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# Maternal Demographic Risk Factors and the Incidence of Low Birthweight, Manitoba 1979-1989

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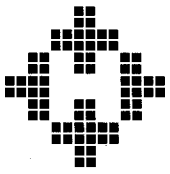

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## THE MANITOBA CENTRE FOR HEALTH POLICY AND EVALUATION

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## Summary

This report summarizes findings from an analysis of birthweight outcomes in Manitoba over the period 1979-89.

The incidence of births of less than 2,500g in Manitoba has historically been lower than the Canadian average. During the 1970s, the incidence of low birthweight declined substantially in all Canadian provinces, continuing a long-standing favourable trend in this health status indicator. However, in the past decade the trend in birthweight outcomes in both Manitoba and Canada has flattened, and there is no longer an appreciable difference between national and Manitoban birthweight outcomes. It is unclear whether the past decade represents a pause in the trend towards a reduction in the incidence of low birthweight or whether, instead, a threshold has been reached which marks the end of prospects for further improvement in birthweight outcomes.

Although the overall provincial rate of low birthweight was stable over the past decade, the incidence of low birthweight among native women declined significantly.

One of the principal objectives of this research was to demonstrate the value of integrating socio-economic measures available from the census with MHSC health care utilization data. In this study, neighbourhood measures of average household income were found to predict the risk of low birthweight for urban women.

Rural non-native women were observed to have consistently better birthweight outcomes than women residing in urban areas, such that the overall rate for rural women was comparable to the rate observed among women living in the wealthiest 20% of urban neighbourhoods. Poor urban women, who are more likely to be young and unmarried relative to women in wealthier neighbourhoods, were found to have a consistently higher risk of a low birthweight birth.

The proportion of births to unmarried women doubled over the decade, from 16.2% in 1979 to 30.6% in 1989. At the same time, the proportion of all births

to women under the age of 20 actually declined, from 12.9% to 9.8%.

There was no change over the decade in the incidence of very low birthweight infants; the approximately 1% of all single births weighing less than 1,500g. A very high proportion of these infants are not viable at birth, and the intensive medical care required for their survival represents a substantial portion of total neonatal health care expenditure.

Some groups of women in the province, most notably rural women between the ages of 20-34, appear to be approaching what may be the minimum attainable low birthweight incidence rate; between 30 and 35 low birthweight infants per 1,000 live single births.

However, there are also segments of the population of reproductively active women, specifically poor urban women and young unmarried women, who continue to face an excess risk of low birthweight and for whom no moderation of risk was observed over the past decade. The flat profile of birthweight incidence over the past decade suggests that any further reduction in the rate of low birthweight in the province will come only from targeting prevention programs specifically to at-risk women. Of the approximately 750 low birthweight singleton infants born annually in Manitoba, perhaps no more than 250-300 may actually be preventable through the joint influence of efforts to improve maternal practices and high quality prenatal medical care. Prevention programs will require expenditures during the antenatal period in excess of the average under provincial medical care, and will also require different delivery models. Without accurate estimates of both the costs of caring for low birthweight newborns in Manitoba and proposed program expenditures on prevention, the cost-effectiveness of prevention efforts cannot be assessed.

## Introduction

The incidence of low birthweight is an indicator of the reproductive health of women of childbearing age in a population, and is also a predictor of an infant's risk of neonatal and post-neonatal morbidity and mortality. Low birthweight infants place substantial demands on the health care system: some studies have estimated that the 6-8% of all births which are less than 2,500g are responsible for 40-50% of the costs of all inpatient care provided to infants.

The incidence of low birthweight in Canada, approximately 55/1000 live births in 1989, is among the lowest in the world. Only a handful of populations, located in the northern latitudes, have lower rates of births less than 2,500g. The rate of low birthweight in Manitoba has historically been lower than the Canadian average (See Figure 1). During the 1970's the incidence of low birthweight declined substantially in all Canadian provinces, continuing a long-standing favourable trend in this health status indicator. In Manitoba, the rate of low birthweight declined from 67/1000 live births in 1972 to 52/1000 in 1980. The consequences of this trend are substantial: had the 1972 incidence rate prevailed in 1980, there would have been an estimated 28%, or 238, additional low birthweight infants born in the province.

However, during the period 1979-89, the trend in birthweight outcomes in both Manitoba and Canada flattened, suggesting that either a plateau or a threshold has been reached in the progressive improvement of birthweight outcomes. It is unclear what factors were responsible for the observed improvement in birthweight outcomes in the previous decade, although demographic factors, such as smaller family size and later age of first births, are felt to be important, as are maternal practices such as stopping smoking and better nutrition and perhaps the coverage and quality of prenatal medical care. In the absence of detailed knowledge of the factors responsible for the reduction in the rate of low birthweight in the previous decade, it is not possible to project the potential for further improvement in birthweight outcomes. What is clear, however, is that biological reproductive failure, which cannot be significantly mediated by medical intervention, defines the threshold of attainable reduction in the incidence of low birthweight. This threshold is thought to be between 30-35/1000 live single births (1,2). Of the approximately 750 low birthweight singleton infants born annually in Manitoba,

perhaps no more than 250-300 may actually be preventable through the joint influence of improved maternal practices and prenatal medical care.

## Methods

Computerized hospital separation records maintained by the Manitoba Health Services Commission (MHSC) were the principal source of data for this study. The study examined birth records for a series of six alternate years between 1979 and 1989. The hospital separation file contains a record of each obstetrical hospital admission in the province and abstracts data on discharge diagnoses (coded to ICD9-CM), surgical procedures, length of stay, maternal parity, the number of previous pregnancies, the duration of gestation estimated from the last known menstrual period, risk assessment scores established in the course of receiving prenatal care, the number of previous hospital admissions in the current pregnancy, a count of the number of episodes of prenatal care and whether the pregnancy had been referred to a regionalized high-risk fetal assessment service. The newborn record contains birth weight in grams, Apgar scores at one and five minutes, and an assessment of gestational age at delivery. Additional information is available from the registration file, which uniquely identifies all persons enrolled in the health insurance system, and includes the date of enrollment, sex, age, household size, residential postal code, status as a treaty native, household structure and the date enrollment ceased (due to death or emigration).

Data on average household income aggregated by geographic area of residence was also used in the study, obtained from public use tapes of a sample of 20% of Manitoban households interviewed in the 1986 Federal Census. This information is currently only available aggregated to geographic areas, the smallest unit being the census enumeration area. There are approximately 1,850 populated enumeration units in Manitoba, with an average of 600 residents per area. Mothers and newborn pairs were assigned to their enumeration area of residence on the basis of postal code recorded in the MHSC registry file, using linkage software developed by Statistics Canada.

All births occurring in Manitoba hospitals for each of the six study years (March 1979 to

April 1980, 1981-2, 1983-4, 1985-6, 1987-8, 1989-90) were eligible for inclusion in the study sample. Cases were ascertained from newborn birth records on annual hospital separation datasets. The sample excluded births occurring in Manitoban hospitals to non-residents of the province, births occurring outside hospitals, pregnancies resulting in multiple births, and births to Manitoban residents in out-of-province hospitals. Eligible cases with missing or out-of-range values for the dependent or independent variables were also withdrawn from the sample.

## Findings

The maternal characteristics available to this study were age, parity, race, marital status, pregnancy history, residence in an urban or rural area and the income rank of the neighbourhood of residence. These maternal characteristics are not considered direct causes of low birthweight: instead, they are factors that identify those groups of women at increased risk. Findings are reported in four areas: 1) trends over the decade in the prevalence of maternal risk factors, 2) trends in the incidence of low birthweight for each of the maternal risk factors, 3) differences in the profile of age and parity risks by race, and 4) the magnitude of differences in birthweight outcomes by income in urban Manitoba.

### Trends in the Prevalence of Risk Factors and the Incidence of Low Birthweight:

Table 1 reports the prevalence of risk factors for low birthweight over the period 1979-89. There has been a substantial change in the demographic profile of women giving birth. For example, the proportion of all births which were delivered of native women increased from 8.6% to 11.7% while the proportion of all births delivered of women over the age of 34

increased from 6.2% in 1979 to 10.6% in 1989. The latter trend, consistent with a general North American pattern towards delayed initiation of fertility, results in an increasing proportion of childbearing women in an age category at higher risk for unfavourable birth outcomes. A more favourable age trend is present in the declining proportion of all births to women under the age of 20, from 12.9% to 9.8%. The most dramatic change in the study period is the proportion of births to women defined as not married. The proportion of unmarried women in the sample doubled over the decade, from 16.2% to 30.6%. As illustrated in Figure 3, this trend was more pronounced among urban women. The only other trend of note is the increasing proportion of women giving birth whose pregnancy history includes a prior pregnancy loss.

Table 2 reports the crude incidence of low birthweight by year, stratified by maternal characteristics. For the province as a whole, the incidence of low birthweight is stable over the decade, and does not evidence any indication of an ascending or descending trend. The observed range in incidence over the study period, from a low of 43.8/1000 in 1989 to a high of 50.7/1000 in 1987 is not a statistically significant difference. Strata-specific incidence is similarly characterized by stability over the study period, with a few notable exceptions. The risk of low birthweight has declined among native women, from approximately 60/1000 births in 1979 to 48/1000 births in 1989, such that by the end of the decade native women have a risk of low birthweight equivalent to the observed rate among non-native women resident in urban centers (See Figure 2). Also demonstrated in Figure 2 is the substantially better birthweight outcome observed among non-native women resident in rural areas relative to non-native urban women. Two other trends should be noted. The incidence of low birthweight among women having at least one previous birth and no history of prior pregnancy loss declined over the decade, as did the risk of low birthweight among women in the not married category (See Table 2).

Regional differences in birthweight outcomes are reported in Table 3. In none of the seven regions was a trend in incidence observed over the decade. Eastern and Central regions had the most favourable birthweight outcomes, with Winnipeg consistently having among the highest regional incidence rates of low birthweight.

There was no change over the decade in the incidence of very low birthweight infants; the approximately 1% of all single births weighing less than 1,500g (Table 4). A very high proportion of these infants are not viable at birth, and the intensive medical care required for their survival represents a substantial portion of total neonatal health care expenditure. As can be seen in the table, the survival rate at 12 months for infants born at less than 1,500g improved dramatically over the decade.

The annual fluctuation of the crude incidence of low birthweight births over the study period, ranging from a low of 43.8 to a high of 50.7 per 1,000 single births, is associated principally with the number of low birthweight births occurring to high risk women. As is demonstrated in Figure 4, the rate of low birthweight is constant over time among married urban women and married rural women. However, wide year-to-year change in the rate of low birthweight is evident among unmarried rural women, and to a lesser extent, among unmarried urban women. In 1987, an excess of 95 low birthweight infants were born relative to expected if the incidence rate observed in 1983 had applied. More than 50% of these excess low birthweight births in 1987 are attributable to a sharp increase in incidence experienced by rural unmarried women relative to the experience of this group in 1983.

**Differences in the Profile of Age and Parity Risks by Race**

Figure 5 further elaborates important differences in the profile of low birthweight risk between native and non-native populations in the province. Here, results are pooled across the six years under study, and presented to compare incidence rates by age and birth order. The profile of risk for non-native women is typical of that found throughout North America. The lowest risk is generally observed among 2nd to 4th births to women aged 20 to 34, and is higher both for first births, and for births to young women less than 20 years of age. However, the profile for native women is substantially different, essentially the opposite of the non-native profile. The rate of low birthweight among young native women giving birth for the first time is much lower than that observed in non-native women, while the rate among native women aged 20-34 giving birth to a second or higher order child is substantially higher than that observed among similar non-native women. The reasons for this pattern of

lower risk among young native women and higher risks among older native age groups relative to non-natives are at present unknown, and are the subject of ongoing research.

**Income Gradient in Birthweight Outcomes**

As shown in Table 5, neighbourhood income is strongly associated with the risk of low birthweight for urban residents. 26.1% of all urban births occur to women in the poorest 20% of neighbourhoods, and these women experienced an incidence of 57.8 low birthweight infants per 1,000 births, compared to 39.5/1000 for women in the wealthiest income quintile.

Rural non-native births do not display a similar gradient in risk by income rank. The probability of a low birthweight birth is constant across all rural area income ranks, and is approximately equivalent to the incidence rate observed in the wealthiest 20% of urban neighbourhoods. This observed absence of a risk gradient may be an artifact of the method of assigning an area-based measure of average income to individual households in rural areas.

The observed increased risk of low birthweight associated with living in a poor neighbourhood is not due to the confounding influence of other risk factors, such as the excess concentration of other risk factors in the lower income ranks. For example, although 43% of all unmarried urban mothers reside in the poorest quintile of neighbourhoods (See Figure 6 and Table 6), the risk gradient by income is present for both married and unmarried women. An unmarried woman living in the poorest 20% of urban neighbourhoods has a risk of low birthweight 46% greater than an unmarried woman living in the wealthiest 20% of neighbourhoods. Similarly, an unmarried urban woman has a risk of low birthweight 40% greater than a married woman, and this risk is constant across neighbourhood income quintile.

The relationship between maternal age, income and birthweight outcome provides a further illustration of these patterns (Figure 7 and Table 7). Births to urban women under the age of 20 are disproportionately concentrated in the lower income quintiles, while births to women over age 34 are concentrated in the higher income quintiles. The risk of low birthweight for

women aged 20-34 and greater than 34 declines steadily as income increases, while at the same time the excess relative risk experienced by women over the age of 34 remains constant across all income groups.

However, some risk factors appear not to be moderated by income rank. For example, the risk of low birthweight for young women under the age of twenty is, with the exception of the wealthiest quintile, constant across income groups.

It is important to recognize the importance of income differentials in the observed pattern of birthweight outcome among urban women. For example, if women in the poorest 20% of neighbourhoods had an incidence of low birthweight equivalent to that of women in the wealthiest 20% of neighbourhoods, the expected number of low birthweight infants born to poor women over the six years in question would have dropped 26%, from 911 to 674. For comparison purposes, if only 20% of women in the poorest income quintile were unmarried, instead of the observed proportion of 42.9% (Table 6 and Figure 6), and the risk of low birthweight was unchanged, the expected number of low birthweight infants would have dropped less than 5%, from 911 to 870.

## Potential for Further Reduction in the Incidence of Low Birthweight

Of the approximately 750 low birthweight infants born annually in Manitoba, perhaps no more than 250-300 may actually be preventable. Rural non-native women between the ages of 20 and 34 have the best birthweight outcomes in the province, and the rate of low birthweight in this group may be approaching the minimum attainable rate of low birthweight, thought to be between 30 and 35 low birthweight births per 1,000 live single births. Further reductions in the overall provincial rate will come from directing prevention efforts to those groups of women who bear a substantial excess risk relative.

For example, of the 10,000 annual births to urban women, the poorest 40% of women have a rate of low birthweight 45% higher than women in the 20% of wealthiest neighbourhoods

(Table 5). Of the estimated 250 low birthweight infants born to the poorest 40% of urban women, approximately 30%, or 80 low birthweight births, could be prevented if the incidence of low birthweight among poor urban women was reduced to that of wealthy urban women.

Some work has been produced in the United States which attempts to estimate the hospital costs associated with the care of low birthweight infants, and evaluate the cost-benefit potential of prevention programs. Table A.1 reproduces one hospital expenditure estimate for a large sample of US hospitals with neonatal intensive care units. Costs are represented only for infants surviving to discharge. Table A.2 projects these birthweight-specific cost distributions to a typical Manitoba birth cohort, and represents two cost scenarios: a low per diem estimate of $150. and a high per diem estimate of $400. The cost of a typical uncomplicated newborn hospital stay, if delivery costs are assigned to the mother, is probably closer to the low estimate. Under both scenarios, 37% of all hospital costs for newborn care are assigned to the 5% of infants who are born at weights of less than 2,500g.

Table A.3 examines the impact on estimated aggregate hospital costs if 20% of births in each birthweight class could be shifted to the next weight class. This would reduce the overall population of low birthweight infants by 86, the goal of the example introduced earlier. An estimated $1,300,000 in averted expenditures is suggested under the $400. per diem scenario, or $446,000 under the $150. per diem scenario.

Any investment in effective prevention programs for the poorest 40% of urban women would be cost-effective if the program attained the target reduction of 80 low birthweight births for less cost that these births would incur in hospital expenditures.

## Conclusions

During the 1970s, the incidence of low birthweight declined substantially in all Canadian provinces, continuing a long-standing favourable trend in this health status indicator.

However, in the past decade the trend in birthweight outcomes in both Manitoba and Canada has flattened, and there is no longer an appreciable difference between national and Manitoban birthweight outcomes.

Rural non-native women were observed to have consistently better birthweight outcomes than women residing in urban areas, such that the overall rate for rural women is comparable to the rate observed among women living in the wealthiest 20% of urban neighbourhoods. Poor urban women, who are more likely to be young and unmarried relative to women in wealthier neighbourhoods, were found to have a consistently higher risk of a low birthweight birth.

The proportion of births to unmarried women doubled over the decade, from 16.2% in 1979 to 30.6% in 1989. At the same time, the proportion of all births to women under the age of 20 actually declined, from 12.9% to 9.8%. Although the overall provincial rate of low birthweight was stable over the past decade, the incidence of low birthweight among native women did decline significantly.

There was no change over the decade in the incidence of very low birthweight infants; the approximately 1% of all single births weighing less than 1,500g. A very high proportion of these infants are not viable at birth, and the intensive medical care invested in their survival represents a substantial portion of total neonatal health care expenditure.

Some groups of women in the province, most notably rural women between the ages of 20-34, appear to be approaching what may be the minimum attainable low birthweight incidence rate; between 30 and 35 low birthweight infants per 1,000 live single births.

However, there are also segments of the population of reproductively active women, specifically poor urban women and young unmarried women, who continue to face an excess risk of low birthweight and for whom no moderation of risk was observed over the past decade. The flat profile of birthweight incidence over the past decade suggests that any further reduction in the rate of low birthweight in the province will come only from targeting prevention programs specifically to at-risk women. Of the approximately 750 low birthweight

singleton infants born annually in Manitoba, perhaps no more than 250-300 may actually be preventable through the joint influence of efforts to improve maternal practices and high quality prenatal medical care. Prevention programs will require expenditures during the antenatal period in excess of the average under provincial medical care, and will also require different delivery models. Without accurate estimates of both the costs of caring for low birthweight newborns in Manitoba and proposed program expenditures on prevention, the cost-effectiveness of prevention efforts cannot be assessed.

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# Tables and Figures

Table 1
Trends in the Distribution
Of Maternal Demographic Characteristics

SINGLE BIRTHS, APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989. MANITOBA

| | | | 1979 | 1981 | 1983 | 1985 | 1987 | 1989 | X2TREND | |
|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL BIRTHS | | | 15,818 | 15,609 | 16,128 | 16,464 | 16,210 | 16,434 | | |
| PROPORTION OF BIRTHS: | | | | | | | | | | |
| RACE | NATIVE | % | 8.6 | 8.9 | 9.5 | 9.7 | 11.1 | 11.7 | 132.7 | <.001 |
| MATERNAL AGE | < 20 | % | 12.9 | 11.8 | 10.8 | 9.6 | 9.4 | 9.8 | 109.9 | <.001 |
| | > 34 | % | 6.2 | 7.2 | 7.2 | 8.3 | 9.6 | 10.6 | 285.9 | <.001 |
| BIRTH ORDER | FIRST | % | 55.5 | 55.4 | 54.2 | 56.2 | 56.9 | 56.9 | 15.8 | <.001 |
| | 5 OR MORE | % | 4.6 | 4.3 | 4.0 | 3.9 | 3.9 | 3.9 | 13.9 | <.001 |
| PREGNANCY HISTORY | PRIOR LOSS | % | 16.1 | 17.2 | 18.6 | 20.3 | 21.7 | 23.6 | 391.5 | <.001 |
| INCOME QUINTILE | URBAN Q1 | % | 25.1 | 25.2 | 26.2 | 26.1 | 26.8 | 27.0 | 13.6 | <.001 |
| | Q2 | % | 16.7 | 16.9 | 17.5 | 17.7 | 17.5 | 17.0 | | NS |
| RESIDENCE | URBAN | % | 61.7 | 61.9 | 62.1 | 63.4 | 63.9 | 65.1 | 58.5 | <.001 |
| MARITAL STATUS | NOT MARRIED | % | 16.2 | 19.2 | 21.6 | 22.5 | 26.0 | 30.6 | 1080.6 | <.001 |

Table 2
Crude Incidence of Low Birthweight
by Maternal Demographic Characteristics

RATE PER 1000 SINGLE BIRTHS
APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989. MANITOBA

| | | 1979 | 1981 | 1983 | 1985 | 1987 | 1989 | $X2_{TREND}$ | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL BIRTHS | 15,818 | 15,609 | 16,128 | 16,464 | 16,210 | 16,434 | | NS |
| | CRUDE INCIDENCE | 47.3 | 47.6 | 44.8 | 46.1 | 50.7 | 43.8 | | |
| RACE | NATIVE | 59.2 | 60.9 | 49.8 | 51.9 | 49.4 | 48.4 | 3.56 | < .05 |
| | URBAN NON-NATIVE | 49.5 | 49.7 | 48.3 | 52.1 | 54.8 | 48.3 | | NS |
| | RURAL NON-NATIVE | 39.9 | 42.5 | 37.6 | 33.4 | 43.3 | 33.4 | | NS |
| MATERNAL | < 20 | 59.8 | 63.0 | 48.9 | 52.8 | 76.3 | 54.7 | | NS |
| AGE | 20 - 34 | 44.9 | 44.5 | 43.1 | 44.4 | 45.5 | 39.8 | | NS |
| | > 34 | 52.4 | 56.1 | 58.6 | 55.5 | 69.5 | 62.6 | | NS |
| BIRTH | FIRST | 56.2 | 56.9 | 49.7 | 57.2 | 62.5 | 52.7 | | NS |
| ORDER | 2 - 4 | 40.0 | 39.8 | 40.5 | 37.5 | 42.4 | 36.5 | | NS |
| | 5 OR MORE | 57.8 | 62.0 | 53.3 | 54.3 | 53.2 | 56.7 | | NS |
| PREGNANCY | PRIOR LOSS | 58.2 | 62.0 | 52.8 | 58.8 | 68.5 | 54.9 | | NS |
| HISTORY | FIRST | 52.8 | 54.1 | 48.7 | 54.5 | 60.2 | 50.2 | | NS |
| | NO LOSS | 39.5 | 37.5 | 38.4 | 34.5 | 35.5 | 33.0 | 5.39 | < .05 |
| INCOME | URBAN: Q1 | 53.4 | 59.9 | 52.7 | 59.4 | 65.8 | 55.2 | | NS |
| QUINTILE | Q5 | 39.4 | 37.4 | 38.9 | 42.8 | 39.9 | 38.4 | | NS |
| MARITAL | MARRIED | 43.7 | 42.4 | 41.3 | 40.9 | 44.2 | 40.7 | | NS |
| STATUS | NOT MARRIED | 65.6 | 70.3 | 58.5 | 65.0 | 70.0 | 50.7 | 5.61 | < .01 |

Table 3
Trends in the Incidence of Low Birthweight
By Health Region

RATE PER 1000 SINGLE BIRTHS
APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989. MANITOBA

| | TOTAL BIRTHS | MEAN INCIDENCE | 1979 | 1981 | 1983 | 1985 | 1987 | 1989 | $X2_{TREND}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| MANITOBA | 96,591 | | 47.3 | 47.6 | 44.8 | 46.1 | 50.7 | 43.8 | 0.62 | NS |
| EASTERN | 8,072 | 38.9 | 40.0 | 42.7 | 34.2 | 36.0 | 41.8 | 38.8 | 0.02 | NS |
| CENTRAL | 8,978 | 39.8 | 47.2 | 31.0 | 43.7 | 33.0 | 50.6 | 32.8 | 0.27 | NS |
| WESTMAN | 10,125 | 41.5 | 39.1 | 51.5 | 38.8 | 36.0 | 46.5 | 36.6 | 0.55 | NS |
| PARKLAND | 3,732 | 43.9 | 37.4 | 56.0 | 40.3 | 47.1 | 46.2 | 35.3 | 0.12 | NS |
| INTERLAKE | 6,104 | 44.1 | 42.0 | 49.0 | 37.6 | 48.0 | 49.7 | 38.2 | 0.02 | NS |
| NORMAN | 10,342 | 45.4 | 48.6 | 49.4 | 42.3 | 40.7 | 48.9 | 43.0 | 0.55 | NS |
| WINNIPEG | 49,238 | 51.2 | 51.5 | 49.4 | 49.9 | 53.1 | 53.8 | 48.8 | 0.10 | NS |
| | X2 | 50.61 | $p < .001$, 7 df | | | | | | | |

Table 4
Trends in Infant Mortality
by Birthweight

RATE PER 1000 LIVE SINGLE BIRTHS
APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989. MANITOBA

| | 1979 | 1981 | 1983 | 1985 | 1987 | 1989* | $X2_{TREND}$ | |
|---|---|---|---|---|---|---|---|---|
| TOTAL LIVE BIRTHS | 15,753 | 15,551 | 16,072 | 16,161 | 16,223 | 16,507 | | |
| < 1,500g | | | | | | | | |
| LIVE BIRTHS | 117 | 117 | 109 | 104 | 143 | 101 | | |
| INCIDENCE/1000 | 7.4 | 7.5 | 6.8 | 6.4 | 8.8 | 6.1 | 0.30 | NS |
| MORTALITY/1000 | 649.0 | 487.1 | 412.8 | 403.8 | 363.6 | 366.3 | 22.23 | <.001 |
| 1,501 - 2,500g | | | | | | | | |
| LIVE BIRTHS | 628 | 535 | 533 | 579 | 613 | 533 | | |
| INCIDENCE/1000 | 39.8 | 34.4 | 33.1 | 35.8 | 37.7 | 32.2 | 4.23 | <.05 |
| MORTALITY/1000 | 36.6 | 33.6 | 31.8 | 39.7 | 26.1 | 18.7 | 2.82 | NS |
| 2,501 - 4,000G | | | | | | | | |
| LIVE BIRTHS | 13,041 | 12,695 | 13,158 | 13,318 | 13,089 | 13,353 | | |
| INCIDENCE/1000 | 827.0 | 816.3 | 818.7 | 824.0 | 806.8 | 808.1 | 15.20 | <.001 |
| MORTALITY/1000 | 5.0 | 4.7 | 5.2 | 5.1 | 3.6 | 3.1 | 7.28 | <.05 |
| > 4,001g | | | | | | | | |
| LIVE BIRTHS | 1,967 | 2,204 | 2,272 | 2,160 | 2,378 | 2,520 | | |
| INCIDENCE/1000 | 124.8 | 141.7 | 141.3 | 133.6 | 146.5 | 152.6 | 40.77 | <.001 |
| MORTALITY/1000 | 3.5 | 2.7 | 2.2 | 3.7 | 1.7 | 1.6 | 1.75 | NS |

WEIGHT CLASS INCIDENCE IS PER 1,000 LIVE BIRTHS
INFANT MORTALITY PER 1,000 LIVE BIRTHS

* DEATHS MAY BE UNDER-ENUMERATED IN 1989 DATA

Table 5
Incidence of Low Birthweight,
By Income Quintile and Residence

RATE PER 1000 SINGLE BIRTHS
NON-NATIVE, APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989

| | URBAN Number Births | % Births | LBW /1000 | RELATIVE RISK OF LBW (95% CI) | RURAL Number Births | % Births | LBW /1000 | RELATIVE RISK OF LBW (95% CI) |
|---|---|---|---|---|---|---|---|---|
| QUINTILE 1 | 15,845 | 26.1 | 57.8 | 1.46 (1.30, 1.63) | 6,102 | 21.4 | 41.3 | 1.11 ( .92, 1.34) |
| QUINTILE 2 | 11,231 | 18.5 | 55.8 | 1.41 (1.25, 1.59) | 4,528 | 15.9 | 38.9 | 1.04 ( .85, 1.28) |
| QUINTILE 3 | 10,563 | 17.4 | 49.0 | 1.24 (1.09, 1.38) | 5,687 | 20.2 | 32.6 | .87 ( .71, 1.06) |
| QUINTILE 4 | 12,567 | 20.7 | 46.7 | 1.18 (1.04, 1.33) | 6,404 | 22.5 | 41.4 | 1.11 ( .93, 1.34) |
| QUINTILE 5 | 10,442 | 17.2 | 39.5 | -- | 5,724 | 20.1 | 37.2 | -- |
| X2TREND | | | 52.94 | p<.001 | | | 0.47 | NS |

QUINTILE 1 = Poorest 20% of Population

Table 6
Distribution of Births and
Incidence of Low Birthweight, Urban Residents
By Income Quintile and Marital Status

RATE PER 1000 SINGLE BIRTHS
URBAN RESIDENTS, APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989

| | | INCOME QUINTILE 1 | 2 | 3 | 4 | 5 | X2 | | $X2_{TREND}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL URBAN | % | 26.1 | 18.5 | 17.4 | 20.7 | 17.2 | | | | |
| (N=60,712) | /1000 | 57.8 | 55.8 | 49.0 | 46.7 | 39.5 | 54.80 | <.001 | 52.94 | <.001 |
| STRATIFIED BY MARITAL STATUS | | | | | | | | | | |
| NOT | % | 42.9 | 20.4 | 14.4 | 12.3 | 9.9 | | | | |
| MARRIED | /1000 | 70.1 | 77.1 | 65.3 | 63.0 | 51.4 | 10.41 | <.03 | 6.23 | <.01 |
| (N=13,099) | | | | | | | | | | |
| MARRIED | % | 21.4 | 18.0 | 18.2 | 23.0 | 19.2 | | | | |
| (N=47,569) | /1000 | 50.9 | 49.2 | 45.6 | 44.3 | 37.8 | 22.33 | <.001 | 20.82 | <.001 |
| RELATIVE RISK | NOT MARRIED | 1.36 | 1.57 | 1.39 | 1.40 | 1.32 | 1.41 | (1.31, 1.53) | | |

Table 7
Distribution of Births and
Incidence of Low Birthweight, Urban Residents
By Income Quintile and Maternal Age

RATE PER 1000 SINGLE BIRTHS
URBAN RESIDENTS, APRIL-MARCH 1979, 1981, 1983, 1985, 1987, 1989

| | | INCOME QUINTILE 1 | 2 | 3 | 4 | 5 | X2 | | $X2_{TREND}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL URBAN | % | 26.1 | 18.5 | 17.4 | 20.7 | 17.2 | | | | |
| (N=60,712) | /1000 | 57.8 | 55.8 | 49.0 | 46.7 | 39.5 | 54.80 | <.001 | 52.94 | <.001 |
| STRATIFIED BY MATERNAL AGE | | | | | | | | | | |
| < 20 | % | 44.5 | 21.0 | 15.0 | 11.7 | 7.5 | | | | |
| (N=5,455) | /1000 | 66.6 | 71.4 | 67.0 | 68.5 | 41.4 | 4.67 | NS | -- | |
| 20 - 34 | % | 24.5 | 18.7 | 18.0 | 21.6 | 17.1 | | | | |
| (N=49,880) | /1000 | 54.7 | 52.7 | 46.4 | 43.8 | 36.7 | 45.41 | <.001 | 43.38 | <.001 |
| > 34 | % | 21.6 | 14.7 | 14.3 | 21.3 | 28.0 | | | | |
| (N=5,367) | /1000 | 71.5 | 69.5 | 61.2 | 62.1 | 55.2 | 3.58 | NS | -- | |
| RELATIVE RISK | <20 | 1.21 | 1.36 | 1.44 | 1.56 | 1.12 | 1.31 | (1.18, 1.47) | | |
| | >34 | 1.30 | 1.34 | 1.32 | 1.41 | 1.50 | 1.37 | (1.37, 1.53) | | |

Table A.1
Estimated Survival Rates, Average Hospital Cost
and Average Length of Stay
for a Sample of US Hospitals [1]

| BIRTH WEIGHT | NUMBER OF BIRTHS | PERCENT SURVIVING TO DISCHARGE | AVERAGE COST OF STAY | AVERAGE LENGTH STAY | COST INTENSITY FACTOR [2] |
|---|---|---|---|---|---|
| 500-999g | 915 | 39.7 | $49,990 | 82 | 3.1 |
| 1000-1499g | 1,278 | 65.5 | $23,262 | 48.5 | 2.5 |
| 1500-1999g | 2,121 | 77.1 | $9,695 | 22.5 | 2.2 |
| 2000-2499g | 4,622 | 92.5 | $2,568 | 7.2 | 1.8 |
| >=2500g | 71,346 | 98.6 | $678 | 3.5 | 1 |

1. Schwartz RM. What Price Prematurity. Family Planning Perspectives 21(4): 170-174, 1989.

2. Cost Intensity Factor estimates the additional costs of care for a weight group, above the base cost of care for normal birthweight infants.

Table A.2
Estimated Survival Rates, Average Hospital Cost
and Average Length of Stay
for an Annual Manitoba Birth Cohort Surviving to Hospital Discharge

ESTIMATE ASSUMING A HOSPITAL PER DIEM COST OF $150.00

| BIRTH WEIGHT | NUMBER OF BIRTHS | NUMBER SURVIVING TO DISCHARGE | AVERAGE COST OF STAY SURVIVORS | AVERAGE LENGTH STAY SURVIVORS | TOTAL COST |
|---|---|---|---|---|---|
| 500-999g | 61 | 24 | $38,130 | 82.0 | $915,120 |
| 1000-1499g | 68 | 45 | $18,187 | 48.5 | $818,415 |
| 1500-1999g | 134 | 103 | $7425 | 22.5 | $764,775 |
| 2000-2499g | 465 | 430 | $1,944 | 7.2 | $835,920 |
| >=2500g | 15,346 | 15,132 | $375 | 2.5 | $5,674,500 |
| TOTAL | 16,074 | 15,734 [1] | | 3.00 [2] | $9,008,730 |

ESTIMATE ASSUMING A HOSPITAL PER DIEM COST OF $400.00

| | | | | | |
|---|---|---|---|---|---|
| 500-999g | 61 | 24 | $101,680 | 82.0 | $2,440,320 |
| 1000-1499g | 68 | 45 | $48,500 | 48.5 | $2,352,250 |
| 1500-1999g | 134 | 103 | $19,800 | 22.5 | $2,039,400 |
| 2000-2499g | 465 | 430 | $5,184 | 7.2 | $2,229,120 |
| >=2500g | 15,346 | 15,132 | $1,000 | 2.5 | $15,132,000 |
| TOTAL | 16,074 | 15,734 [1] | | 3.00 [2] | $24,193,090 |

1. This estimate is based on a typical US neonatal mortality rate of approximately 20/1000 live births. The rate of neonatal death in Manitoba over the past decade has averaged 10-14 deaths per 1,000 live births.

2. All Length-of-Stay averages are representative of US data, for live discharges. In Manitoba, current average length of stay for all newborn separations, including stays for infants who died in hospital is 4.6.

Table A.3
Estimated Averted Hospital Expenditures
If Prevention Programs Shifted 20% of Low Birthweight Births to Next Highest Weight Class

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ESTIMATE ASSUMING A HOSPITAL PER DIEM COST OF $150.00

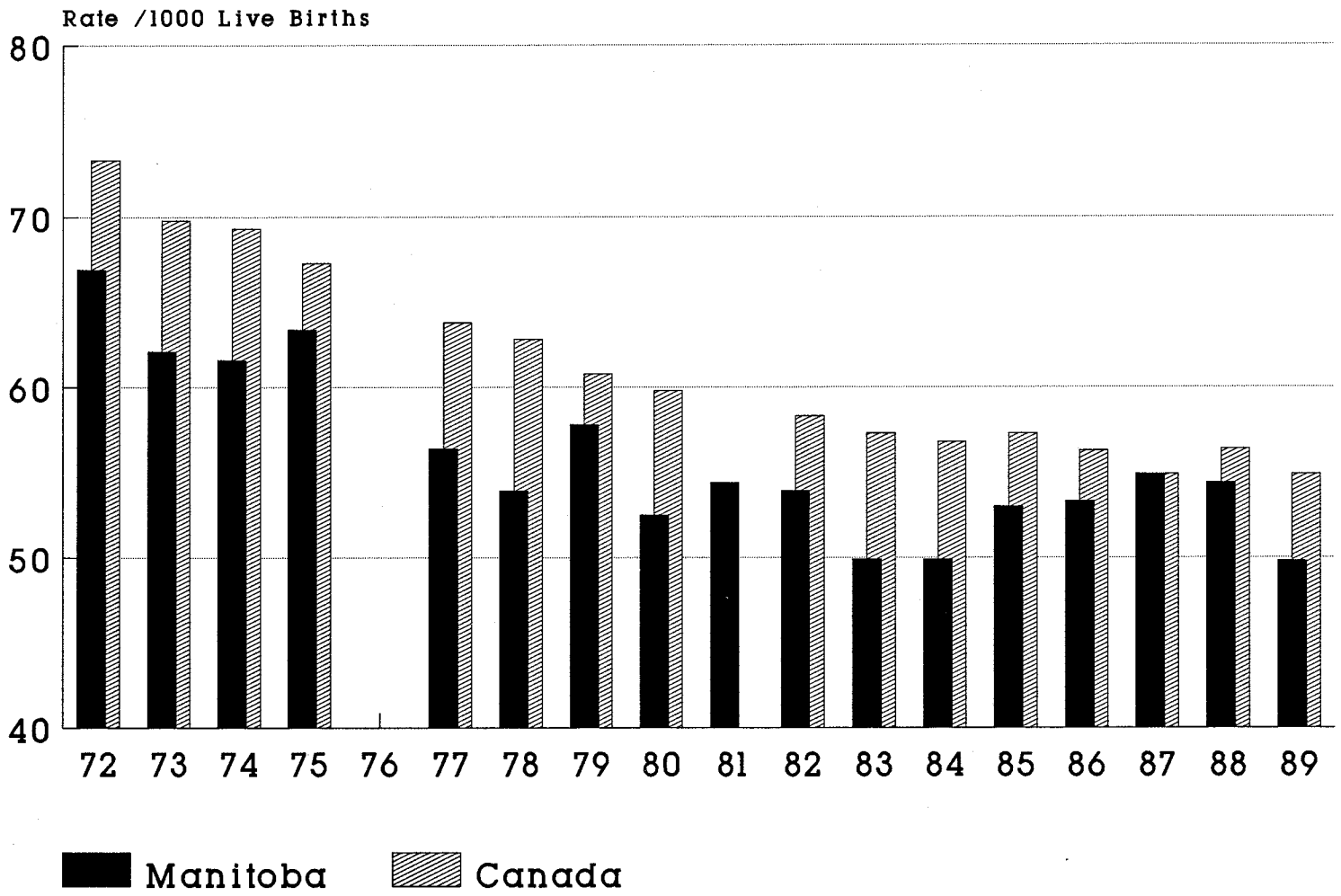
| BIRTH WEIGHT | SURVIVING INFANTS | ESTIMATED TOTAL COST | IF 20% OF BIRTHS SHIFTED TO NEXT WEIGHT CLASS | ESTIMATED TOTAL COST | AVERTED EXPENDITURE |
|---|---|---|---|---|---|
| 500-999g | 24 | $915,120 | 24-5=19 | $724,470 | $190,650 |
| 1000-1499g | 45 | $818,415 | 45-9+5=41 | $745,667 | $72,748 |
| 1500-1999g | 103 | $764,775 | 103-21+9=91 | $675,675 | $89,100 |
| 2000-2499g | 430 | $835,920 | 430-86+21=365 | $709,560 | $126,360 |
| >=2500g | 15,132 | $5,674,500 | 15132+86=15218 | $5,706,750 | -$32,250 |
| TOTAL | 16,074 | $9,008,730 | 16,074 | $8,562,122 | $446,608 |

ESTIMATE ASSUMING A HOSPITAL PER DIEM COST OF $400.00

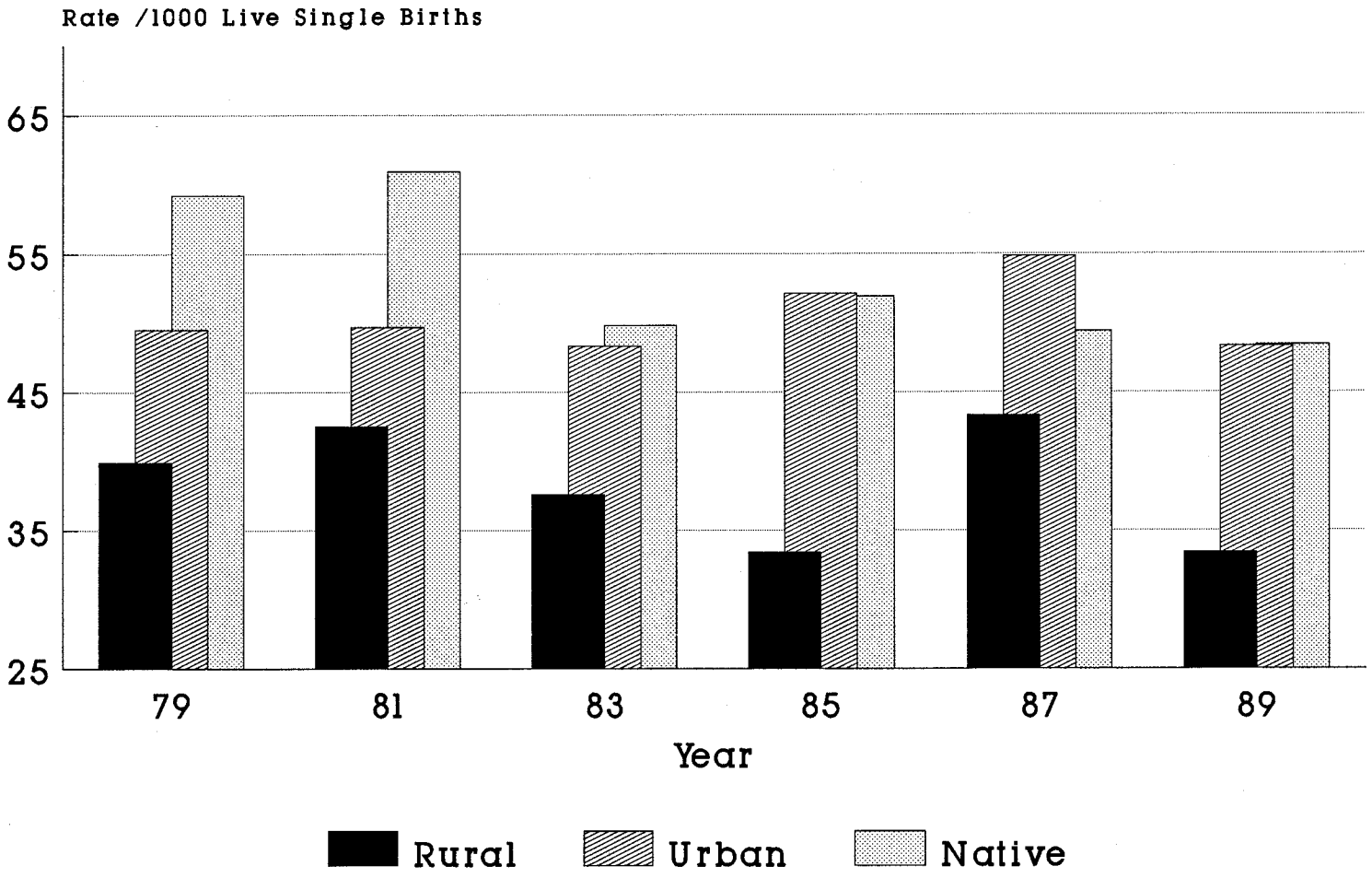
| BIRTH WEIGHT | SURVIVING INFANTS | ESTIMATED TOTAL COST | IF 20% OF BIRTHS SHIFTED TO NEXT WEIGHT CLASS | ESTIMATED TOTAL COST | AVERTED EXPENDITURE |
|---|---|---|---|---|---|
| 500-999g | 24 | $2,440,320 | 24-5=19 | $1,952,500 | $488,064 |
| 1000-1499g | 45 | $2,352,250 | 45-9+5=41 | $1,988,500 | $363,750 |
| 1500-1999g | 103 | $2,039,400 | 103-21+9=91 | $1,801,800 | $237,600 |
| 2000-2499g | 430 | $2,229,120 | 430-86+21=365 | $1,892,160 | $336,960 |
| >=2500g | 15,132 | $15,132,000 | 15132+86=15218 | $15,218,000 | -$86,000 |
| TOTAL | 16,074 | $24,193,090 | 16,074 | $22,852,716 | $1,340,377 |

# Figure 1: Incidence of Low Birthweight

Canada, Manitoba 1972-89



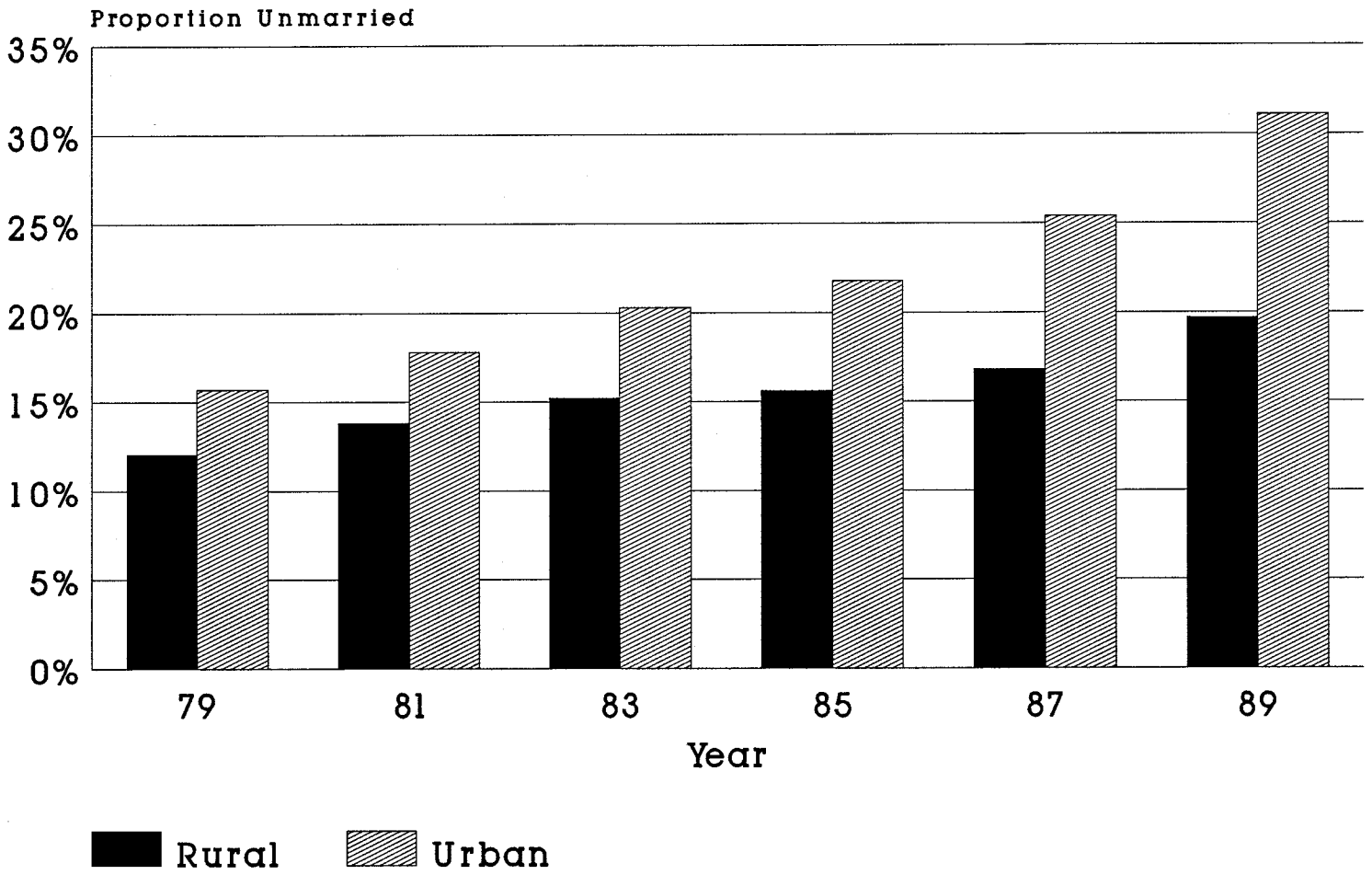
# Figure 2: Trend in Incidence
## of Low Birthweight
### By Native Status and Residence



# Figure 3: Distribution of Births

## By Mothers' Marital Status

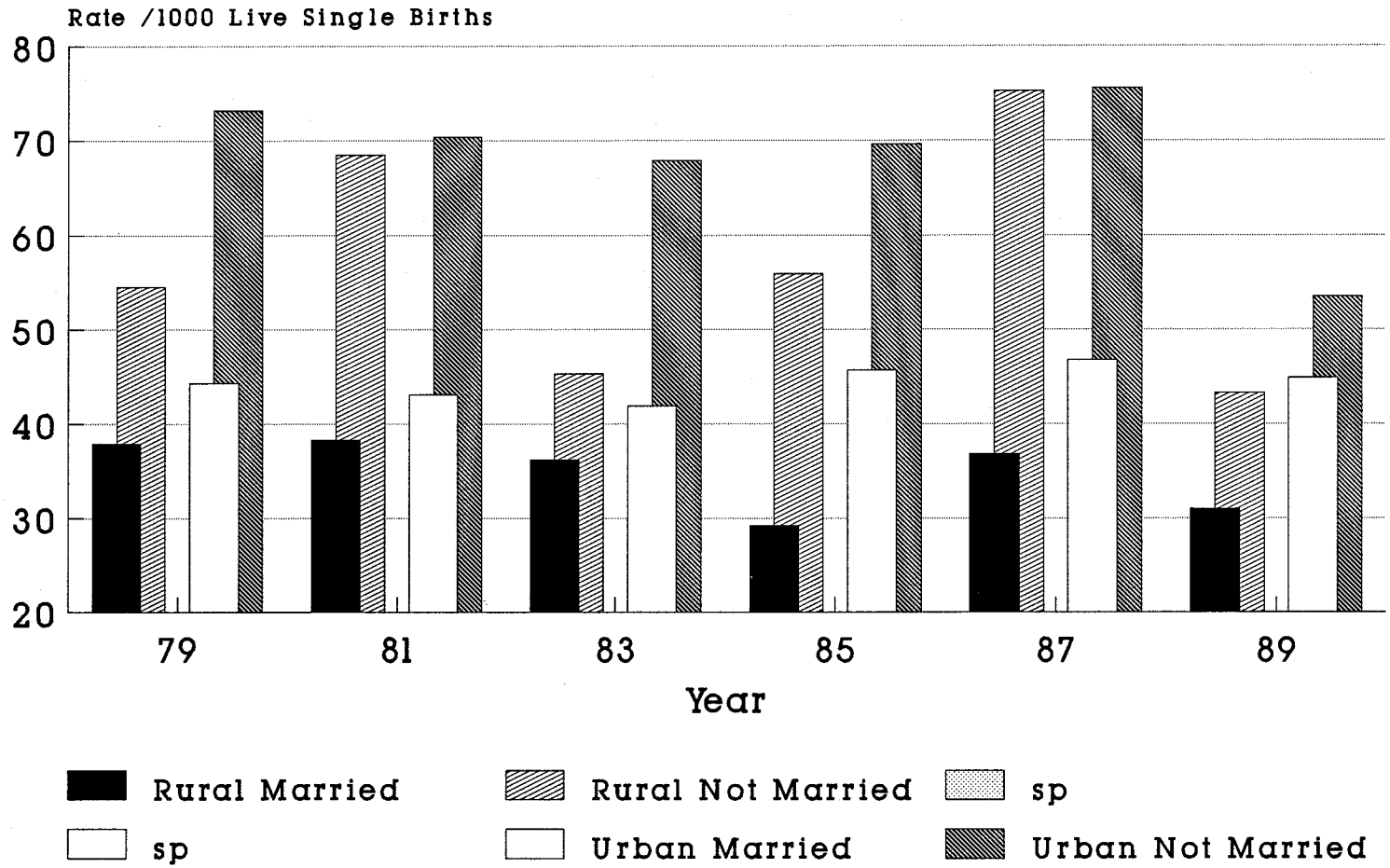
Non-Native, Live Single Births



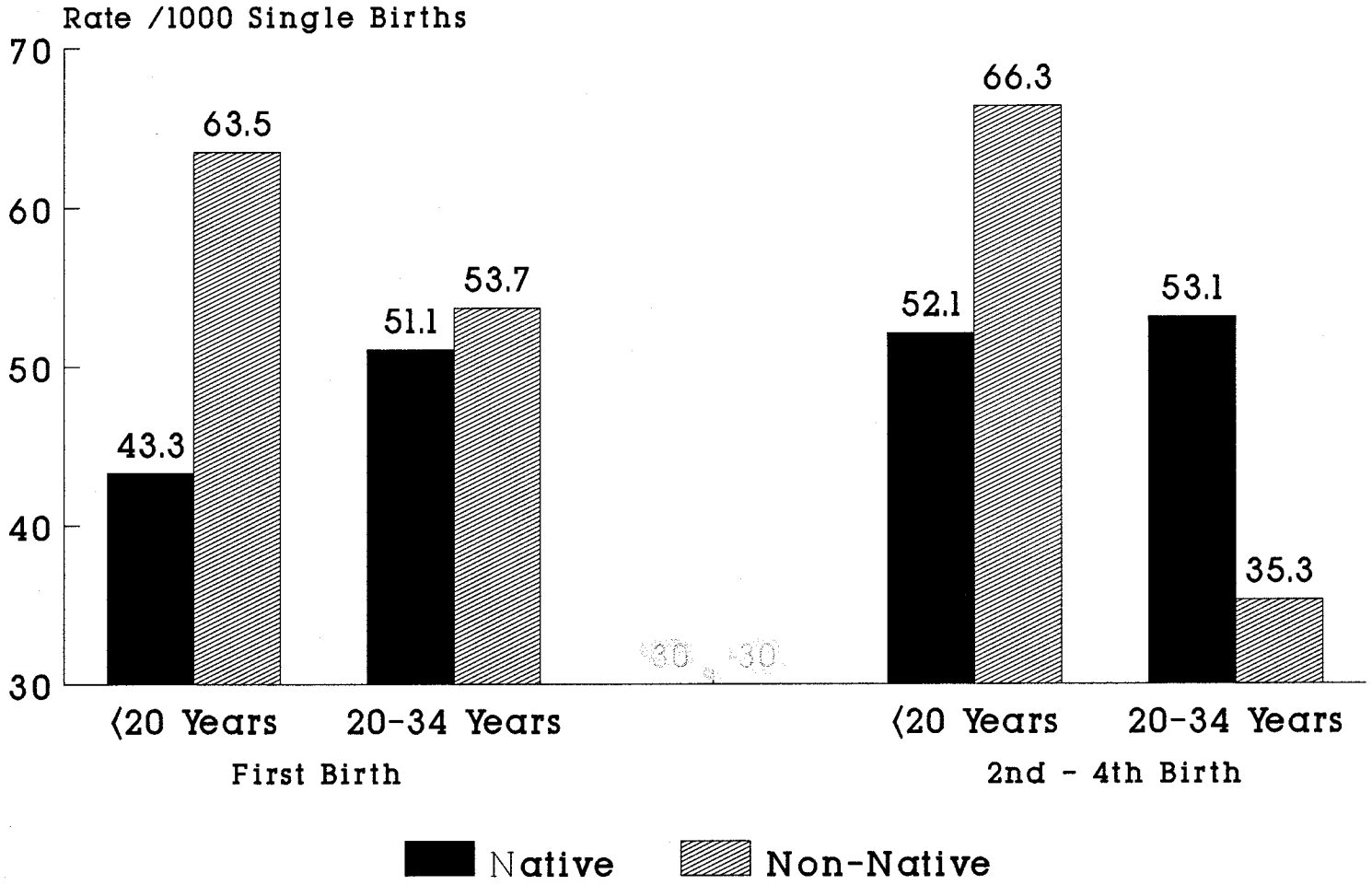
# Figure 4: Incidence of Low Birthweight

## By Mothers' Marital Status and Residence

Non-Native Births, April-March



# Figure 5: Incidence of Low Birthweight By Age and Native Status

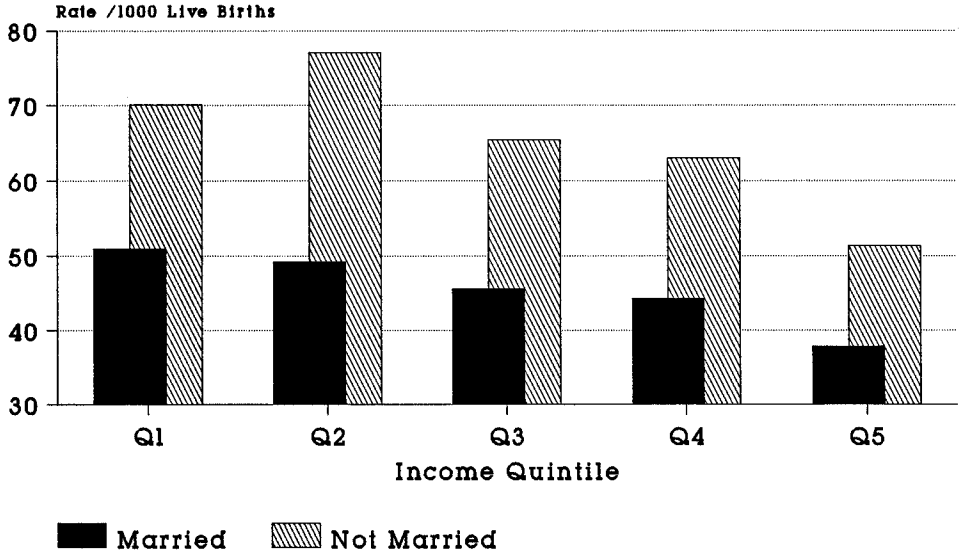


# Figure 6: Distribution of Births

By Marital Status and Income Quintile
Urban Residents, Single Births


# Incidence of Low Birthweight

By Marital Status and Income Quintile
Urban Residents

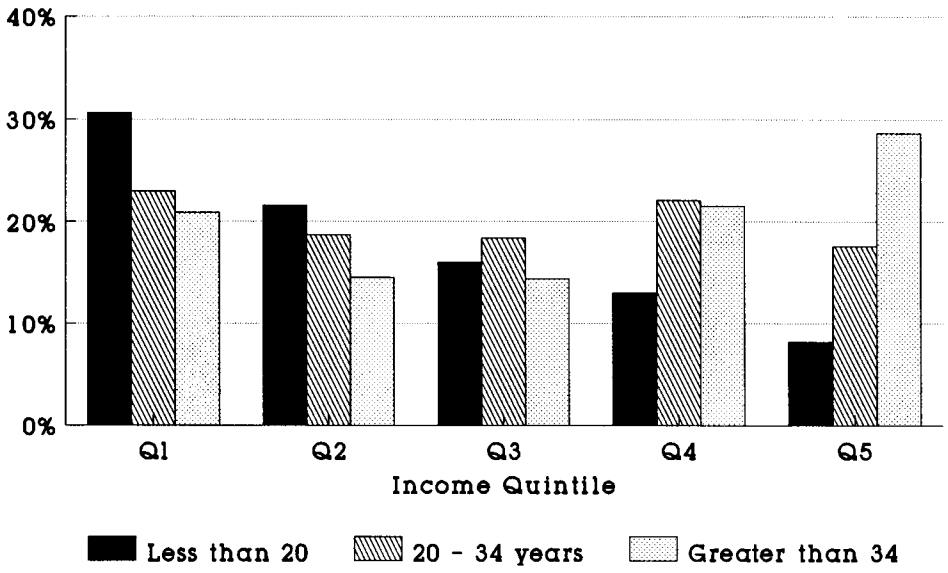



Quintile 1 = Poorest 20% of Population

# Figure 7: Distribution of Births

## By Income Quintile and Age

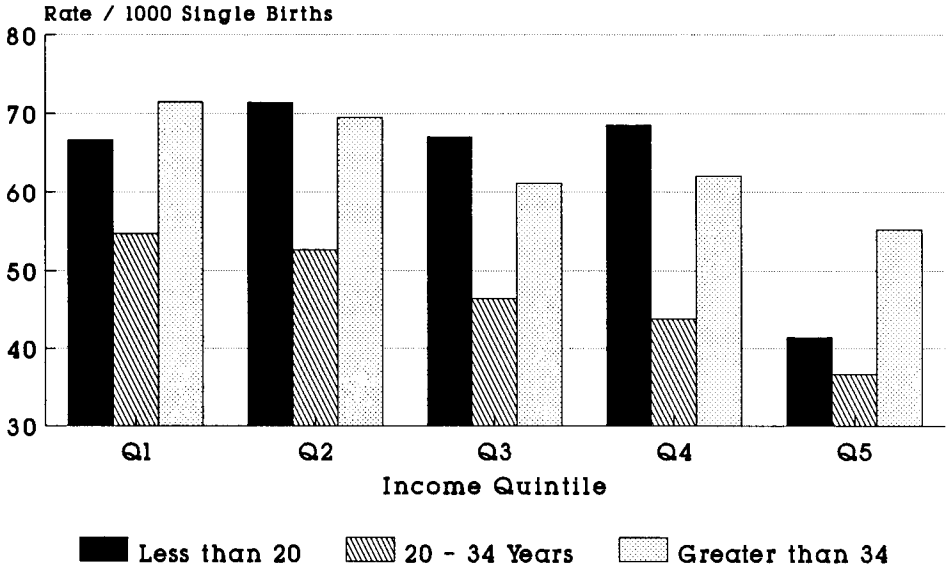
Urban Residents, Single Births




# Incidence of Low Birthweight

## By Age and Income Quintile

Urban Residents, Single Births




Q1 = Poorest 20% of Population

MANITOBA CENTRE FOR HEALTH POLICY AND EVALUATION

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