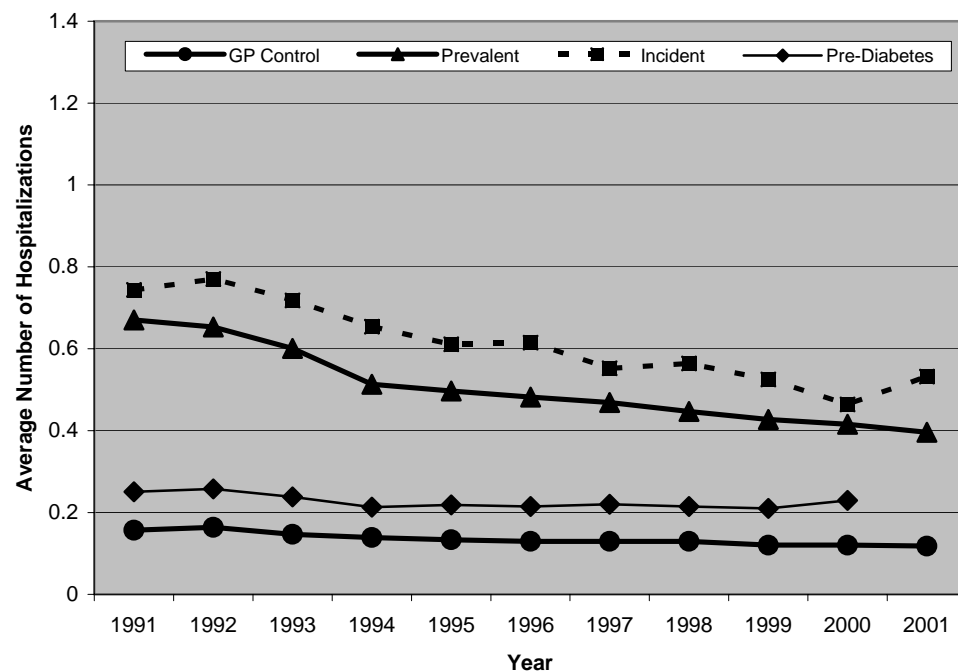


Figure 20: Crude Hospital Utilization Ratios (1991 – 2001) – Registered Indian and General Populations Combined

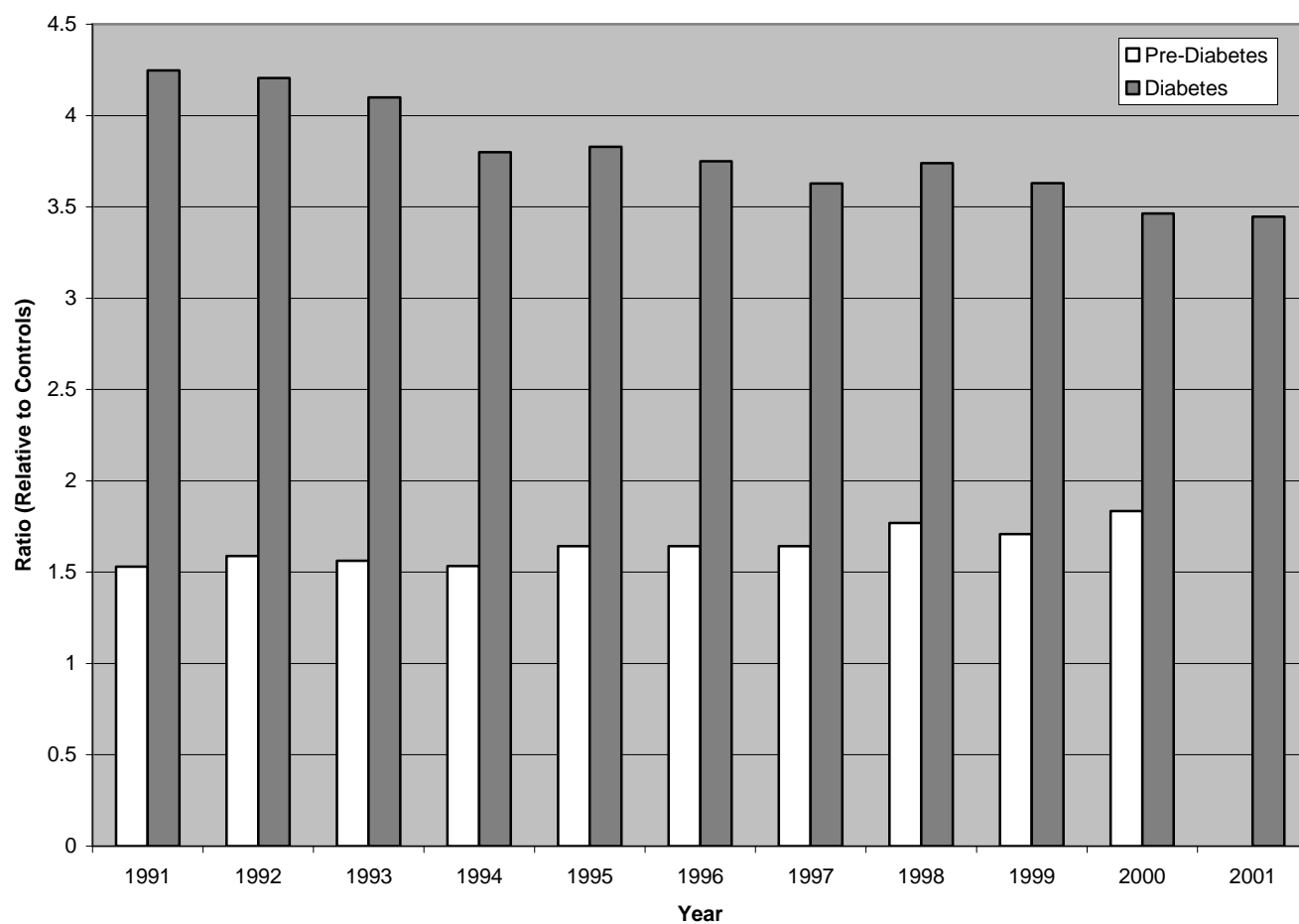


Figure 21a: Average Hospital Costs – Registered Indian Population

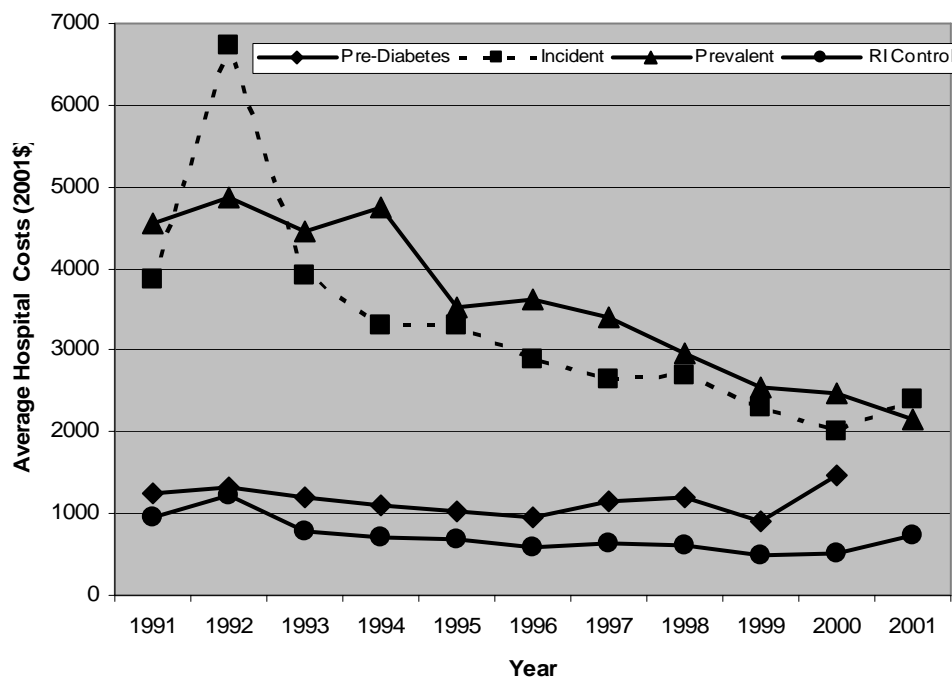


Figure 21b: Average Hospital Costs – General Population

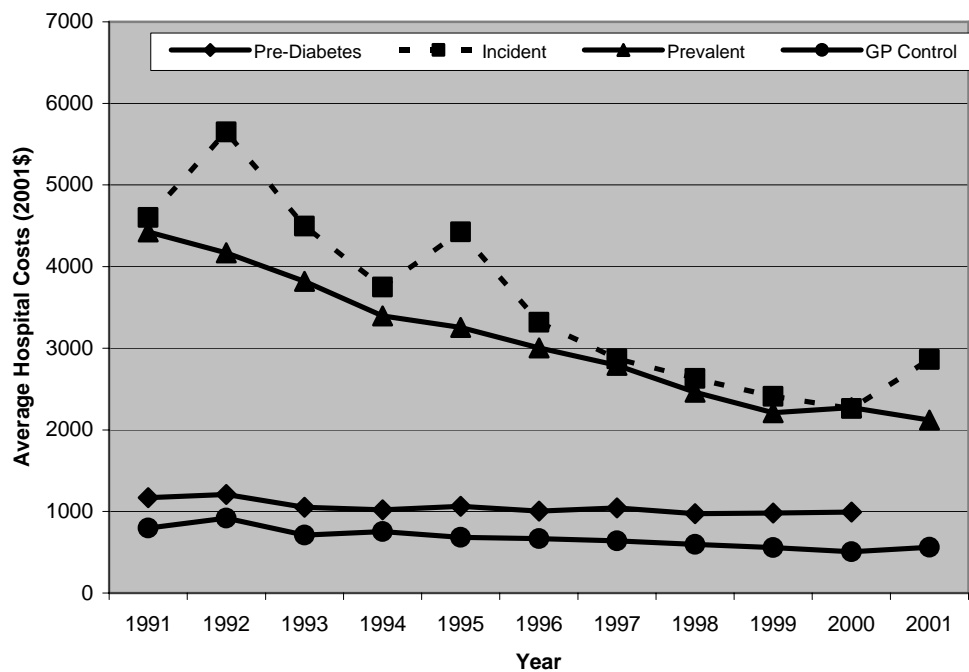


Figure 22: Crude Overall Hospital Cost Ratios (1991 to 2001) – Registered Indian and General Populations Combined

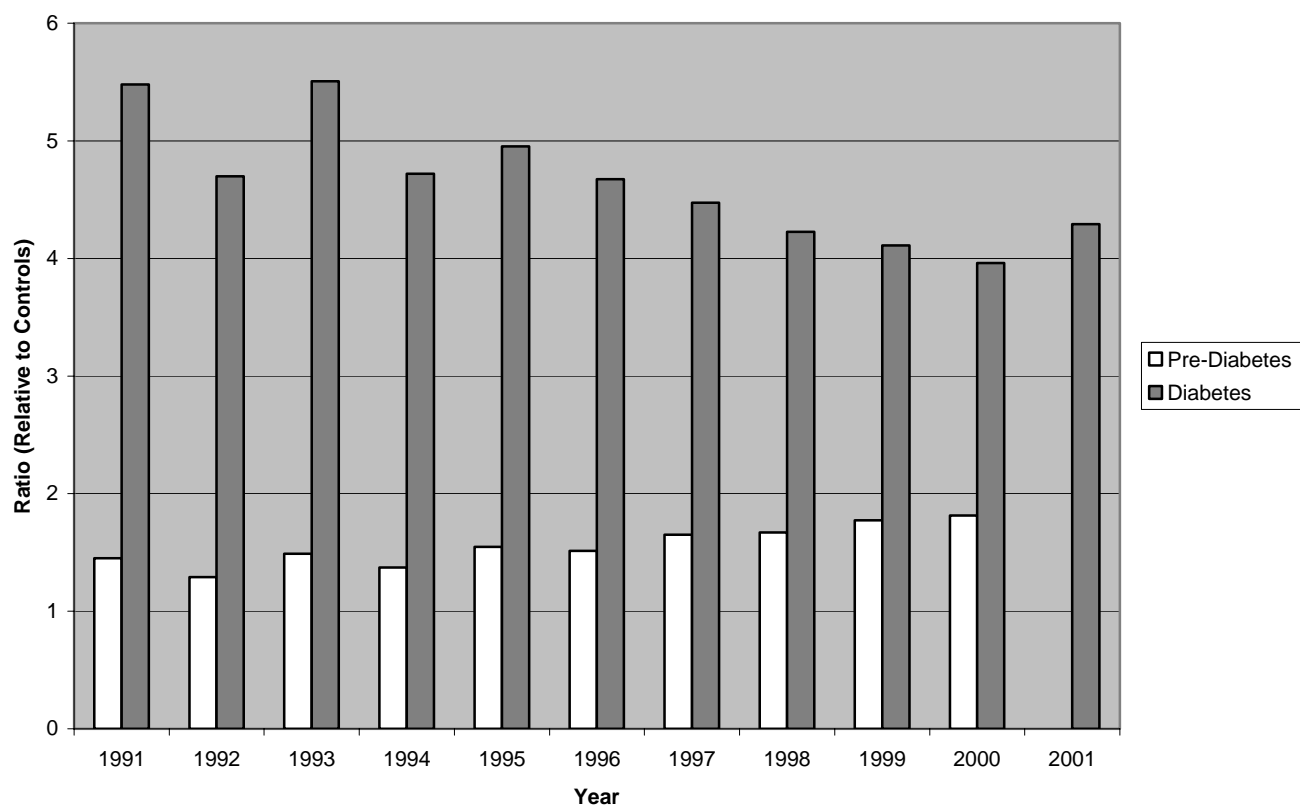


Figure 23a: Average Number of Day Surgeries (1991 to 2001) – Registered Indians

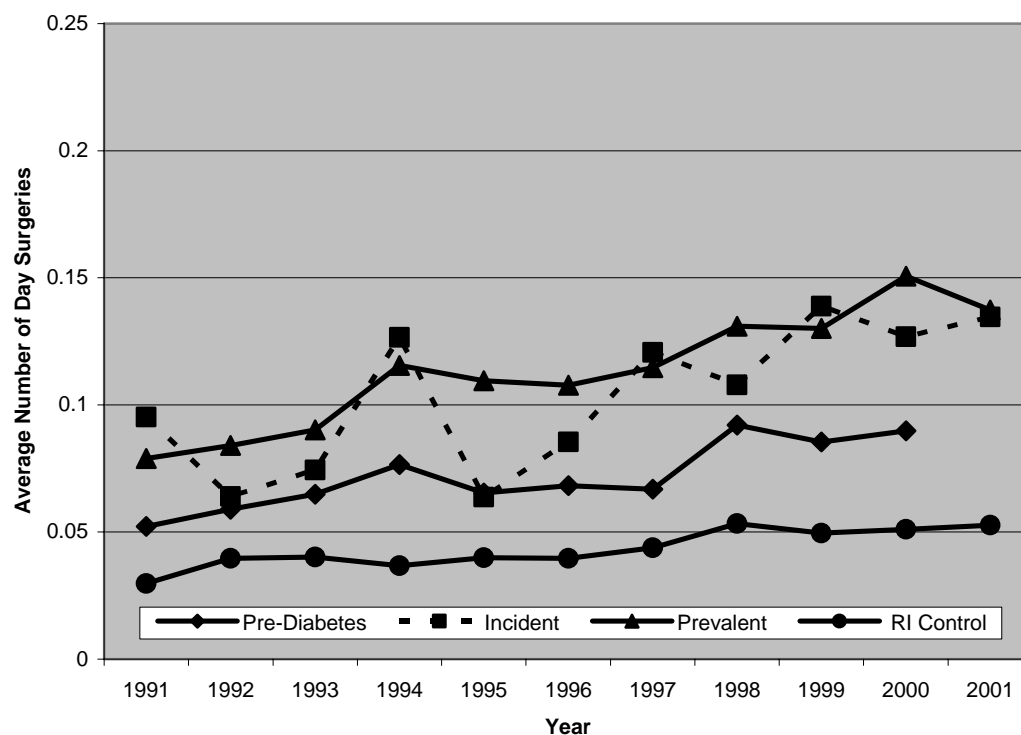


Figure 23b: Average Number of Day Surgeries (1991 to 2001) – General Population

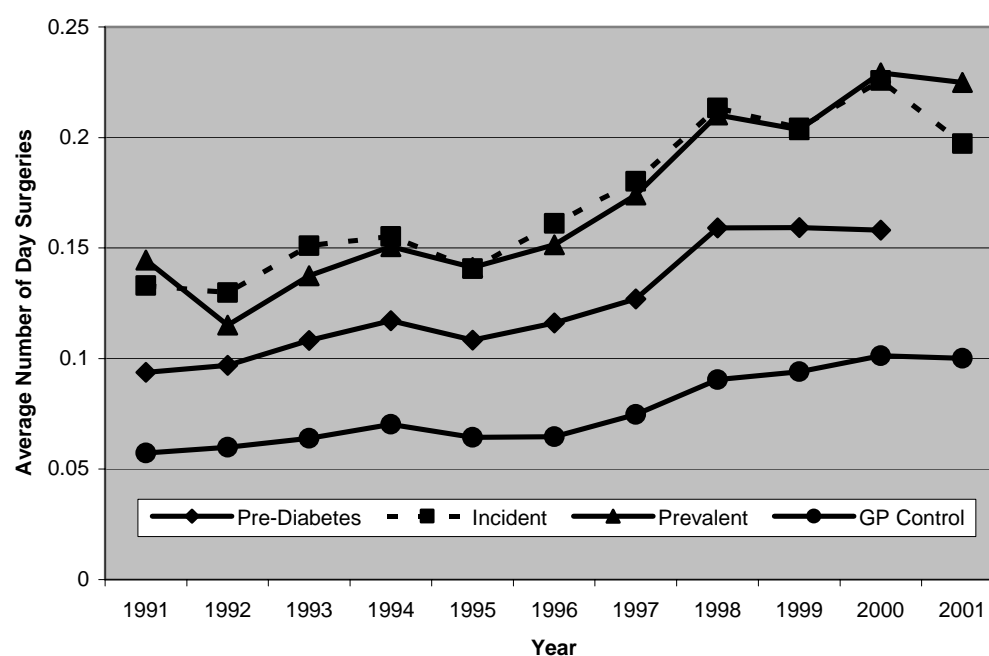


Figure 24: Crude Day Surgery Utilization Ratios (1991 to 2001) – Registered Indian and General Populations Combined

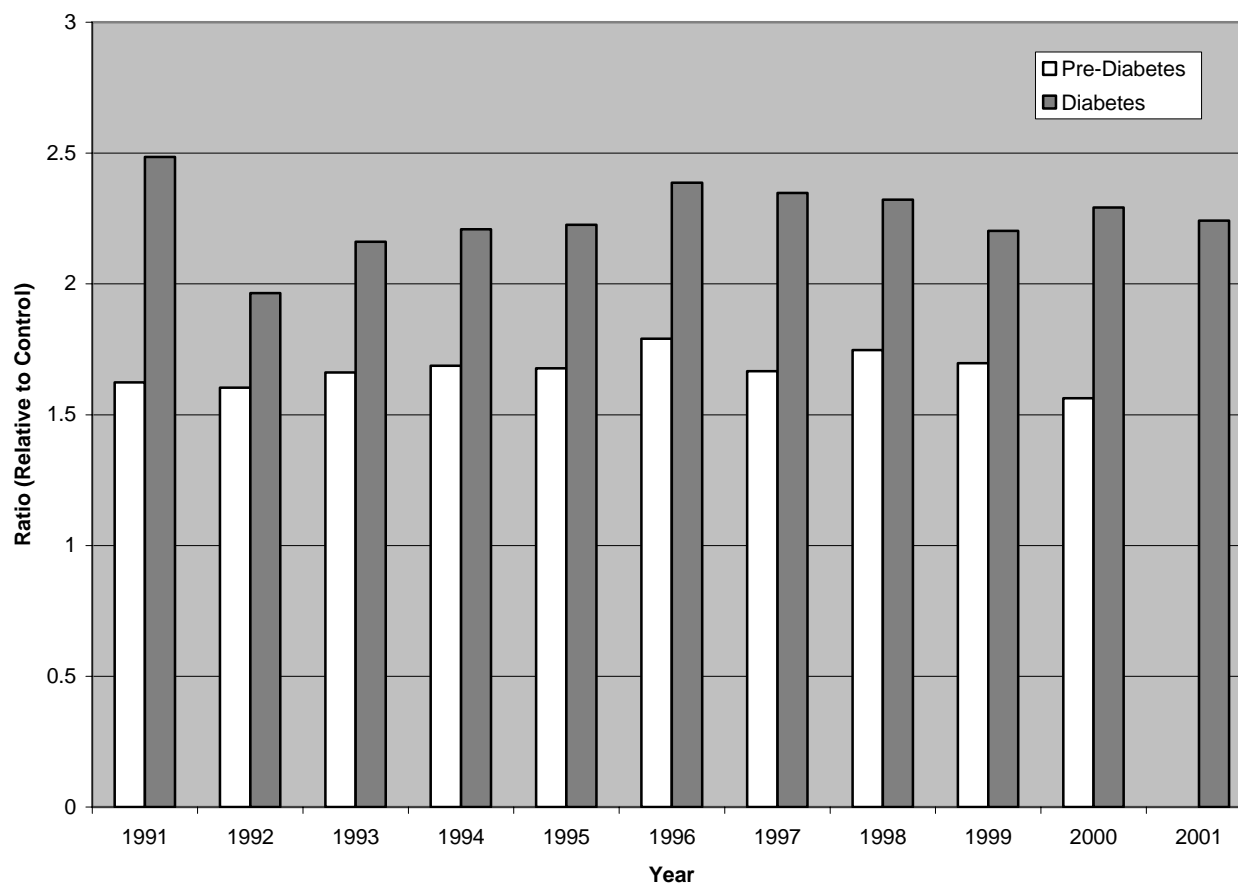


Figure 25a: Average Day Surgery Costs (1991 to 2001) – Registered Indian Population

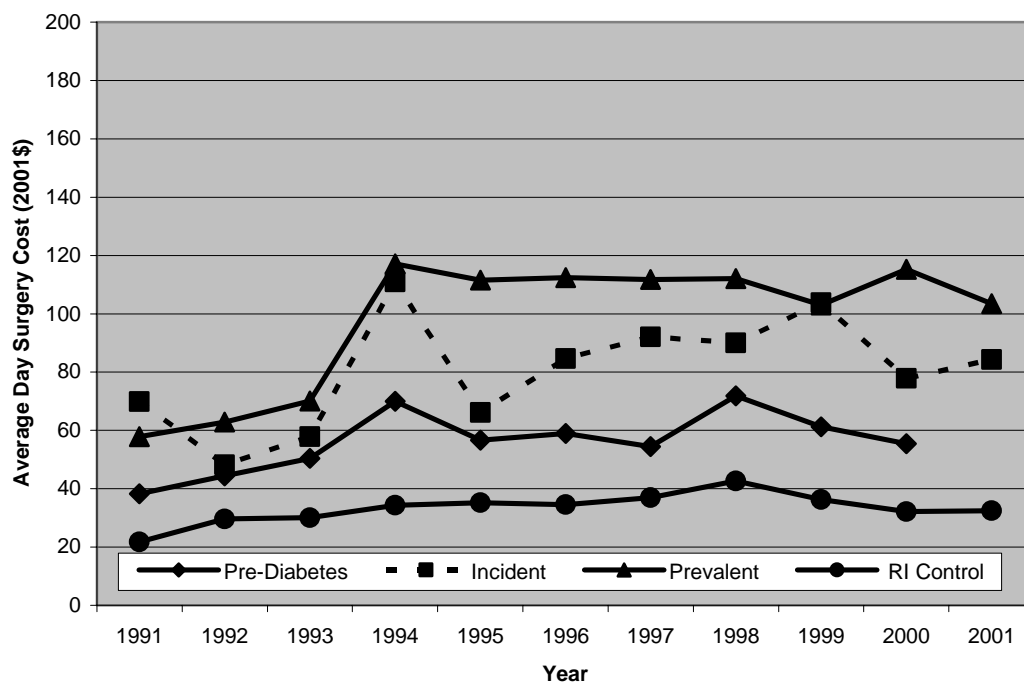


Figure 25b: Average Day Surgery Costs (1991 to 2001) – General Population

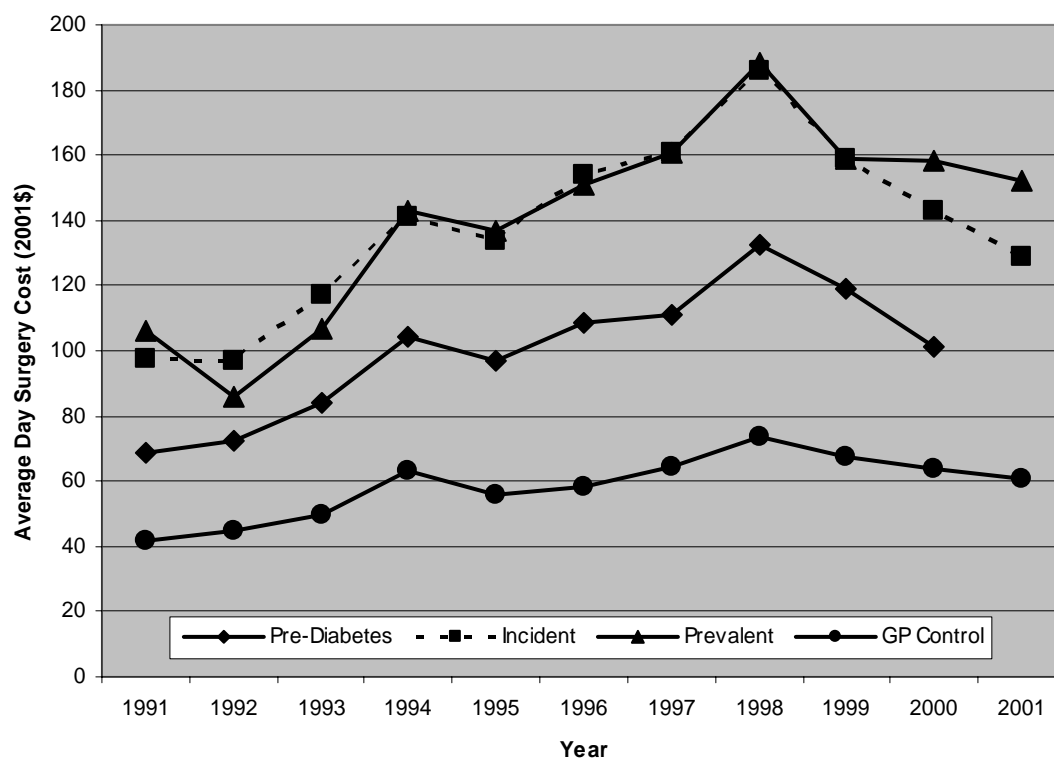


Figure 26: Crude Day Surgery Cost Ratios (1991 to 2001) – Registered Indian and General Populations Combined

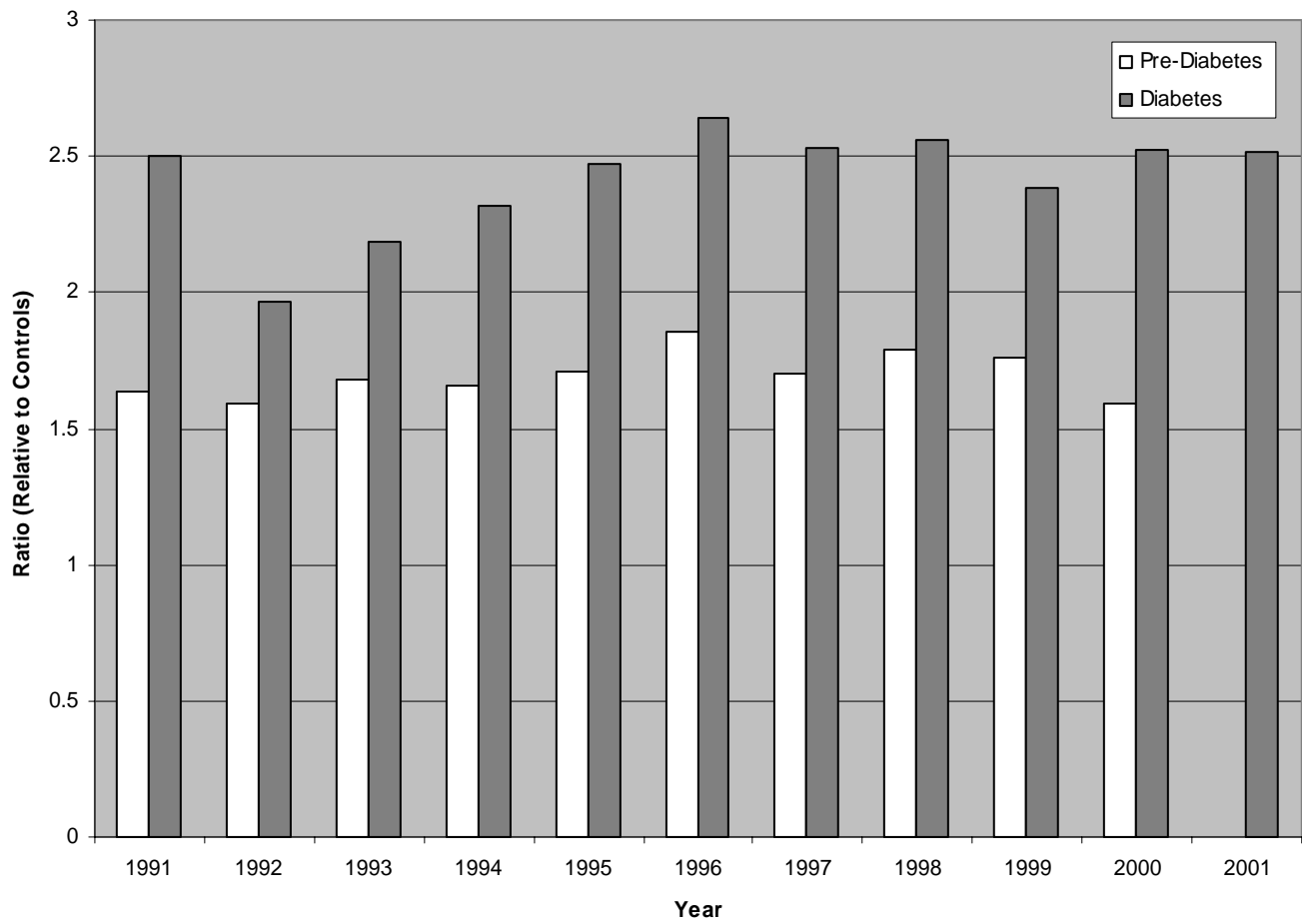


Figure 27: Average Duration of Peritoneal Dialysis or Hemodialysis for Individuals on Dialysis (1991 to 2001) – Registered Indian and General Populations Combined

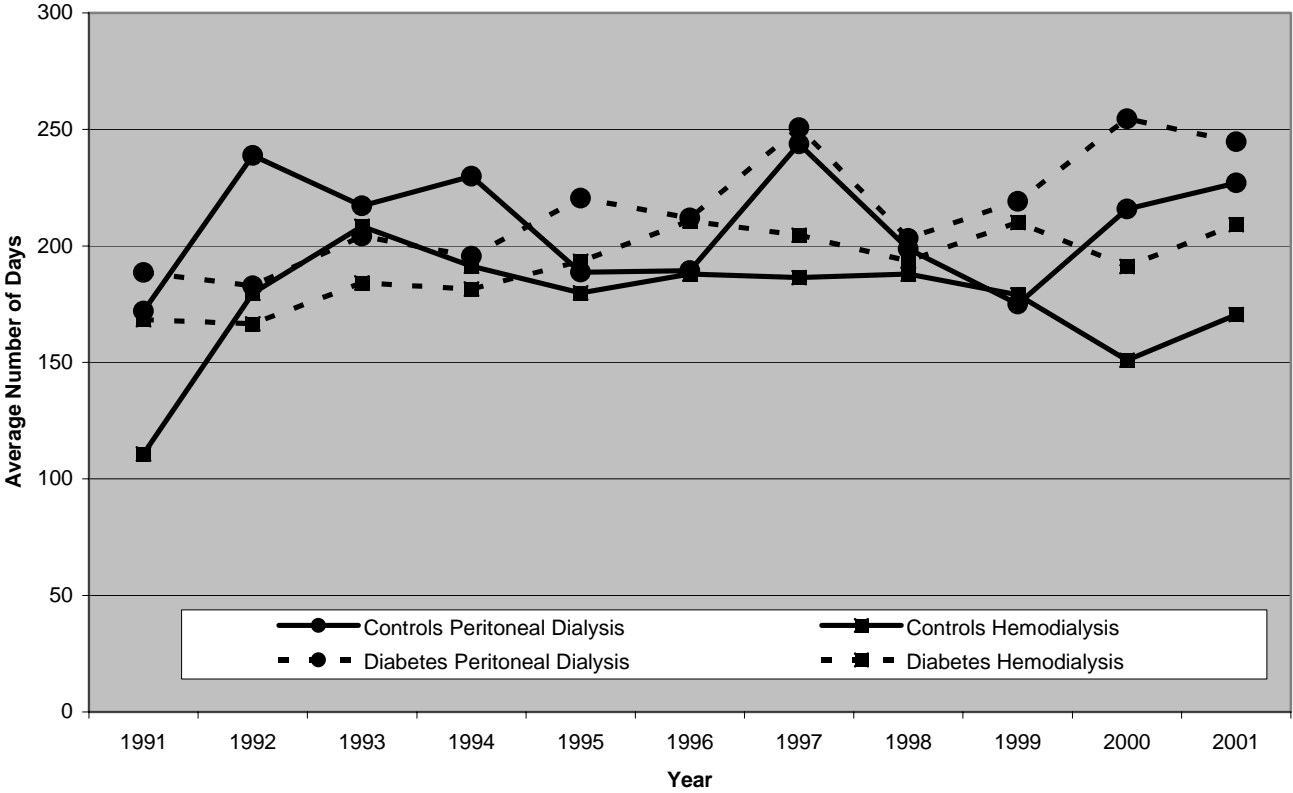


Figure 28a: Average Dialysis Costs (1991 to 2001) – Registered Indian Population

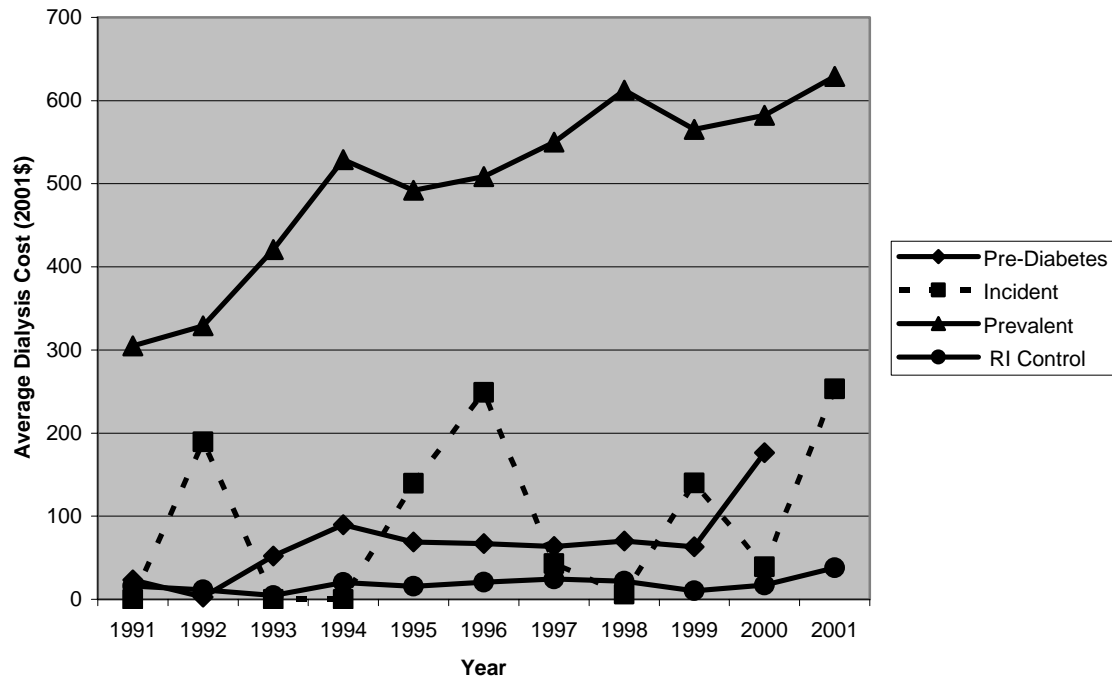


Figure 28b: Average Dialysis Costs (1991 to 2001) – General Population

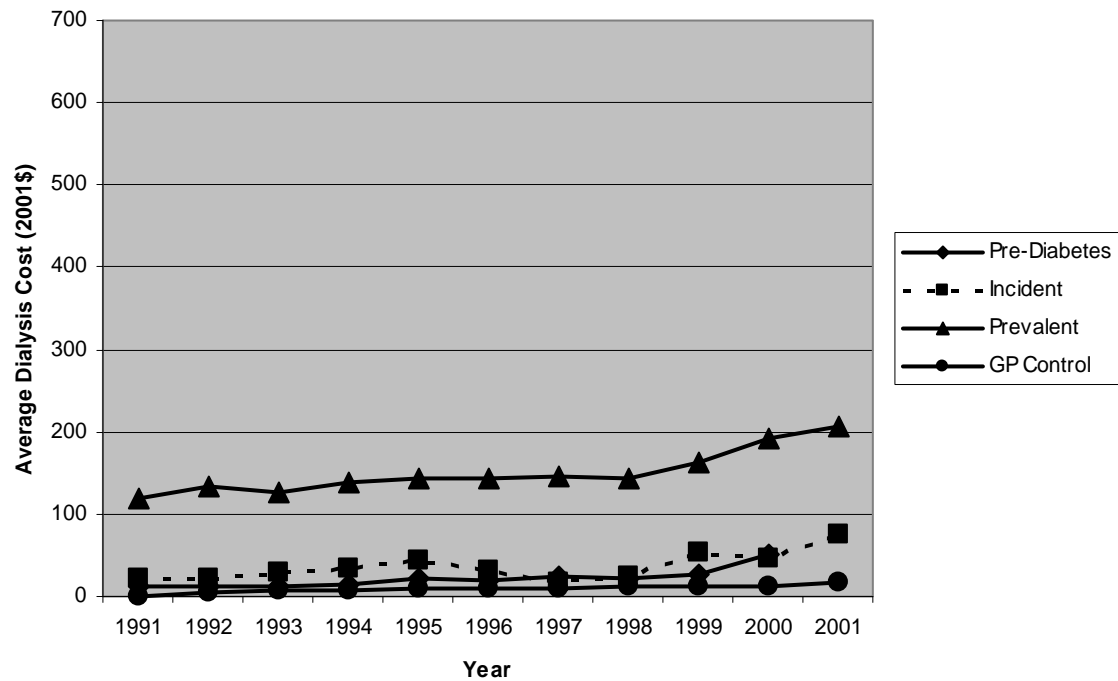


Figure 29: Crude Dialysis Cost Ratios (1991 to 2001) – Registered Indian and General Populations Combined

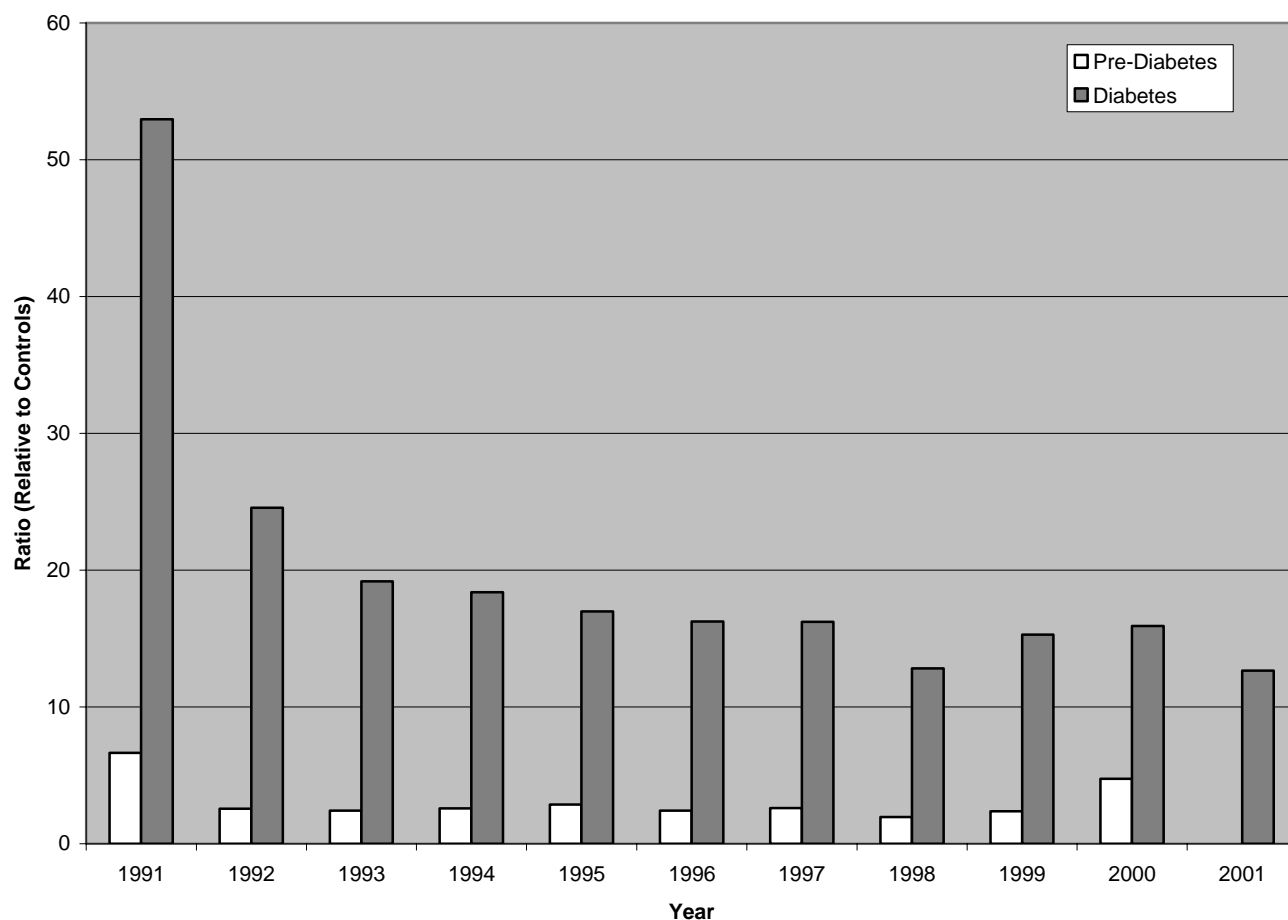


Figure 30: Average Dialysis Costs for Individuals on Dialysis (1991 to 2001) – Registered Indian and General Populations Combined

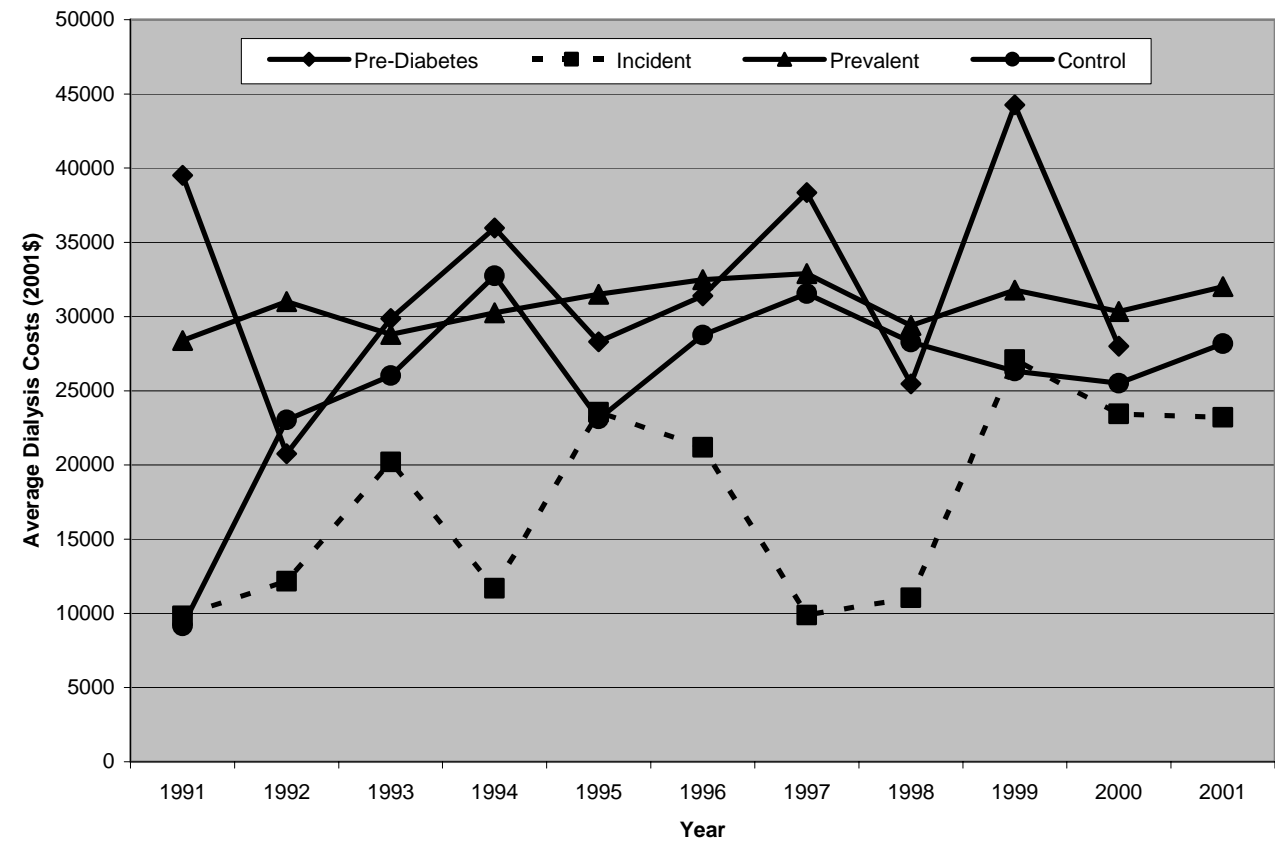


Figure 31: Average Total Health Care Costs (Excluding Prescriptions 1991 to 2001) – Registered Indian and General Population Combined

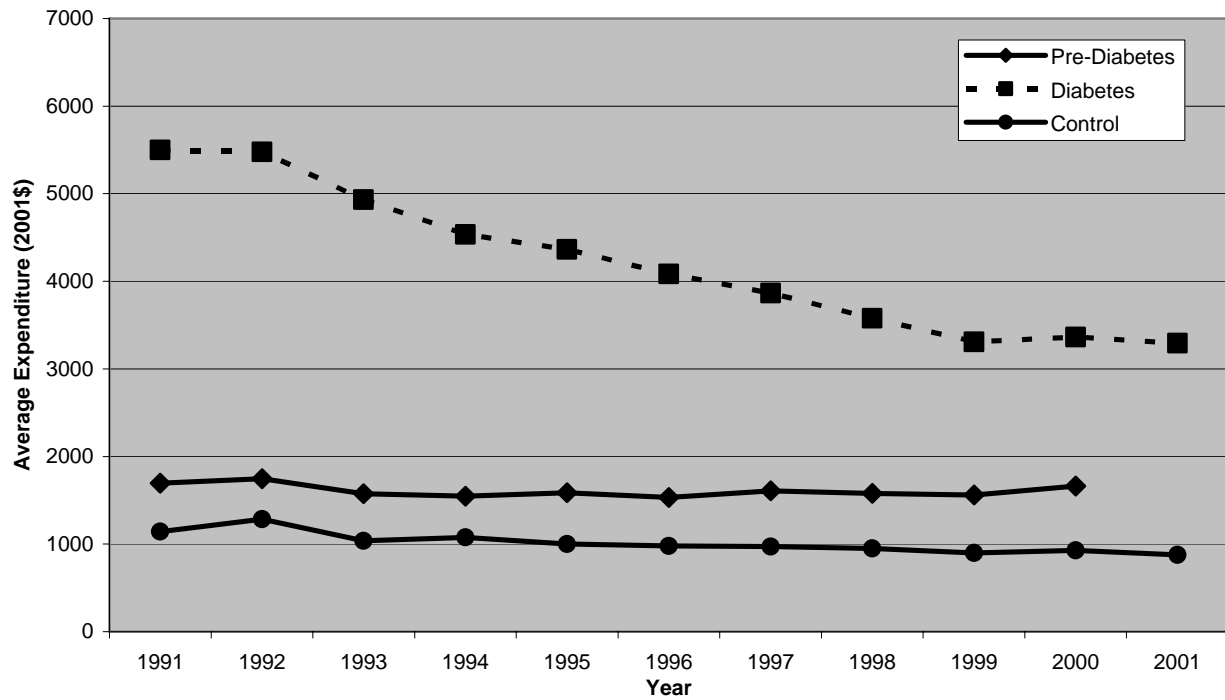


Figure 32a: Crude Total Cost Ratios (Excluding Prescriptions 1991 to 2001) – Registered Indian and General Populations Combined

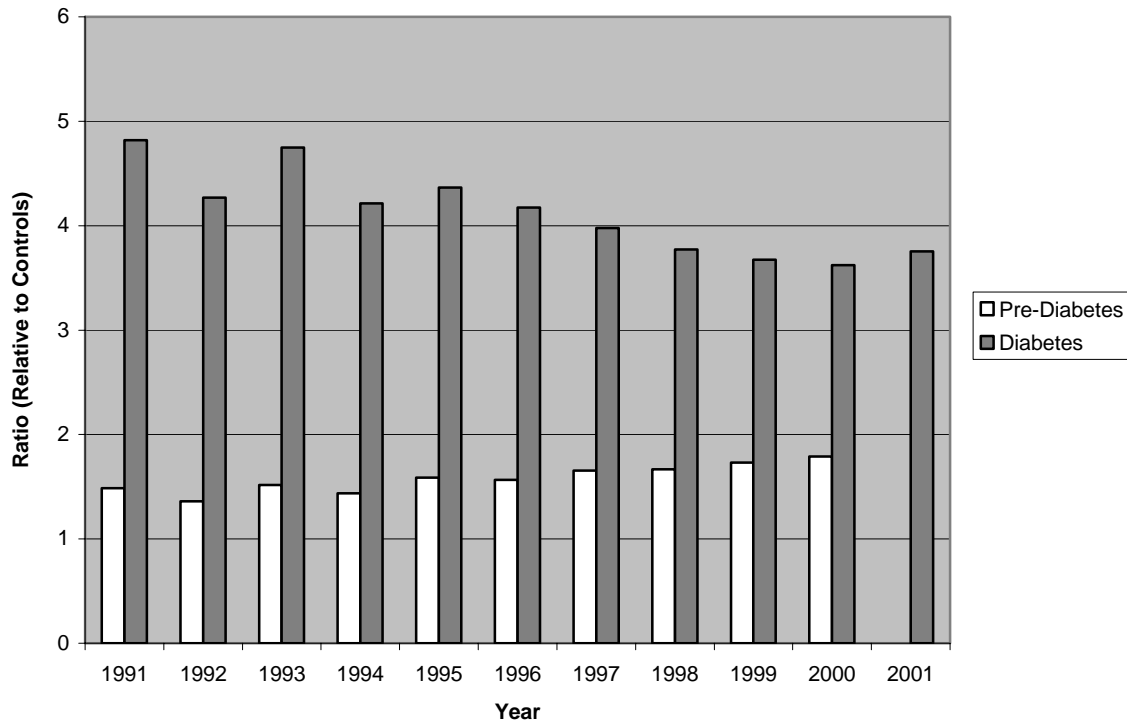


Figure 32b: Age-Standardized Total Cost Ratios (Excluding Prescriptions 1991 to 2001) – Registered Indian and General Populations Combined

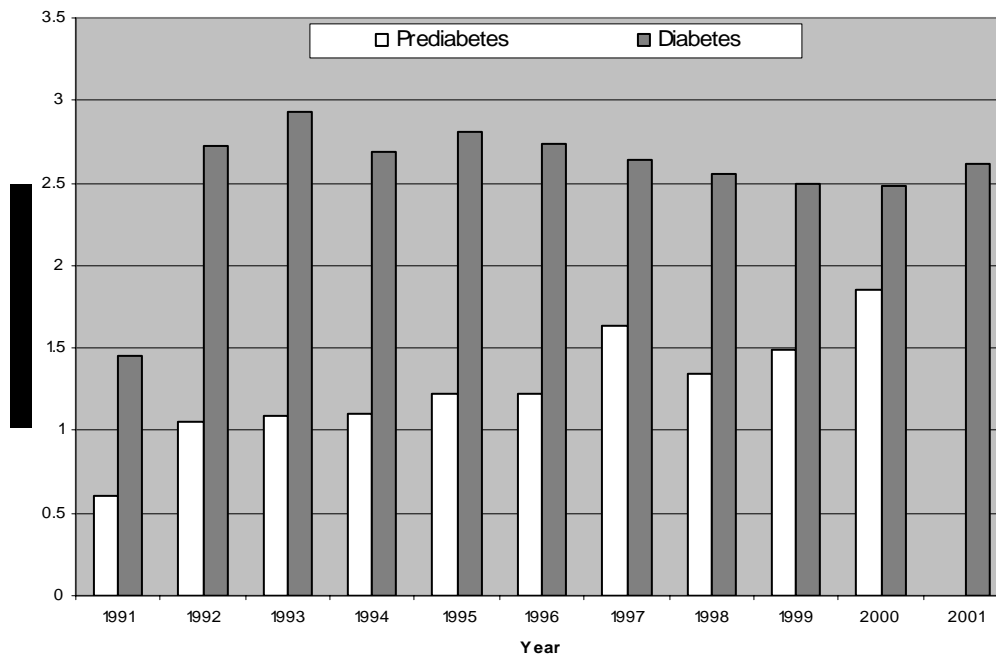


Figure 33a: Average Crude Total Health Care Costs (Excluding Prescriptions 1991 to 2001) – Registered Indian Population

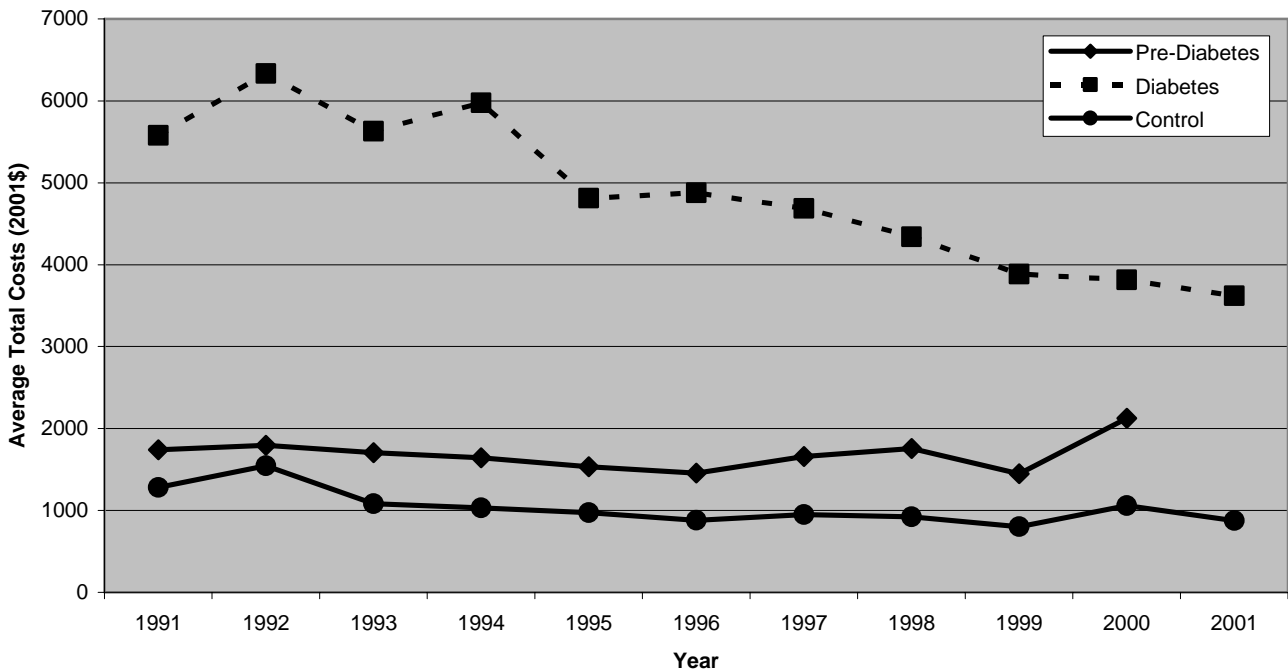


Figure 33b: Average Crude Total Health Care Costs (Excluding Prescriptions 1991 to 2001) – General Population

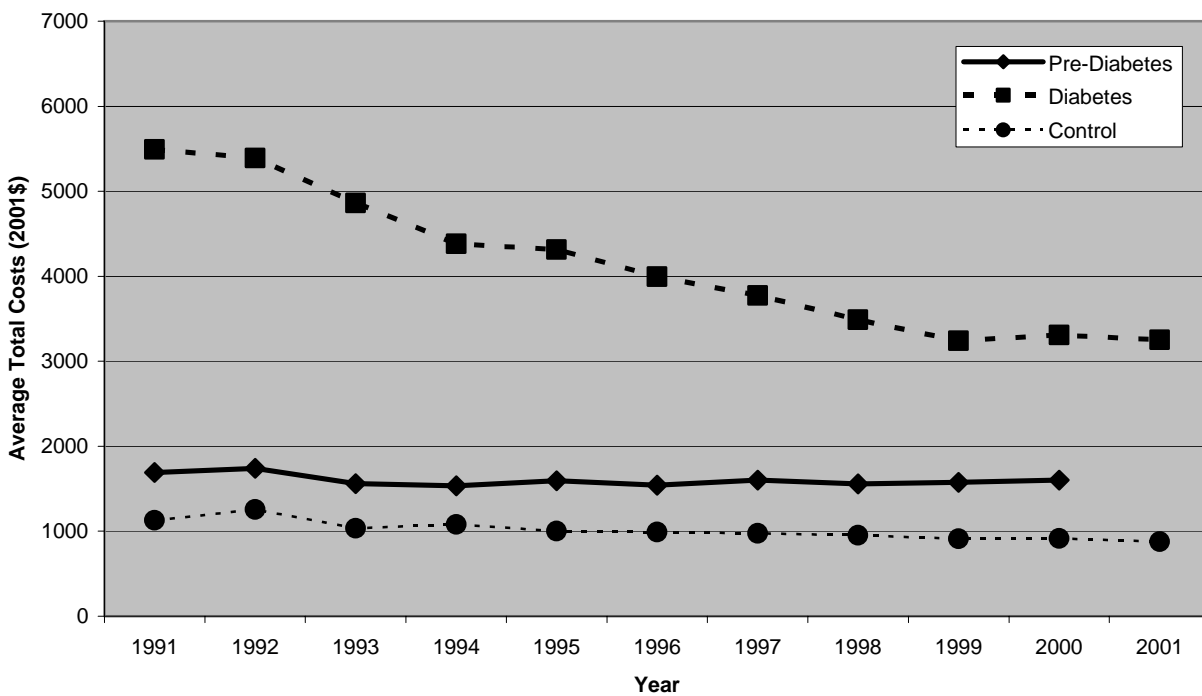


Figure 34: Crude and Age-Standardized Total Costs (Excluding Prescriptions 1991 to 2001) – Registered Indians Relative to the General Population

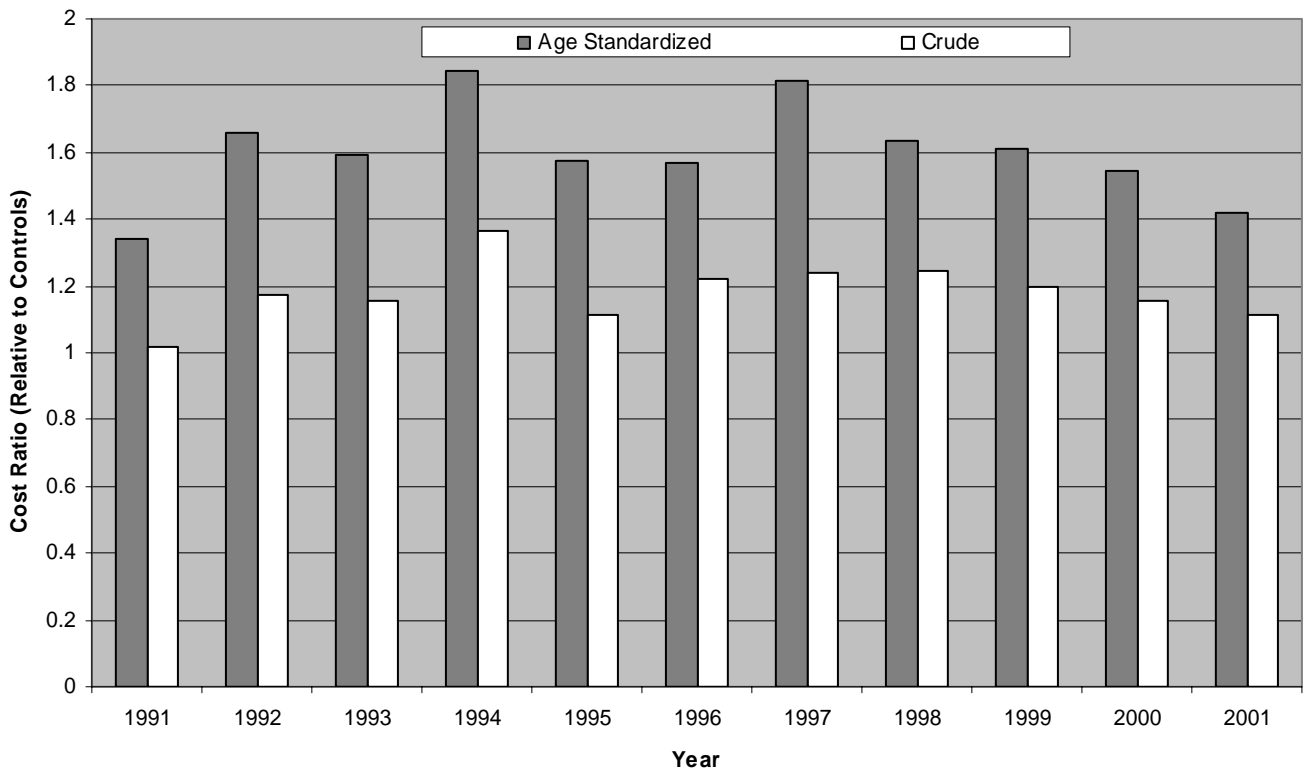


Figure 35: Age-Specific Costs (2001) – General Population versus Registered Indians

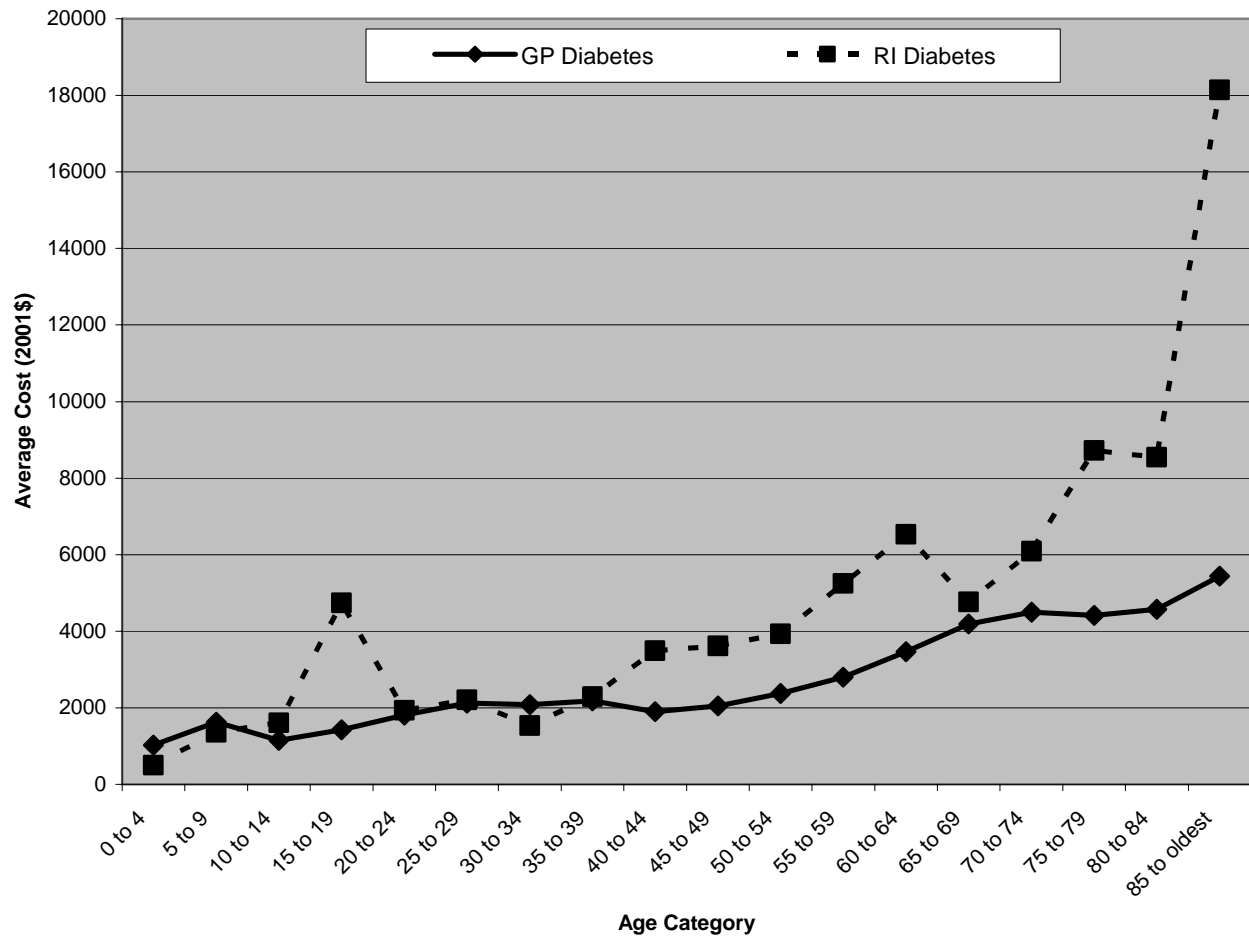


Figure 36a: Total Health Care Expenditures for the General Population with Diabetes, 1991

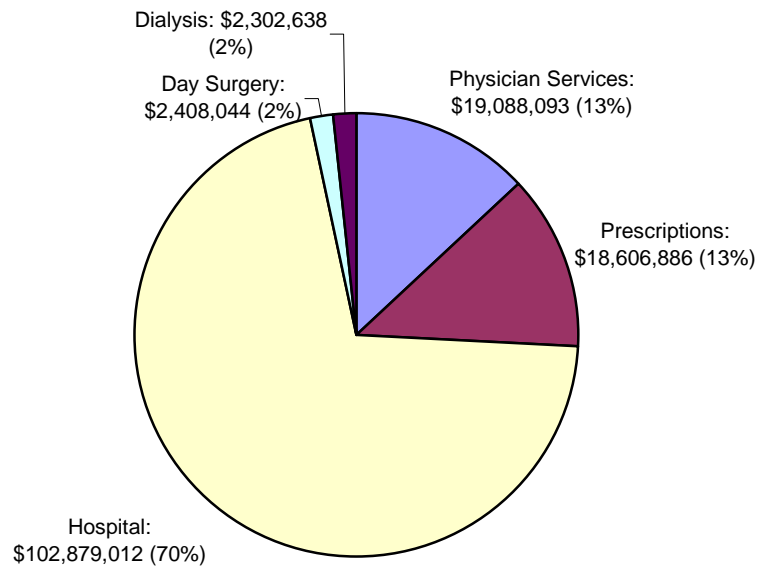


Figure 36b: Total Health Care Expenditures for the General Population with Diabetes, 2001

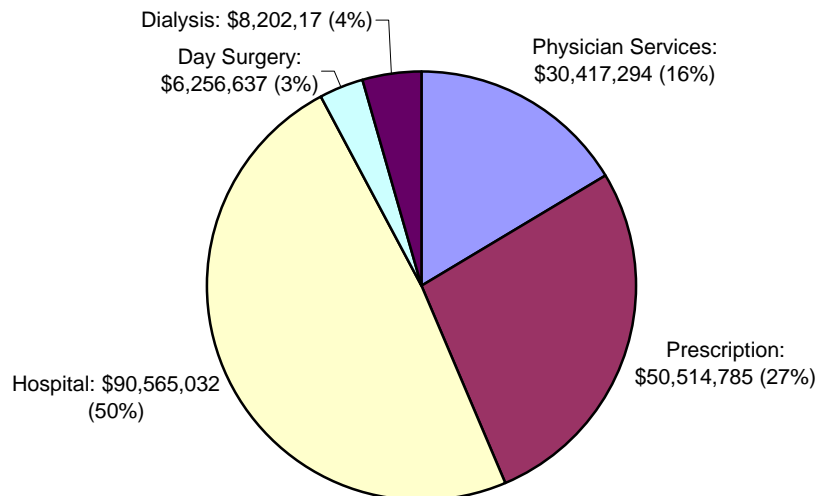


Figure 37: Total Costs (Including Prescriptions 1991 to 2001) – General Population

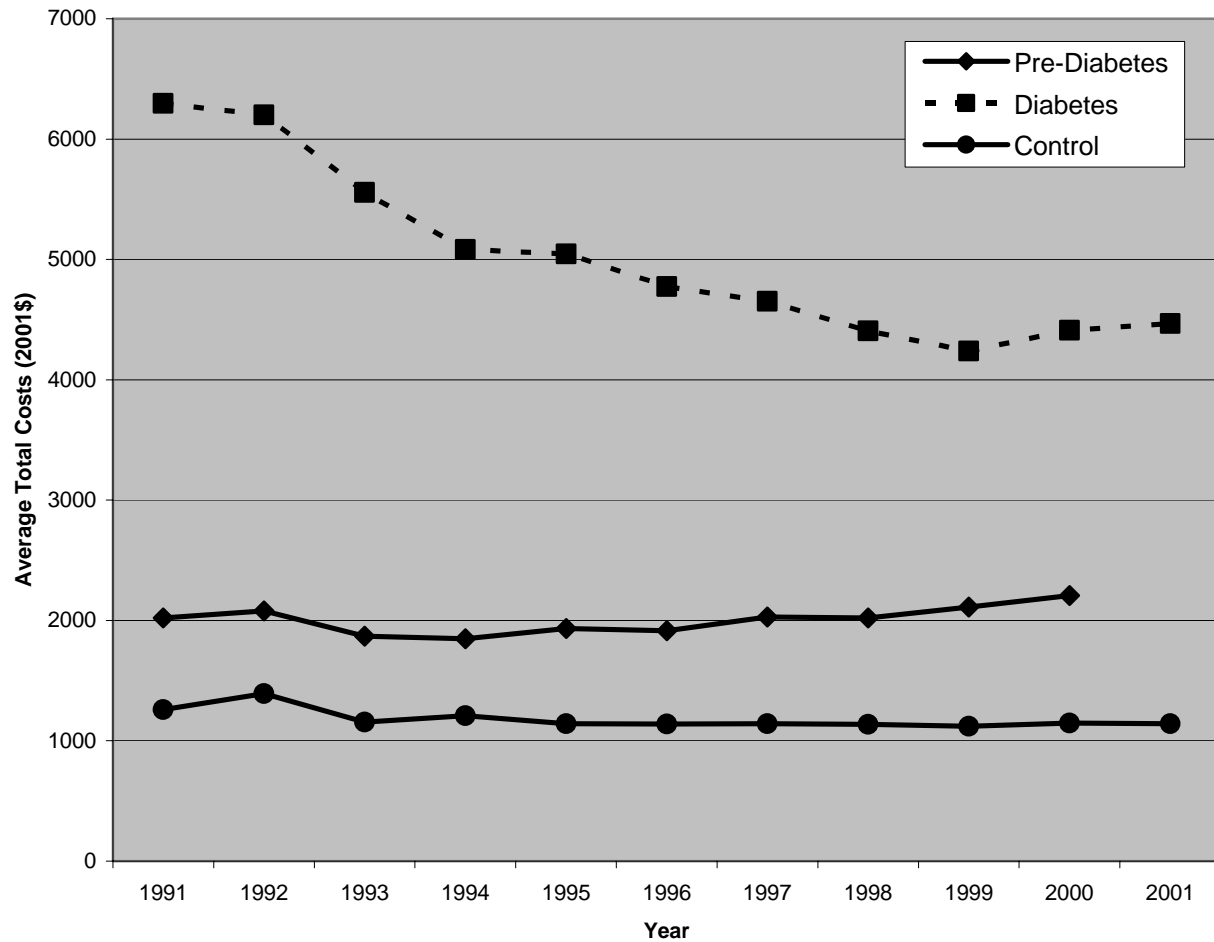


Figure 38a: Crude Total Cost Ratios (Including Prescriptions 1991 to 2001) – General Population

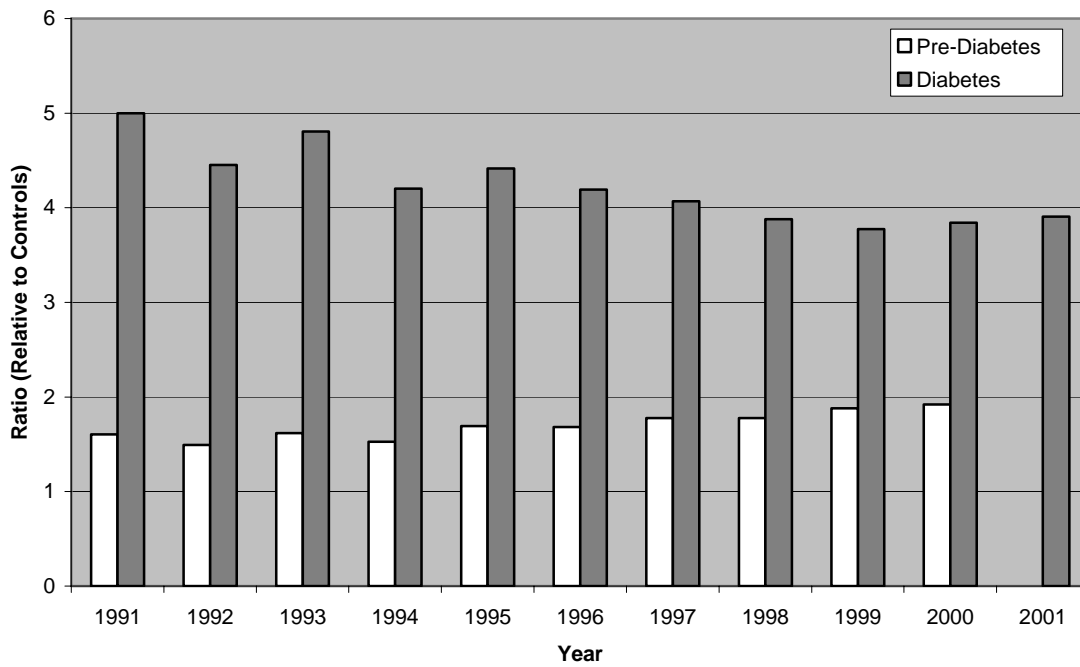
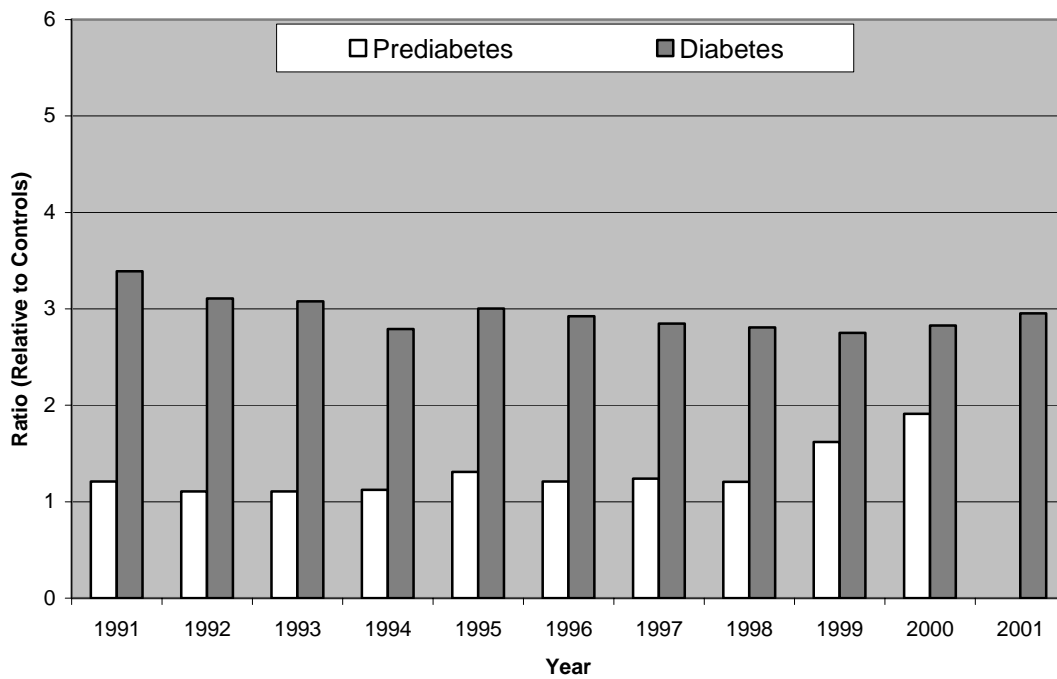


Figure 38b: Age-Standardized Total Cost Ratios (Including Prescriptions 1991 to 2001) for the General Population



APPENDIX A:
SASKATCHEWAN HEALTH DATA DICTIONARIES

Subject File : RSCHSUBJ.ASC (192,237 records)

Variable	Description	Position	Length	Type
STUDYID	study identification number	1	7	categorical
CASEID	case identification number for cases CASEID=STUDYID for controls CASEID=matching case's STUDYID	8	7	categorical
DIABCASE	diabetes case control indicator 0 = diabetes case 1 = control 1 2 = control 2	15	1	categorical
SEX	sex 1 = male 2 = female	16	1	categorical
YOB	year of birth	17	4	continuous
INDEX	index date Reported as a perpetual date.	21	5	continuous
SOURCE	data source of index diabetes event 0 = control 1 = hospital services file 2 = physician services file	26	1	categorical
ENROL	study enrolment date Reported as a perpetual date.	27	5	continuous
EXIT	study exit date Reported as a perpetual date.	32	5	continuous
COVEXIT	coverage at exit date 00 = active coverage 01 = deceased 02 = inactive coverage	37	2	categorical
REGIND	registered Indian status N = never registered Y = ever registered	39	1	categorical
PREVFLAG	prevalent diabetes flag 0 = subject did not meet diabetes definition in 1989 or 1990 1 = subject met diabetes definition in 1989 or 1990	40	1	categorical
URB_RUR	urban rural indicator 0 = large urban centre 1 = small urban centre 3 = rural 4 = unknown	41	1	categorical

RHA1	regional health authority 1 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	42	2	categorical
RHA1P	proportion of subject's RM allocated to RHA1	44	4.2 explicit two-place decimal	continuous
RHA2	regional health authority 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	48	2	categorical
RHA2P	proportion of subject's RM allocated to RHA2	50	4.2 explicit two-place decimal	continuous
RHA3	regional health authority 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	54	2	categorical
RHA3P	proportion of subject's RM allocated to RHA3	56	4.2 explicit two-place decimal	continuous

Notes:

1. The study identification number is unique to an individual.
2. Case identification number: for diabetes cases the CASEID is the same as the STUDYID and for controls the CASEID identifies to which case the control is matched.
3. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.
4. The year of birth for subjects born before 1906 is set to 1906.
5. The index date of diabetes case subjects is the earliest date between January 1, 1991 and December 31, 2001 that an individual meets the diabetes definition criteria. This date is set to 0 for controls.
6. The enrol date is the later of January 1, 1989 or actual coverage initiation.
7. Exit date is the earliest of death, coverage termination, or study end (December 31, 2001).
8. For subjects where the COVEXIT variable is reported as 01, study exit is due to death and the exit date is the date of death as reported on the person registry system. If COVEXIT is 1A, study exit is due to coverage termination; the most likely reason for coverage termination is leaving the province.
9. Registered Indians are not eligible for Saskatchewan prescription drug benefits because they receive these benefits from the federal government.
10. Urban rural indicator: large urban centres with populations of 100,000 or larger include Saskatoon and Regina; small urban centres with populations between 5,000 and 99,999 include Estevan, Humboldt, Lloydminster, Meadow Lake, Melfort, Moose Jaw, Nipawin, North Battleford, Prince Albert, Swift Current, Weyburn, and Yorkton.
11. A rural municipality (RM) may be cross more than one regional health authority (RHA). In these cases, a proportion of each RM's population is assigned to each of the RHAs it crosses. If a subject's RM crosses more than one RHA, each RHA and its assigned proportion is reported. No RM is split among more than three RHAs.

Hospital Services File : RSCHHOSP.ASC (632,253 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
ADMT_DT	admission date Reported as a perpetual date.	8	5	continuous
DISC_DT	discharge date Reported as a perpetual date.	13	5	continuous
DAYSSTAY	length of stay in days	18	4	continuous
DCTYPE	discharge type A = alive D = deceased O = other	22	1	categorical
DAY_SX	day surgery flag 0 = inpatient stay 1 = day surgery record	23	1	categorical
HOSPTYPE	type of hospital B = base C = community R = regional U = out of province	24	1	categorical
DX1	diagnosis one	25	5	categorical
DX1TYPE	diagnosis one type M = most responsible	30	1	categorical
DX2	diagnosis two	31	5	categorical
DXTYPE	diagnosis two type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	36	1	categorical
DX3	diagnosis three	37	5	categorical
DX3TYPE	diagnosis three type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	42	1	categorical
DX4	diagnosis four	43	5	categorical

DX4TYPE	diagnosis four type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	48	1	categorical
DX5	diagnosis five	49	5	categorical
DX5TYPE	diagnosis five type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	54	1	categorical
RIW	resource intensity weight	55	10.4 (implicit 4-place decimal)	continuous

Notes:

1. The perpetual date is based on a calendar with Day 1 = January 1, 1960.
SAS uses a perpetual calendar with Day 0 = January 1, 1960.

2. Diagnoses are reported using ICD-9 codes 001 through 999.9 and V01 through V99.9 up to four digits, as specified in Table 1: Diagnoses of interest.

3. Diagnosis type: Prior to April 1, 1999 diagnoses were labelled primary, secondary, and other and are reported in that order on this file. Beginning April 1, 1999 each diagnosis was also assigned a type and the most responsible is always reported first but the other diagnoses are not reported in a hierarchical order. For these other diagnoses, the associated diagnosis type may be used to assess the relevance of the other diagnoses.

Most responsible: the one diagnosis which describes the most significant condition of the patient during hospitalization.

Pre-admit comorbidity: the diagnosis which has a significant influence on the patient hospitalization; sometimes described as primary.

Post-admit comorbidity: the diagnosis which describes a condition arising during the patient hospitalization; sometimes described as complication.

Secondary: the diagnosis which did not significantly contribute to the patient hospitalization.

4. The day surgery flag differentiates inpatient stays from day surgery admissions. The working definitions for day surgery have changed over time:

The first definition came into effect around 1989 and is a patient:

- who is not admitted as an inpatient to an inpatient bed, and
- undergoes an elective surgical, diagnostic or treatment procedure, and
- who is released on the same day, and
- who meets the criteria for category (1) or (2) day surgery patients.

A category (1) day surgery patient requires:

- a pre-admission work-up (history and physical exam), and
- a general anaesthetic or regional block, and
- post-operative observation in a recovery room or distinct observation unit with dedicated registered nursing care.

Examples of category (1) procedures include: dilation and curettage, arthroscopy, partial osteotomy, etc.

A category (2) day surgery patient requires:

- hospital treatment facilities (staff support and equipment not normally available in a physician's office), and
- local anaesthesia or sedative (e.g., IV diazepam) and or nursing support during administration of the treatment or procedure, and
- post-procedural assessment prior to release.

Examples of category (2) procedures include: biopsies, invasive diagnostic procedures of uterus, vasectomy, etc.

The second definition came into effect around 1997 or 1998 and was not meant to replace the above; it was an attempt to standardize the definition across the country. It reads as follows:

A service provided to a patient who is pre-booked and admitted to a formally organized unit of the hospital. This service requires an operating or procedure room and a post-anaesthetic or recovery room. Pre-operative, post-operative and discharge care, and follow-up instruction are provided. Such patients do not require admission to an inpatient bed and are usually discharged within a few hours following surgery.

For reporting purposes, the following two criteria must be met before submitting a day surgery claim:

- the patient must meet the day surgery definition and
- the procedure must appear on the Appendix H of the CIHI (Canadian Institute for Health Information) Directory for Use with Complexity.

These definitions are not applied consistently across facilities or even within facilities over time. This is not a validated field.

The most current definition came into effect April 1, 2002 but is not described here because it is outside the study period.

5. The discharge type is NOT a validated field.

6. Type of hospital: base includes St. Paul's, Royal University, Saskatoon City, Pasqua, Plains, and Regina General Hospitals and Wascana Rehabilitation Centre; regional includes Moose Jaw Union, Providence Place, Victoria, Holy Family, North Battleford Union, Swift Current Union, and Yorkton Regional Hospitals and after January 1, 2001 Lloydminster Hospital.

7. Resource intensity weight (RIW) is calculated by CIHI. An explanation of RIW and how it is calculated can be found at the following web site:

http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=casemix_rlw_e

All acute care hospitals in Saskatchewan (SK) have been reporting to CIHI since the 1998/99 fiscal year. Prior to that, about 80% of SK hospital separations were processed by CIHI. RIWs are therefore reported only on records from facilities reporting to CIHI.

RIWs have been used to calculate the cost of a hospital stay by multiplying the RIW by the cost per weighted case for that fiscal year (e.g., based on SK 1996/97 hospital services utilization and funding, the cost per weighted case was \$2,166.00 for 1996/97). See below Table I: cost per weighted case by fiscal year. This information is available since 1995/96 only.

For those records where no RIW is reported, an estimated RIW based on length of stay may be used. These are available upon request.

Table I: cost per weighted case by fiscal year

fiscal year	cost/weighted case
1995/96	\$2,031.47
1996/97	\$2,165.63
1997/98	\$2,249.09
1998/99	\$2,439.18
1999/00	\$2,840.05
2000/01	\$2,992.82
2001/02	\$3,369.77

Physician Services File : RSCHDRSV.ASC (340,052 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	date of service Reported as a perpetual date.	8	5	continuous
DOCSPEC	physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	13	1	categorical
DIAG_CAT	diagnosis	14	4	categorical
FSC	physician fee-for-service code	18	5	categorical
AMTPAID	amount paid	23	7.2 (implicit two-place decimal)	continuous

Notes

1. This is a service record file. It contains only those records with a fee-for-service code (FSC) of interest (see Table 2: Fee-for-service codes of interest). See the medical visit file for a comprehensive capture of all physician services, albeit collapsed to visits.

2. The perpetual date is based on a calendar with Day 1 = January 1, 1960.
SAS uses a perpetual calendar with Day 0 = January 1, 1960.

3. Diagnosis is reported using ICD-9 codes 001 through 999 and V01 through V99 up to three digits and Medical Services Plan (MSP) codes Z01 through Z99 and C01 through C99, as specified in category Table 1: Diagnoses of interest.

4. Fee-for-service codes are listed in the *Payment schedule for insured services provided by a physician* see www.health.gov.sk.ca/info_center_publications_mshr.html.

5. Services delivered by physicians in salaried or contractual arrangements may or may not be captured (e.g., those on alternate payment contracts, some ER physicians, salaried Northern Medical Services physicians, etc).

Physician Visit File : RSCHVIST.ASC (15,236,278 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	date of visit Reported as a perpetual date.	8	5	continuous
DOCSPEC	prescribing physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	13	1	categorical
DIAG_CAT	diagnosis	14	4	categorical
AMTPD	amount paid	18	9.2 implicit two-place decimal)	continuous

Notes

1. This is a visit-based file. Visits were collapsed from service-based records on the following variables: unique identifier, diagnosis, date of service, practitioner number, clinic number, and location of service. That is, all services delivered to a single person by a single physician for the same diagnosis on the same day at the same clinic and same location of service are reduced to a single visit record. The amount paid is calculated by summing the amount paid for each service record.

2. The perpetual date is based on a calendar with Day 1 = January 1, 1960.
SAS uses a perpetual calendar with Day 0 = January 1, 1960.

3. Diagnosis is reported using ICD-9 codes 001 through 999 and V01 through V99 up to three digits and Medical Services Plan (MSP) codes Z01 through Z99 and C01 through C99, as specified in category Table 1: Diagnoses of interest.

4. Services and therefore visits delivered by physicians in salaried or contractual arrangements may or may not be captured (e.g., those on alternate payment contracts, some ER physicians, salaried Northern Medical Services physicians, etc).

Prescription Drug File: RSCHDRUG.ASC (19,772,257 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	dispensing date	8	5	continuous
RX_CAT	drug category	13	3	categorical
DOCSPEC	prescribing physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	16	1	categorical
QUANTITY	quantity dispensed	17	5	continuous
STRENGTH	strength	22	8.4 (implicit four-place decimal)	continuous
FORM	dosage form CAP = oral capsule CHT = chewable tablet CRT = controlled release tablet ECC = enteric coated capsule ECT = enteric coated tablet INJ = injection IRR = liquid irrigation LAC = long acting capsule LIQ = oral liquid ODT = oral disintegrating tablet PWD = powder RCT = rectal SKL = sprinkle capsule SLT = sublingual tablet SRT = sustained release tablet SUP = rectal suppository TAB = oral tablet XRC = extended release capsule	30	3	categorical
TOTLSUBM	total submitted cost	33	7.2 (implicit two-place decimal)	continuous

PLANCOST	government share of cost	40	7.2 (implicit two-place decimal)	continuous
TOTLAPPR	total approved cost	47	7.2 (implicit two-place decimal)	continuous

Notes

1. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.
2. For drug category key see Table 3: Drug categories.
3. Strength is reported for categories 77, 79, and 200 through 349 otherwise zero filled. Strength is typically reported as number of mg per tablet, capsule or mL.
4. Dosage form is reported for categories 77, 79, and 200 through 349 only, otherwise blank.
5. Quantity is reported for categories 77, 79, and 200 through 349 only, otherwise zero filled. Quantity is typically reported as number of units (e.g., tablets, mL) dispensed.
6. Total submitted cost is the total cost submitted by the dispensing pharmacist.
7. Total approved cost is the total cost approved for payment by the Drug Plan.
8. Patient share of cost may be calculated by subtracting the government share of cost from the submitted or the approved cost.
9. There are 12 records on this file with a quantity dispensed of zero. There are several possible explanations:
 - a) although system will give a warning if 0 is entered for quantity, it can be overridden,
 - b) pharmacist dispensed sample medication, and therefore claimed only the dispensing fee
 - c) a paper claim which was manually processed and quantity not reported or not entered.

APPENDIX B: CONSUMER PRICE INDEX



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Canada



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				Other links



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Table 326-0002^{1,2,3,4,5,17} - Consumer price index (CPI), 2001 basket content, annual (Index, 1992=100)

Survey or program details:
Consumer Price Index - 2301

Geography⁶=Saskatchewan

Commodities and commodity groups ⁹	Medicinal and pharmaceutical products	Prescribed medicines	Health care services
1991	97.6	96.1	95.6
1992	100.0	100.0	100.0
1993	105.3	106.4	102.7
1994	106.2	107.1	104.2
1995	107.2	108.1	105.5
1996	106.0	106.0	107.6
1997	99.2	97.2	108.4
1998	101.5	99.4	111.3
1999	99.9	97.1	113.9
2000	101.8	97.6	116.3
2001	105.5	101.6	119.8
2002	106.1	102.1	121.8
2003	107.1	102.9	124.3
2004	105.9	100.4	128.5

Source: Statistics Canada

APPENDIX C:
ESTIMATION OF RESOURCE INTENSITY WEIGHTS (RIWS)
BASED UPON LENGTH OF STAY (LOS)

# of days					
length of stay	1991/92	1992/93	1993/94	1994/95	1995/96
0	0.4249	0.4514	0.455	0.5281	0.5303
1	0.5554	0.5481	0.5612	0.6655	0.5996
2	0.6653	0.6656	0.6622	0.679	0.6908
3	0.7188	0.727	0.7472	0.7101	0.7166
4	0.7619	0.8161	0.8028	0.8923	0.8422
5	0.8653	0.8967	0.8835	0.9169	0.9504
6	0.989	0.9681	0.984	1.0572	1.1399
7	1.1711	1.0131	1.0916	1.0996	1.1202
8	1.108	1.128	1.1649	1.1693	1.2385
9	1.2774	1.1945	1.268	1.4224	1.3376
10	1.3593	1.3541	1.2908	1.4115	1.4139
>10	0.1445*los+0.0022	0.1423*los+0.0018	0.1438*los+0.0023	0.1539*los+0.0029	0.1578*los+0.0024

# of days	fiscal year					
length of stay	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02
0	0.4914	0.5032	0.4799	0.4518	0.4422	0.4294
1	0.6408	0.6054	0.5719	0.5191	0.5173	0.4984
2	0.6477	0.6446	0.6478	0.6037	0.6034	0.5841
3	0.6989	0.7288	0.7098	0.6722	0.6809	0.6570
4	0.8172	0.8315	0.783	0.7525	0.7736	0.7537
5	0.9157	0.9136	0.8837	0.8384	0.8562	0.8225
6	1.0661	1.0167	0.947	0.9061	0.9226	0.8834
7	1.0935	1.0779	1.0102	0.9851	0.9891	0.9584
8	1.2222	1.1969	1.0600	1.0546	1.1303	1.0334
9	1.3139	1.2851	1.1854	1.1507	1.2204	1.1131
10	1.4048	1.3461	1.2403	1.2065	1.1846	1.1803
>10	0.1236*los+0.0044	0.1195*los+0.0043	0.1113*los+0.0042	0.1357*los+0.0045	0.1404*los+0.0036	0.1455*los+0.0037

APPENDIX D: IMPUTATION OF DAY SURGERY DIAGNOSTIC PROCEDURE GROUP WEIGHTS

Calendar Year	Mean Imputation Values ¹		Replacement Values ²
	Control	Diabetes Cases	Diabetes Cases and Controls
1991	-	-	0.2175
1992	-	-	0.2220
1993	-	-	0.2304
1994	0.2683	0.2753	-
1995	0.2591	0.2803	-
1996	0.2669	0.2902	-
1997	0.2543	0.2708	-
1998	0.2393	0.2615	-
1999	-	-	-
2000	-	-	-
2001	-	-	-

1 Missing day surgery DPGs for 1994 to 1998 were replaced with the mean value for each cohort for a particular year. There were no missing day surgery DPG weights for 1999 to 2001.

2 Actual DPG weights were unavailable for three fiscal years: 1991/92 through 1993/94. Although 1993/94 was the introductory year for DPGs and DPG weights, the reported values for this fiscal year are considered unreliable. We therefore used the fiscal annual average DPG weight calculated and provided by Saskatchewan Health (W. Downey, personal communication, October 11, 2001) for all day surgery records for the calendar years 1991 through 1993.

APPENDIX E: DIALYSIS COST ESTIMATION

	Hemodialysis	Peritoneal Dialysis
Total expenses Including Physician Billings ¹ (2000 US\$)	\$42,057	\$26,959
Physician Billing ¹ (2000 US\$)	\$6,761	\$1,899
Total expenses Excluding Physician Billings (2000 US\$)	\$35,296	\$25,060
2000 Canadian Dollars ¹	\$51,179	\$36,337
2001 Canadian Dollars ²	\$52,719	\$37,431

¹ US \$1 = CAN \$1.45

² Converted to 2001 dollars using the Consumer Price Index Health Care Services Basket

¹ Lee et al. (2002). Cost analysis of ongoing care of patients with end-stage renal disease: The impact of dialysis modality and dialysis access. American Journal of Kidney Diseases; 40: 611 – 622.