

**The Birth Certificate and Medicaid Data Match Project:
Initial Findings in Infant Mortality**

Dawn Brintnell, MPH
Melanie Peterson-Hickey, Ph.D.
David Stroud, MBA
Susan Castellano, BA
Cheryl Fogarty, BSN, MPH

March 2005

This paper is the result of a collaborative effort between the Minnesota Department of Health and the Minnesota Department of Human Services. Data for this report were obtained through a data-sharing agreement between these two departments.

Introduction

There has been a strong interest in examining pregnancy and birth outcomes within the Medicaid population, because Medicaid enrollment serves as a proxy for lower socioeconomic status, a measure otherwise missing from birth certificate data. It is also useful because Medicaid enrollment and claims data contain a wealth of information related to pregnancy management and health conditions experienced during the pregnancy. In linking birth certificate data with Medicaid data the ensuing data provide a more complete picture for evaluating services and outcomes for pregnancies. This report explores infant mortality rates for Medicaid and non-Medicaid populations in Minnesota by age of mother, race/ethnicity, cause of death, and timing of prenatal care initiation.

Infant mortality has long been considered an important indicator used to compare the health and well-being of populations across and within countries. Between 1950 and 2001, the infant mortality rate in the U.S. declined by almost 77 percent.¹ While this is a dramatic reduction, the U.S. has not experienced the rate of improvement in infant mortality that has occurred in other industrialized nations. In addition, while U.S. rates have improved, they have not improved at the same rate as other countries. In fact, the rank of the U.S. rates relative to other industrialized countries has actually fallen over time.² For example, in 1960 with an infant mortality rate of 26.0 the U.S. ranked 11th in the world behind countries like New Zealand, England and Denmark. In 2000, with an infant mortality rate of 6.9, the U.S. rank had fallen to 27th behind the Czech Republic, Greece, and Portugal. Singapore had the lowest infant mortality rate in 2000 at 2.5, less than half of the U.S. rate for that year.

Figures compiled by the National Center for Health Statistics indicate that the U.S. infant mortality rate for 2002 was 7.0 per 1,000 live births.³ This figure represents an increase from the 2001 rate of 6.8, the first time the rate had not either declined or stayed the same since 1958.

In Minnesota, the infant mortality rate declined from 5.4 in 2001 to 5.3 in 2002.⁴ Oftentimes, Minnesota has one of the lowest infant mortality rates in the U.S. In fact, Minnesota is usually one of the 5 to 10 states with the lowest infant mortality rate behind states like New Hampshire and Massachusetts that had rates below 5.0 per 1,000 live births. Minnesota's low overall rate, however, masks differences for some groups within the state. Infant mortality rates in Minnesota are higher for teens, Populations of Color and as this report indicates, some groups of Medicaid enrollees.

Methods

The data for this report were obtained through a data-sharing agreement between the Departments of Health and Human Services (MDH and DHS, respectively). The birth and death certificate data were obtained from public vital statistics records kept at MDH. Birth certificate data are population based and includes all births occurring in Minnesota as well as births occurring out-of-state to Minnesota residents. Birth records contain a range of demographic data including conditions at birth, race, ethnicity, age of mother, birthweight of baby, prematurity, obstetric care, and infant death. Death certificates are also population-based, including all deaths occurring in Minnesota as well as deaths occurring out-of-state to Minnesota residents. Death records contain demographic information and conditions at death including race and ethnicity, cause of death, age and gender.

Medicaid claims data and enrollment files, were obtained by the DHS. This report includes data from both fee-for-services (FFS) claims submitted to DHS for payment and managed encounter data as submitted from contracted health plans for pregnant women enrolled in the Prepaid Medical Assistance Program (PMAP). DHS data include demographic data such as age of mother, race ethnicity, some pregnancy risk factors such as tobacco or alcohol use, and obstetric care.

Using a multi-step approach, birth records were matched with DHS eligibility files in an iterative linking process using unique identifiers.⁵ From this process, publicly funded clients were identified, and as a

group were compared to non-publicly funded clients. Several comparisons in birth outcomes as well as causes of death, time of death, and various maternal characteristics were made to identify any differences between these two populations. Vital statistics data have been matched to DHS eligibility records for calendar years 1997-2001 for infant mortality and birth outcome calculations.

While the numbers of births and deaths used to calculate infant mortality rates are a census of events, they are subject to random variation. Because of this variation and the rare nature of infant death, the rates should be interpreted with caution. In the five years examined in this study, a total of 1,889 infants died in Minnesota. The small number of deaths often make sub-group rates highly variable. To account for this random variation, confidence intervals were calculated. To do this, estimates of relative standard error (RSE) of the infant mortality rates were calculated using the following formula:

$$RSE = 100 * \sqrt{1/D + 1/B}$$

where D is the number of deaths and B is the number of births.

Assuming a binomial distribution, the confidence intervals are calculated as follows:

$$\text{Lower Limit} = \text{IMR} - 1.96 * \text{IMR} * (\text{RSE}/100)$$

$$\text{Upper Limit} = \text{IMR} + 1.96 * \text{IMR} * (\text{RSE}/100)$$

where IMR is the infant mortality rate.

The interpretation of the confidence interval is that 95 times out of 100, the true infant mortality rate for the group in question lies within the confidence interval.

Data provided by DHS include enrollment in both the Medical Assistance and MinnesotaCare programs, both of which are part of the federal Medicaid program as administered in Minnesota. The Medical Assistance program is for low-income children under the age of 21, and parents or caretakers of dependent children, pregnant women, people who are 65 or older and people who have a disability. Program income limits vary depending on family size, age, pregnancy status and disability status. The

program covers a comprehensive range of health care services, including doctor visits, hospitalization, prescriptions, eye exams, eye glasses, and dental care. There is no cost for those who meet the income limits, however co-pays may apply to some services. The MinnesotaCare program provides comprehensive coverage similar to the Medical Assistance Program to Minnesota residents who do not have access to affordable health insurance. Income limits vary depending on family size, but are the same or higher than the Medical Assistance Program. Enrollees pay a monthly premium based on their family's income, size and number of family members covered. For the purposes of this report, we will refer to the population receiving publicly funded medical insurance as the Medicaid population, which will include both Medical Assistance and MinnesotaCare unless otherwise specified.

The non-Medicaid population in this report includes women who were covered by private health insurance, self-insured, or uninsured individuals. In 2002, overall figures indicate that 70.6 percent of Minnesotans were covered by some form of private health insurance, 24.0 percent were covered by public insurance and 5.4 percent of Minnesotans were uninsured. While we are not certain about the demographic characteristics of our non-Medicaid comparison group for this report, we do know that this group includes the uninsured. A report by the Health Economics Program at the Minnesota Department of Health (2002) indicated that significant differences existed between the uninsured and the overall weighted survey population.⁶ For example, this comparison indicated greater proportions of uninsured were in the 18-34 year old age range; more likely non-White; were less likely to be U.S. born; were more likely to be Hispanic, African American or American Indian; more likely to be poor; and a greater percent of the uninsured had less than a high school high school education. Women of childbearing age (17-44 years) had similar characteristics. Women in this age group were uninsured at a slightly higher percent than the overall uninsured rate (7.4% and 5.4% respectively); most likely to be uninsured were American Indian (23.7%), Hispanic (22.6%), or African American (17.7%); more often born outside of the U.S. (19.4%); high school graduate or less education (20.9%); and under 200% of the federal poverty guidelines (39.4%). Because the non-Medicaid group includes the uninsured some differences between

the Medicaid and the non-Medicaid group may not reflect the true difference between those with public and private insurance.

Definitions. Infant mortality is defined as death occurring within the first year of life. It is expressed as a rate of deaths per 1,000 live births. The rates in this report are calculated using linked birth and death certificates as opposed to calculating the crude infant mortality rate using the number of deaths and live births occurring in the same year. Linked data are preferable because they account for fluctuations in the number of births from year to year and also include more complete race data as well as information regarding prenatal care, conditions present at birth, and other maternal characteristics. Data represent infants born in calendar years 1997-2001.

Race and ethnicity categories are based on the race and ethnicity of the mother as reported on the birth certificate.⁷ On the birth certificate, race and Hispanic ethnicity were obtained separately and are analyzed separately in this report. Hispanic ethnicity includes anyone indicating they are of Hispanic/Latino descent irrespective of race. The combining of race and Hispanic infant deaths does not match total infant deaths because Hispanics, who can be any race, are counted in the race categories and because the “other” race category is excluded from this analysis.

Developed by Dr. Greg Alexander, the GINDEX determines adequacy of prenatal care by combining measures of the month or trimester prenatal care began, the number of prenatal visits and the gestational age of the fetus at the time of birth. The GINDEX includes gestational age of over 36 weeks and the number of prenatal visits exceeding nine to impute adequacy of prenatal care. GINDEX categories include: "adequate or better", where prenatal care started in the first trimester and the woman had an adequate number of prenatal visits; “intermediate”, prenatal care started in the first or second trimester and the woman had an intermediate range of visits; and “inadequate or none”, either that prenatal care

was nonexistent or started in the third trimester or that the woman had an inadequate number of visits, regardless of when prenatal care began.

Causes of infant death were categorized by ICD codes as indicated on the death certificate (Table 1). The categories are as follows: congenital anomalies, SIDS, prematurity, unintentional injury, maternal complications, placenta and/or cord complications, perinatal infections, respiratory distress syndrome, intrauterine hypoxia and birth asphyxia, and pneumonia or influenza. The congenital anomaly category includes birth defects of any of the major organ systems and specific anomalies such as spina bifida and anencephaly. The SIDS category includes both SIDS and any other ill-defined asphyxia-related cause of death.

Injuries include all injuries and accidents due to the environment or human actions including transport or motor vehicle accidents, accidental drowning and submersion, other accidental threats to breathing, or assaults (homicide). Maternal complications include hypertension, renal disease, and multiple gestation. Perinatal infections are infections contracted by the newborn and include meningitis or other infections specific to the perinatal period.

Table 1.
International Classification of Diseases (ICD 9 & 10)*

Cause of Death	ICD-9	ICD-10
Congenital Anomalies	740 - 795	Q00 - Q99
Sudden Infant Death Syndrome (SIDS)	798	R95
Prematurity	765	P07
Unintentional Injury	800 - 949	V01 - X59
Maternal Complications	761	P01
Placenta or Cord Complications	762	P02
Perinatal Infections	771	P35 - P39
Respiratory Distress Syndrome	769	P22
Intrauterine Hypoxia and Birth Asphyxia	771	P35 - P39
Pneumonia / Influenza	487	J10 - J18

*ICD 10 codes were adopted in the U.S. in 1999

Results

In 2000, there were 67,547 live births in Minnesota. Medicaid enrollees in Minnesota represented 31.3 percent of these births, lower than the percentage of Medicaid births in the U.S. (35.6 percent). In other states, Medicaid births range from 20.8 percent to 55.2 percent of total births. The 1997-2001 matched data set used for this report indicates some marked differences for the Medicaid and non-Medicaid populations (Table 2). Births rates to teen moms (age 15-19 years), are notably higher among the Medicaid population. In the Medicaid population, 19.5 percent of births are births to teen mothers as compared to 4.4 percent of non-Medicaid mothers. Education status also differed among Medicaid and non-Medicaid populations where 74.4 percent of Medicaid and 29.2 percent of non-Medicaid populations had medium to low years of education based on maternal age.

Analysis of descriptive data also indicated that a higher percent of Medicaid mothers were Women of Color. Whites were 71.2 percent of the Medicaid population and 91.5 percent of the non-Medicaid

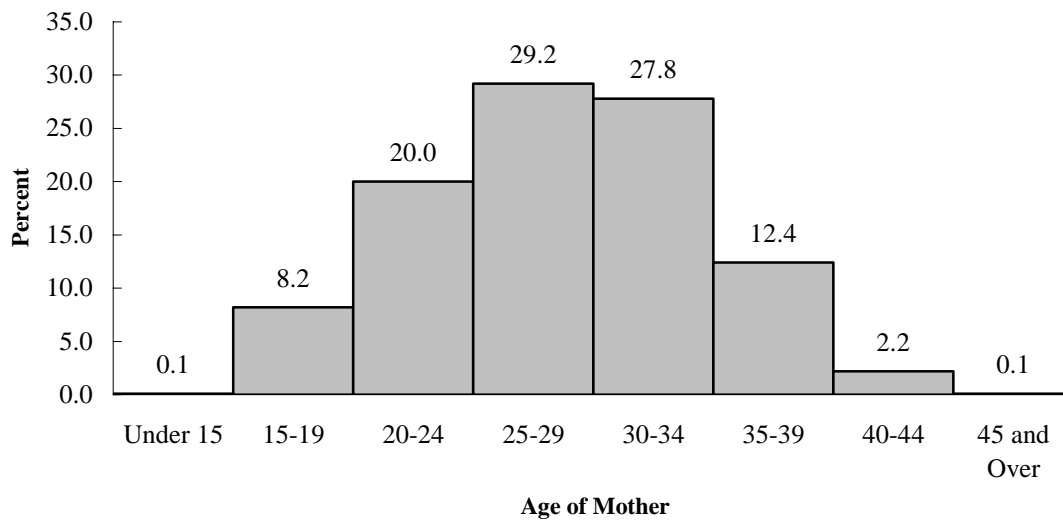
population. For each of the four major racial/ethnic groups identified, mothers were more likely to be enrolled in Medicaid at the time of the birth of their child. American Indian and African American women were five to seven times more likely to be enrolled in Medicaid than White women. Hispanics were over 5 times and Asians were almost one and half times as likely to be enrolled in Medicaid. Another striking difference in these populations was the percent of births to foreign-born mothers. Among the Medicaid population, 21.7 percent were foreign-born mothers as compared to 8.8 percent of non-Medicaid mothers. These data indicate that non-Medicaid mothers began prenatal care earlier. In fact, 89.4 percent began prenatal care in their first trimester of pregnancy as compared to 69.6 percent of Medicaid mothers. In terms of parity, or the number of births to one woman, Medicaid rates were higher than the non-Medicaid population. These groups also differed in self-reports of tobacco and alcohol use where Medicaid mothers reported using tobacco and alcohol three times more often than the non-Medicaid group.

Table 2.
Percent of Live Births to Medicaid and Non-Medicaid Populations
Select Comparisons. Minnesota 1997-2001

	Medicaid	Non-Medicaid		Medicaid	Non-Medicaid
Teen Mothers (15-19 yrs)	19.5%	4.4%	Maternal Race/Ethnicity		
			Asian	6.4%	4.3%
Education Status			African American	15.8%	2.7%
Low	26.2%	3.6%	American Indian	5.1%	0.7%
Medium	48.2%	25.7%	Hispanic	13.3%	2.5%
High	25.5%	70.7%	White	71.2%	91.5%
Parity (mean)	1.28	1.01	Trimester Prenatal Care Began		
Used Tobacco	25.5%	7.3%	First	69.6%	89.4%
Used Alcohol	2.5%	.6%	Second	24.2%	8.9%
			Third	6.2%	1.7%
Mother Foreign Born	21.7%	8.8%			

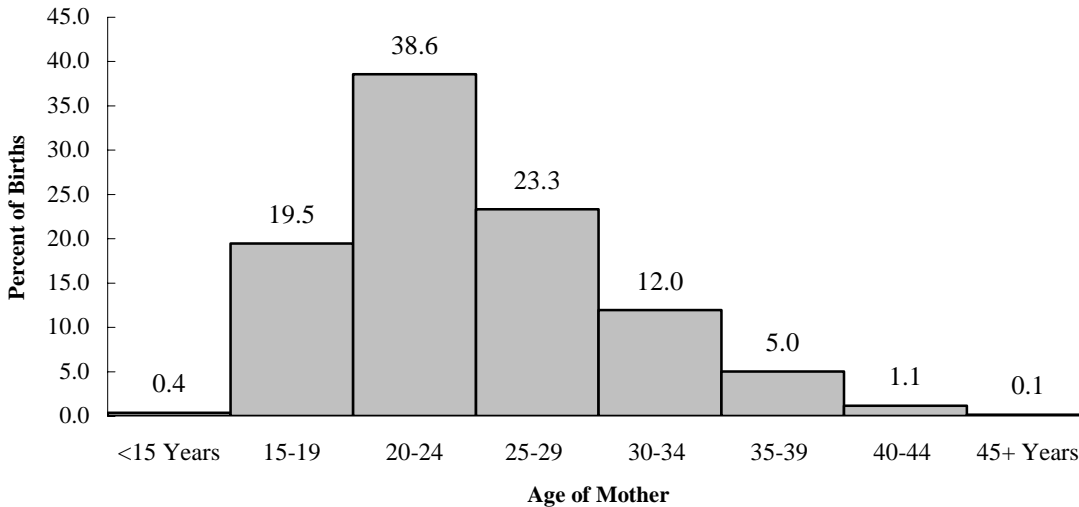
A distribution of overall births by age groups (Figure 1), indicates that most births occur to mothers in the 20-34 year old age groups. Overall, 29.2 percent of all births are to mothers in the 25-29 year old age group and 27.8 percent are to mothers in the 30-34 year old age group. A smaller percent of births occur in all other age groups with only a very small number of births occurring to women under 15 years older and 40 years old and older.

**Figure 1. Distribution of Births by Maternal Age
Minnesota, 1997-2001**



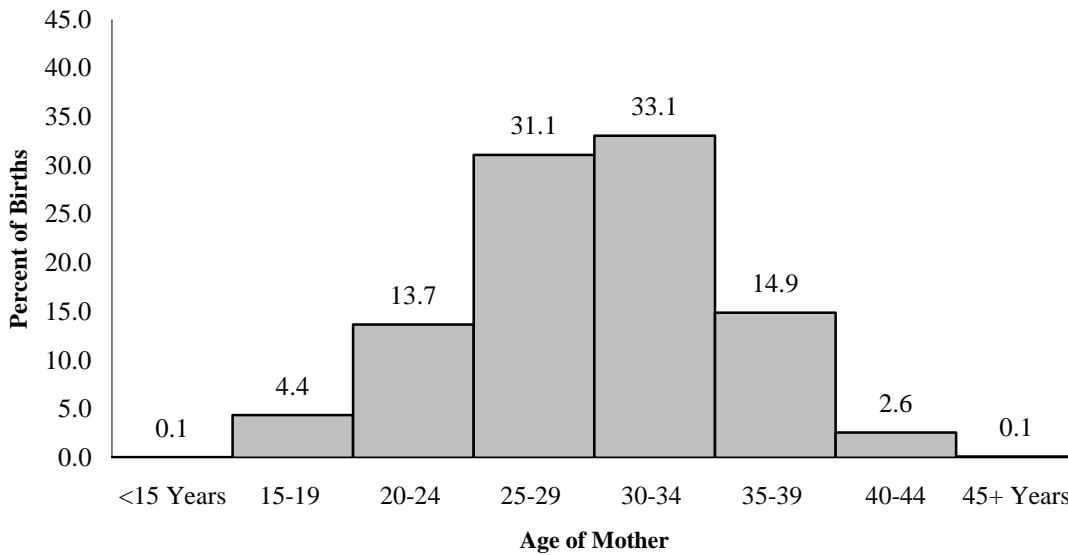
For the Medicaid population, the distribution of births is skewed toward younger maternal age at birth (Figure 2). The greatest proportion of births in the Medicaid population occur to mothers aged 20 to 24 (38.6%). Only 12 percent of the Medicaid births occurred to women aged 30 to 34.

**Figure 2. Medicaid Births by Maternal Age
Minnesota, 1997-2001**



By comparison, the non-Medicaid population has a higher proportion of births to older mothers (Figure 3). The greatest percent of births occur to women between the ages of 25 and 34 (64.2%), while only 13.7 percent of births occurred to women who are between 20 and 24 years of age.

**Figure 3. Non-Medicaid Births by Maternal Age
Minnesota, 1997-2001**



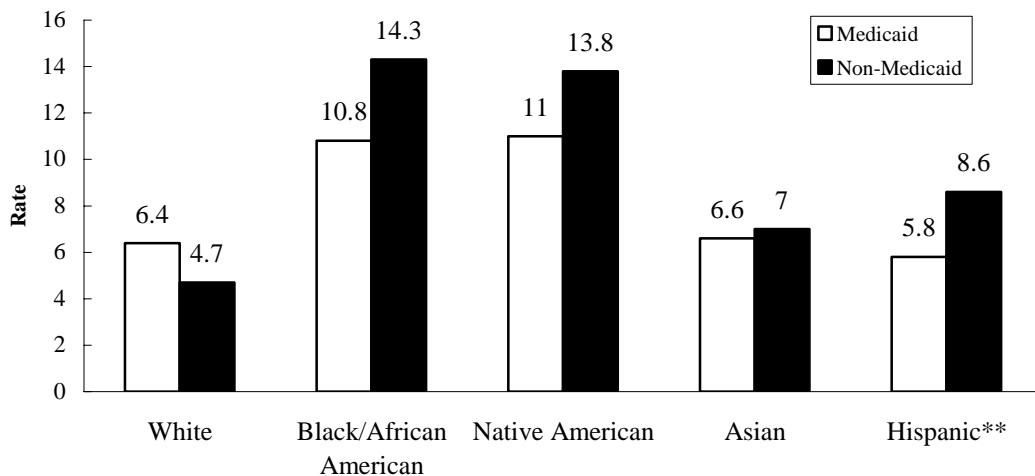
In calendar years 1997-2001, Minnesota as a whole had an infant mortality rate of 5.9 per 1,000 live births (Table 3). For Medicaid clients, the infant mortality rate was 7.6 deaths per 1,000 live births. Within Medicaid, clients served by Medical Assistance had an infant mortality rate of 7.8 deaths per 1,000 live births whereas the MinnesotaCare rate was 6.2 per 1,000.

Table 3. Infant Mortality Numbers and Rates by Race/Ethnicity and Medicaid Status, Minnesota, 1997-2001				
	Medicaid		Non-Medicaid	
	Number	Rate*	Number	Rate
White	380	6.4	1062	4.7
Black/African American	142	10.8	96	14.3
Native American	46	11.0	24	13.8
Asian	35	6.6	75	7.0
Hispanic**	64	5.8	53	8.62
All	614	7.4	1275	5.2

*Rate is number of deaths per 1,000 births
 **Hispanic ethnicity may include any race

Race-specific rates showed substantial variation, though few of these differences achieved statistical significance (Figure 4). Between Medicaid and non-Medicaid, the only population that differed significantly within racial category was Whites. Within Medicaid, Whites had significantly lower rates of infant mortality compared to all other racial categories. The only other statistically significant difference within the Medicaid population was between Asians and African Americans with Asians having a lower risk of infant mortality. Within the non-Medicaid population, Whites again had a statistically significant lower rate of infant mortality compared to all other racial categories. Also, significant difference between Asian and African American populations was seen again.

**Figure 4. Infant Mortality Rates by Race/Ethnicity and Medicaid Status
Minnesota 1997-2001**

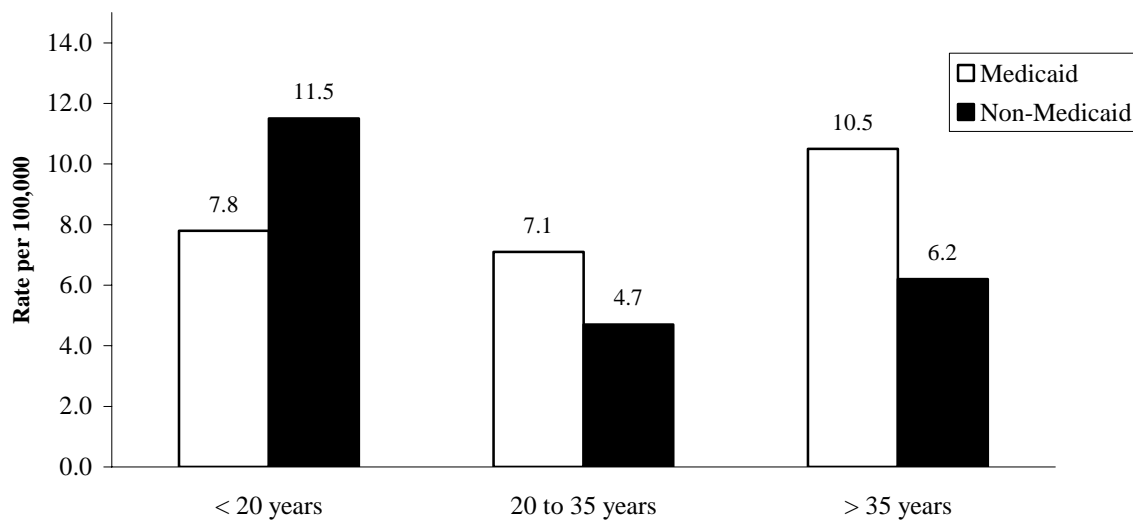


Ethnicity. Hispanic ethnicity is associated with higher infant mortality in the non-Medicaid population but lower infant mortality within the Medicaid population. While the difference between Hispanics and non-Hispanics in the non-Medicaid population is statistically significant, the difference in the Medicaid population is not. With those indicating Hispanic ethnicity, the rate in the Medicaid population is lower than the non-Medicaid rate, however this difference is not statistically significant.

Maternal Age. Age-of-mother-specific infant mortality rates indicate that women between the ages of 20 and 35 experience the lowest rates of infant death (Figure 5). And though the infant mortality rate for

teens is higher than the overall rate for the state, when comparing the Medicaid to non-Medicaid populations, teen mothers in Medicaid programs experienced a statistically significant lower infant mortality rate. Teen Medicaid mothers had an infant mortality rate of 7.8 per 1,000 whereas teen mothers not utilizing Medicaid programs had an infant mortality rate of 11.5 per 1,000. In the other age categories, however, Medicaid participants had significantly higher rates of infant mortality than the non-Medicaid population. For women aged 20 to 35, Medicaid clients and non-Medicaid clients had rates of 7.1 and 4.7 per 1,000 respectively. For women over the age of 35, the rates were 10.5 and 6.2 per 1,000 for Medicaid and non-Medicaid births respectively.

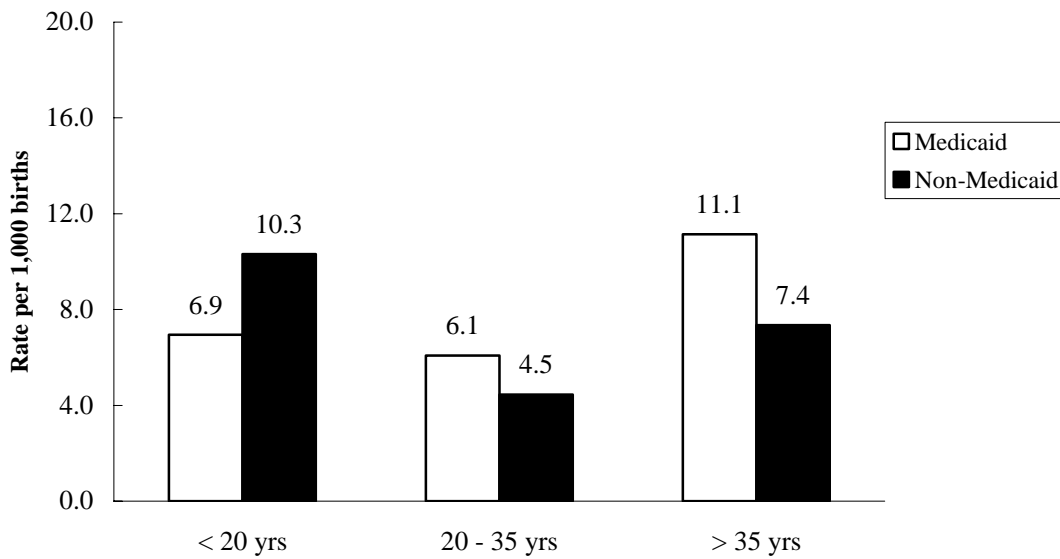
**Figure 5. Infant Mortality Rates by Age of Mom
Minnesota 1997-2001**



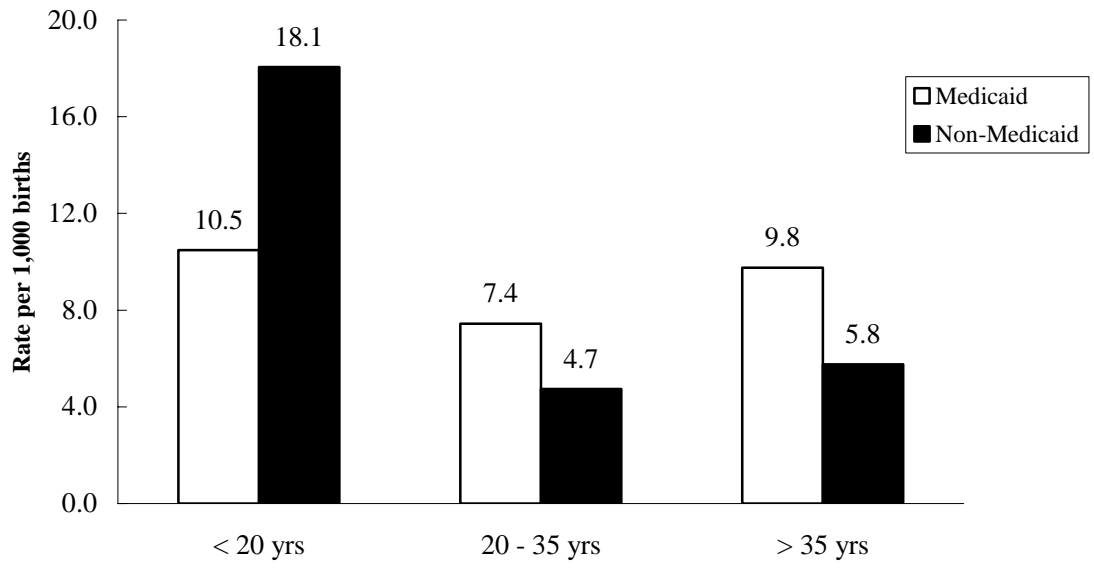
Parity and Infant Death. Parity is the number of live births to one woman. Comparing Medicaid and non-Medicaid populations, the only statistically significant differences are between those in the 20 to 35 year old age range with the non-Medicaid group having lower infant mortality rates. This is true for both first and subsequent births (Figures 6,7). Within Medicaid, there are no statistically significant differences (Figure 8). Within the non-Medicaid group, mothers under 20 years had a significantly higher infant mortality rate for both first and subsequent births than the other age categories; however, first and

subsequent births to teens did not differ significantly (Figure 9). Within first births to non-Medicaid women, those in the over 35 category did have a significantly higher rate of infant mortality than the 20 to 35 age range.

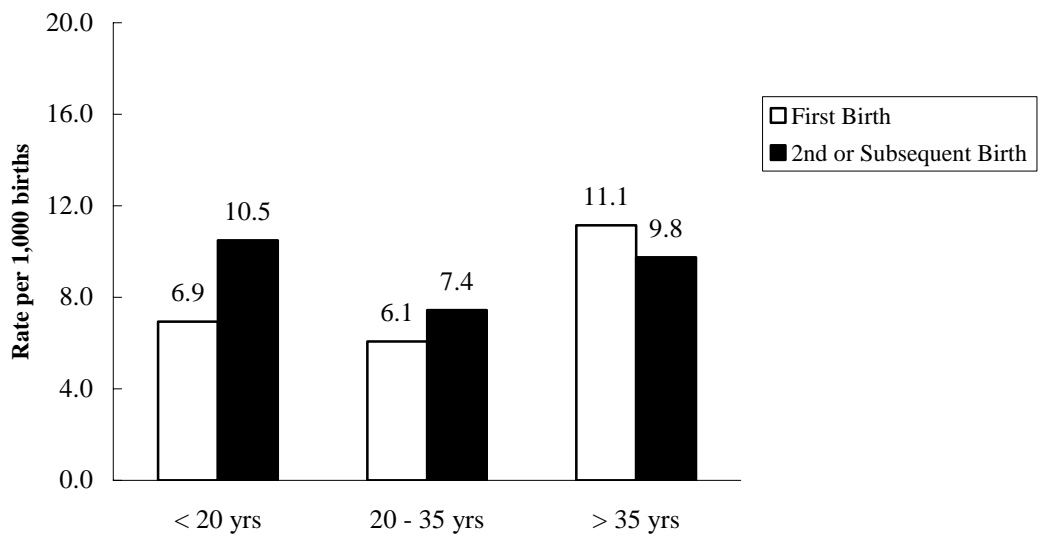
Figure 6. Infant Mortality Rates for 1st Birth Medicaid v. Non-Medicaid, Minnesota 1997-2001



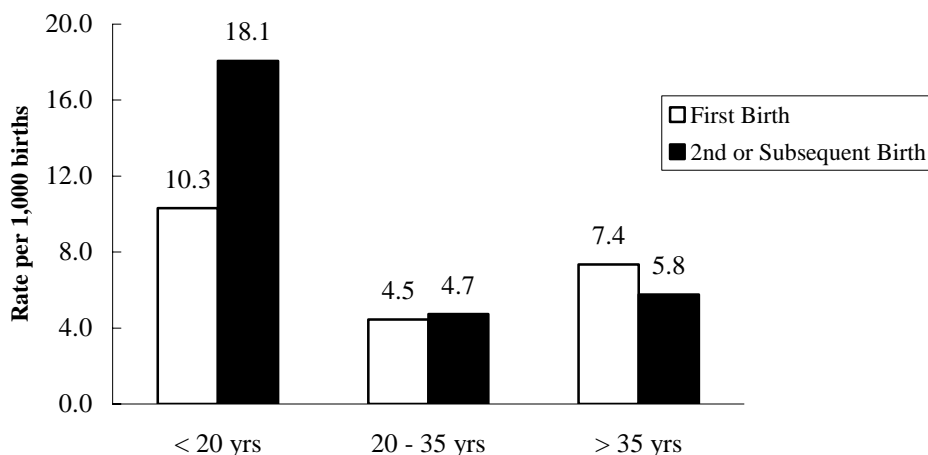
**Figure 7. Infant Mortality Rates for 2nd or More Births
Medicaid v. Non-Medicaid, Minnesota 1997-2001**



**Figure 8. Infant Mortality Rates by 1st and Subsequent Births
Medicaid, Minnesota 1997-2001**

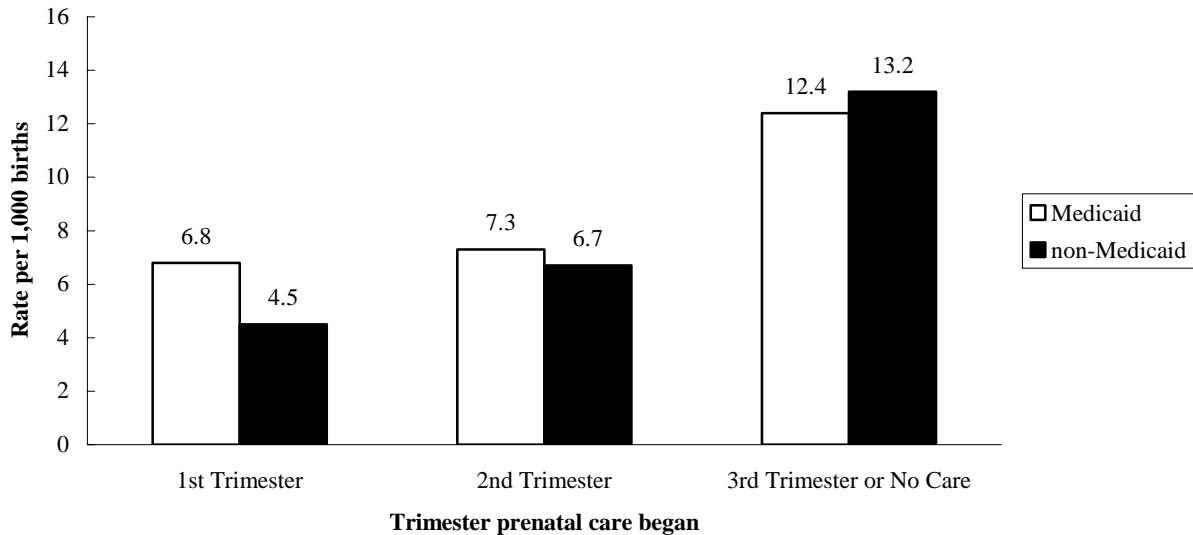


**Figure 9. Infant Mortality Rates by 1st and Subsequent Births
Non-Medicaid, Minnesota 1997-2001**



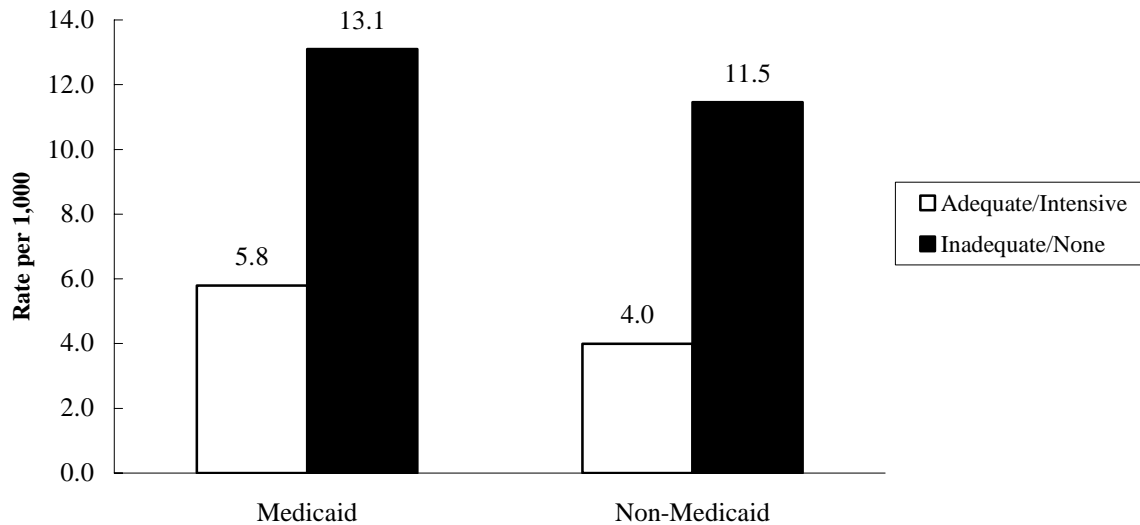
Prenatal Care and Infant Mortality. Early and adequate prenatal care has been promoted as a means to improve birth outcomes. Non-Medicaid women receiving care in the first trimester had a significantly lower risk of infant death than Medicaid women who also initiated care during the first trimester (Figure 10). There were no statistically significant differences between Medicaid and non-Medicaid for those who began care in the second trimester or for those who began care in the third trimester/received no care. Within the Medicaid group, there was no significant difference in infant mortality between those initiating care in either the first or second trimester. Those beginning care in the third trimester or receiving no prenatal care at all, however, did differ significantly from those who began care earlier. Within the non-Medicaid population, women beginning care in the first trimester had a significantly lower rate of infant mortality than those who initiated care later. Those starting care in the second trimester also had a rate of infant mortality lower than those beginning prenatal care in the third trimester or who received no prenatal care at all.

**Figure 10. Infant Mortality Rates by Initiation of Prenatal Care: Minnesota
1997-2001 Medicaid v. Non-Medicaid**



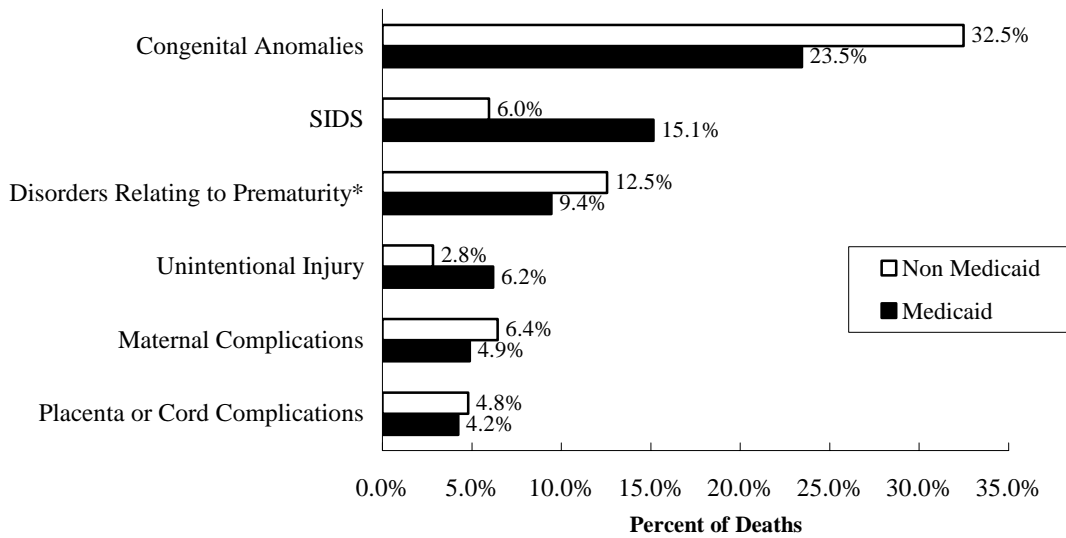
Adequacy is a measure that combines the trimester prenatal care began along with the number of visits received during pregnancy. Using the GINDEX categories, those who received adequate/intensive prenatal care had a lower risk of infant death than those who received inadequate/no prenatal care, irrespective of Medicaid status (Figure 11). Non-Medicaid women who received adequate/intensive prenatal care had a significantly lower infant mortality rate than Medicaid women who also received that level of care. There were no significant differences between women who received inadequate or no prenatal care between Medicaid and non-Medicaid populations.

**Figure 11. Infant Mortality Rates by Prenatal Care Index
Medicaid v. non-Medicaid, Minnesota 1997-2001**



Infant Mortality Causes. The percent of total deaths for cause-specific infant mortality were also calculated in both the Medicaid and non-Medicaid populations (Figure 12). In both the Medicaid and non-Medicaid groups, congenital anomalies accounted for the greatest percent of infant deaths. A total of 23.5 percent of Medicaid and 32.5 percent of non-Medicaid infant deaths were due to congenital anomalies. In the Medicaid population, another 15.1 percent of deaths were attributed to SIDS accounting for the second greatest percent of infant deaths in this population. SIDS accounted for only 6.0 percent of non-Medicaid infant deaths. The second largest percent of deaths in the non-Medicaid population was due to disorders related to prematurity (12.5 percent), while disorders related to prematurity accounted for 9.4 percent of infant deaths in the Medicaid population. There were also differences in other causes of death for these two populations. Unintentional injury accounted for 6.2 percent of Medicaid deaths, and only 2.8 percent of infant deaths in the Non-Medicaid population. The Non-Medicaid populations had greater percentages of infant deaths due to maternal complications and placenta or cord complications as compared to the Medicaid population.

Figure 12. Causes of Death Medicaid v. Non Medicaid, 1997-2001



Prematurity. Infants born at less than 37 weeks of gestation have a much higher risk of mortality than those born at or near full term. Both Medicaid and non-Medicaid had very high rates of infant mortality for preterm births (Table 4). While the preterm Medicaid rate is higher than the non-Medicaid rate, the difference is not statistically significant. However, in full term births, the non-Medicaid population had a significantly lower rate.

**Table 4.
Infant Mortality Rates and Gestation, Medicaid and Non-Medicaid
Minnesota, 1997-2001**

	Non-Medicaid		Medicaid	
	Number	Rate	Number	Rate
Full term	412	3.9	245	2.0
Preterm	625	33.3	230	31.6

Infant Mortality and Infant Birthweight. Infant mortality is highly correlated with birth weight. Not surprisingly, infants born at lower birth weights are less likely to survive. The highest rates of infant

mortality are found in those weighing less than 500g for both Medicaid and non-Medicaid (Table 5). Within the Medicaid group, all birth weight categories differed statistically significantly with the exception of normal and high birthweight infants. Within the non-Medicaid group, all weight categories differed significantly. Between groups, the only weight category where Medicaid and non-Medicaid rates of infant mortality differed significantly was that of normal weight.

Table 5. Infant Mortality (Singleton) by Birthweight: Minnesota, 1997-2001

Medicaid v. Non-Medicaid

	Medicaid		Non-Medicaid	
	Number	Rate	Number	Rate
Extremely Low (<500 g)	82	752.3	262	837.1
Very Low (500 to 1499 g)	139	138.9	334	146.0
Moderately Low (1500 to 2499 g)	105	21.0	196	17.5
Normal (2500 to 4000 g)	261	3.8	414	2.1
High (>4000 g)	21	2.6	43	1.2

Infant Age at Death. When examining the percent of total deaths between the Medicaid and non-Medicaid populations, 39.9 percent of the non-Medicaid deaths and 28.8 percent of Medicaid deaths occur within 24 hours of birth (Table 6). Through the end of the first week, cumulative percents of 60.6 of non-Medicaid deaths and 42.9 percent of Medicaid deaths occur among these populations. Between 8 and 28 days, the percent of deaths is roughly equal between the two populations (12.3 and 13.0 percent for Medicaid and non-Medicaid, respectively). After 28 days and through the first year, Medicaid death rates are substantially higher than non-Medicaid death rates.

Table 6. Infant Age at Death
Minnesota, 1997-2001

Medicaid Non-Medicaid

	Number	Percent	Number	Percent
Less than one day	171	28.8	499	39.9
One through Seven days	84	14.1	259	20.7
8 through 28 days	73	12.3	163	13.0
29 through 365 days	240	40.4	297	23.7

Multiple Births and Infant Mortality. Multiple birth infants have higher risk of infant mortality than singletons. When comparing singleton births to multiples births, multiples have an infant mortality rate of 24.7 compared to 5.2 for singletons. Medicaid infants have significantly worse outcomes for multiples and singletons than the non-Medicaid infants (Table 7).

Table 7. Infant Mortality by Birth Number
Minnesota 1997-2001, Medicaid v. Non-Medicaid

	Medicaid		Non-Medicaid	
	Number	Rate*	Number	Rate
Singleton	540	6.7	1073	4.5
Multiple	74	36.1	202	22.7

*Infant Mortality Rate per 1,000 births

Discussion

While there are many factors that research indicates may have an impact on infant mortality rates, this paper has provided a comparison of Medicaid and non-Medicaid using several distinct factors, including characteristics of the mother, prenatal care, and birth outcomes.

As expected, Medicaid recipients overall had a higher infant mortality rate than the non-Medicaid population. Medicaid recipients, by definition, are of low socio-economic status, which is associated with poorer birth outcomes in the United States.^{8,9} What is interesting, however, is that for teenaged mothers, Medicaid recipients actually fared better than their non-Medicaid counterparts with regard to infant mortality. This phenomenon has been reported in other states as well^{10,11}

Research is clear that infants of teen mothers, for both biological and social reasons, have higher infant mortality than infants of older mothers.^{12,13} However, in our study, mothers under 20 in the Medicaid group had a lower risk of infant mortality than teen mothers in the non-Medicaid group. The data suggest that Medicaid serves pregnant teens better than non-Medicaid. However, the results of this study are inconclusive and unable to explain this difference. Birth and infant death data from the state of Alabama (1991-94) found similar results on the relative risk of infant mortality for teen mothers on Medicaid vs self pay vs privately insured as compared to older mothers covered by those three types of payers.¹⁴

With regard to race, White non-Medicaid mothers had better outcomes than White Medicaid mothers. For all other race categories, however, those women enrolled in Medicaid had a lower risk of infant mortality than their same-race non-Medicaid counterparts. It is noteworthy, however, that the infant mortality rate for White Medicaid recipients is lower than all of the populations of color groups except for the Asian population. This finding is consistent with infant mortality rates by race in Minnesota and throughout the U.S.⁹ Hispanic ethnicity follows a similar pattern to race in that Hispanic Medicaid mothers had no significant difference in the risk of infant mortality than their non-Medicaid counterparts.

The interplay of parity and age did not have the expected effect on infant mortality found in a previous study of adolescent births and infant deaths in Minnesota. Comparing first to subsequent births to teen-aged mothers in both the Medicaid and non-Medicaid populations, subsequent births did not have an increased risk of infant mortality unlike findings from other studies.^{14,15,16} Differences between this study and the previous Minnesota study may be somewhat explained by larger numbers of events and the time frame—their data were from all linked births and infant deaths to adolescents in Minnesota from 1980-88.¹⁵ Infant mortality rates have declined for all groups and populations since the 1980s.

Unintentional injury deaths accounted for a high proportion of the deaths in the Medicaid population. Other studies report similar disparities. A North Carolina study compared injury deaths to infants and children by Aid to Families with Dependent Children (AFDC) status vs non AFDC children and found higher rates in the AFDC children.¹⁷ Other studies used proxy demographic indicators for low income including maternal age, education, lack of prenatal care, and race and found similar results.^{18,19,20} Of the injury-related deaths in the Medicaid population, over one in three was related to co-sleeping with adults compared to less than one in five in the non-Medicaid population. Why co-sleeping related deaths are higher in the Medicaid population is unclear. One study examined co-sleeping deaths specifically in low income African American populations in Chicago and St. Louis. The results of this study indicated that the Medicaid population was more likely to lack adequate sleeping accommodations, i.e. a safe crib, than the non-Medicaid population.^{21,22} Given the low income of the Medicaid population, the lack of a suitable crib is plausible and has been seen elsewhere.^{23,24} The National Infant Sleep Position Study has determined that bedsharing is a growing trend in the U.S. among many populations with Black or Asian race, maternal age below 18, and low income being the strongest predictors.²⁵

Also higher for the Medicaid population was the proportion of deaths due to Sudden Infant Death Syndrome (SIDS). It was noted that mothers on Medicaid were much more likely to report smoking during the pregnancy than non-Medicaid mothers (25.5% vs 7.3%). Fetal exposure to tobacco may double or triple an infant's risk for SIDS.^{26,27} Fetal exposure combined with the likely exposure to environmental tobacco smoke in the home during infancy, could also account for some of the difference in the proportion of SIDS deaths in the two populations.²⁸ Other factors potentially contributing to this disparity could be an increased risk of prematurity in the Medicaid population, differences in infant sleep position among some Medicaid participants such as teens, and use of improper bedding materials.²⁸ Although, technically, positional asphyxia, entrapment, or overlay by soft and/or excessive bedding material or other unsafe sleep environments should not be counted as a SIDS death, the likelihood of improper coding on the death certificate for at least some deaths in Minnesota is possible.

Onset and adequacy of prenatal care was selected as a comparison factor because it is recorded on the birth certificate and because one of the Medicaid program's primary roles is to provide health care coverage to low income women so they have access to prenatal care. Much research has been reported stating what prenatal care can't do. In particular it cannot entirely prevent preterm births and low birth weight births.²⁹ It has also been known for over a decade that when preconception care is provided and pregnancies are intentional or planned, births are more likely to be healthy than when just prenatal care is provided.^{29,30,31} However, low income women who are not pregnant may have interruptions in their health insurance coverage making it unlikely that they will get preconception care. Nor do we know even of the non-Medicaid population how many women actually get preconception care since no data collection or reporting is done. What we can safely say is that lack of access to the screening and testing and health care routinely provided during prenatal care as well as health and nutrition education, behavioral advice, and childbirth preparation puts mother and baby at much great risk of poor birth outcomes including death.³²

Both populations who began care in the first or second trimester had significantly lower rates of infant death. Lower rates of infant death were achieved by women in both populations who had the recommended number of prenatal care visits (adequate/intensive). The measure does not account for the quality and content of care. The data in this report demonstrate that lower rates of infant death are achieved when prenatal care begins early and continues appropriately throughout the pregnancy.

Much of the other findings in this paper are as expected. It comes as no surprise that in both Medicaid and non-Medicaid populations premature infants experienced a much higher risk of mortality, as did infants born in multiple births.^{29,33} For multiple births, non-Medicaid infants had a lower risk of death when compared to the Medicaid population. Low birthweight is also associated with an increased risk of

mortality for all infants.^{32,34} However, no differences in infant mortality between the Medicaid and non-Medicaid groups were found for premature/low birth weight infants.

Limitations

The small number of infant deaths during the study period make the rates for infant mortality highly susceptible to random variation, especially rates calculated for sub-populations. For many rates the confidence intervals are very wide and make interpreting the data difficult. Several other limitations of this data became apparent including a lack of a clear description of Non-Medicaid population.

When working with birth and death certificate data, it is important to keep in mind the data are not collected for research purposes. Specific to these analyses, race and ethnicity are not always accurate due to the lack of self-report or misinterpretation of race categories. The determination of cause of death may be inconsistent between physicians and coroners/medical examiners. Also of concern is the lack of procedural consistency from facility to facility in the completion of the birth certificate form.

While Medicaid status is a proxy for poverty or low income level, the non-Medicaid group is comprised of both privately insured births and those without any medical coverage. While it is tempting to suggest that this report is largely a comparison of poor versus not poor Minnesotans, or those with Medicaid coverage versus those with private health coverage, that would not be wholly accurate. This limitation, however, does not exaggerate the effect of poverty on infant mortality and may, in fact, mask more acute differences in experience between those living in poverty and not. Additionally, those assigned to the Medicaid population may not have been covered for the length of their pregnancy. It is known that in approximately 70% of pregnancies covered by Medicaid, the woman enrolled because she was pregnant and thereby met the lowered income guidelines for pregnant women (275% vs. 175% of Federal Poverty Level). It is not known, however, when in the pregnancy a woman enrolls, how quickly her application is processed, and when she may actually begin to get care. In some cases it is likely that coverage was

obtained after the delivery of the child (Medicaid coverage is retroactive). Therefore, some of the women in the Medicaid group were actually uninsured for most or all of their pregnancy and received little or no prenatal care. Their outcomes associated with prenatal care may not accurately match the experience of women who were enrolled for the full duration of their pregnancy.

Further Research

Further research is needed to elucidate the relationships between improved outcomes for teen mothers and women of color and Medicaid status. It would be interesting to know if these findings were unique to the Minnesota population or if other states had a similar experience. Additional years of data from Minnesota would also be of interest. The increased number of events would make further investigation into the finding presented in this report possible. Also, national level data examining the outcomes of both Medicaid and non-Medicaid populations would be helpful for policy decision making. With these data, additional analyses should be carried out to examine the relative effects of Medicaid status, race, age, and other factors on infant mortality. Ideally, it would be of interest to compare Medicaid recipients and those with private insurance.

¹ National Center for Health Statistics. Health, United States, 2004. With Chartbook on Trends in the Health of Americans, Hyattsville, Maryland: 2004

² Ibid

³ MacDorman MF, Martin JA, Matthews TJ, et al. Explaining the 2001-02 infant mortality increase: Data from the linked birth/infant death data set. National vital statistics reports; vol 53 no 12. Hyattsville, Maryland; National Center for Health Statistics. 2005.

⁴ 2002 Minnesota Vital Statistics, Minnesota Center for health Statistics, Minnesota Department of Health.

⁵ Gyllstrom, ME, Jensen, JL, Vaughan, JN, Castellano, SE, Oswald, JW. Linking Birth Certificates with Medicaid Data to Enhance Population Health Assessment: Methodological Issues Addressed. Journal of Public Health Management Practice, 2002, 8(4), 38-44.

⁶ 2001 Minnesota Health Access Survey, MDH Health Economics Program. Please contact the Health Economics Program for more information on the results of this study

⁷ Racial and Ethnic definitions include the following.

“White” refers to people having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicated their race or races as “White” or wrote in entries such as Irish, German, Italian, Lebanese, Near Easterner, Arab, or Polish.

“Black or African American” refers to people having origins in any of the Black racial groups of Africa. It includes people who indicated their race or races as “Black, African Am., or Negro,” or wrote in entries such as African American, Afro American, Nigerian, or Haitian.

“American Indian and Alaska Native” refers to people having origins in any of the original peoples of North and South America (including Central America), and who maintain tribal affiliation or community attachment. It includes people who indicated their race or races by marking this category or writing in their principal or enrolled tribe, such as Rosebud Sioux, Chippewa, or Navajo.

“Asian” refers to people having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent. It includes people who indicated their race or races as “Asian Indian,” “Chinese,” “Filipino,” “Korean,” “Japanese,” “Vietnamese,” or “Other Asian,” or wrote in entries such as Burmese, Hmong, Pakistani, or Thai. For purposes of this report, “Asian” also includes those of “Native Hawaiian and Other Pacific Islander” descent.

Hispanic and non-Hispanic ethnicity use the following definition. Hispanics may be of any race.

“Hispanic or Latino” refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The term, “Spanish origin” can be used in addition to “Hispanic or Latino”

⁸ Rodwin V, Neuberger L. Infant mortality and income in 4 world cities: New York, London, Paris, and Tokyo. *Am J Public Health*. 2005;95:86-90.

⁹ Hogue CJ, Hargraves MA. Class, race, and infant mortality in the United States. *Am J Public Health*. 1993;83:9-12.

¹⁰ Guillory VJ, Samuels ME, Probst JC, Sharp G. Prenatal care and infant birth outcomes among Medicaid recipients. *J of Health Care for Poor and Underserved*. 2003;14:272-289.

¹¹ Moss NE, Carver K. The effect of WIC and Medicaid on infant mortality in the United States. *Am J Public Health*. 1998;88:1354-1360.

¹² American Academy of Pediatrics Committee on Adolescence. Care of adolescent parents and their children. *Pediatrics*. 2001;107:429-434.

¹³ Phipps MG, Blume JD, DeMonner SM. Young maternal age associated with increased risk of postneonatal death. *Obstet Gynecol*. 2002;100:481-486.

¹⁴ Cowden AJ, Funkhouser E. Adolescent pregnancy, infant mortality, and source of payment for birth: Alabama residential live births, 1991-1994. *J Adolesc Health*. 2001;29:37-45.

¹⁵ Hellerstedt WL, Pirie PL, Alexander GA. Adolescent parity and infant mortality, Minnesota, 1980 through 1988. *Am J Public Health*. 1995;85:1139-1142.

¹⁶ Scholl TO, Hediger ML, Belsky DH. Prenatal care and maternal health during adolescent pregnancy: a review and meta-analysis. *J Adolesc Health*. 1994;15:444-456.

¹⁷ Nelson MD. Socioeconomic status and childhood mortality in North Carolina. *Am J Public Health*. 1992;82:1131-1133.

-
- ¹⁸ Scholer SJ, Hickson GB, Ray WA. Sociodemographic factors identify US infants at high risk of injury mortality. *Pediatrics*. 1999;103:1183-1188.
- ¹⁹ Tomashek KM, Hsia J, Iyasu S. Trends in postneonatal mortality attributable to injury, United States, 1988-1998. *Pediatrics*. 2003;111:1219-1225.
- ²⁰ Brenner RA, Overpeck MD, Trumble AC, DerSimonian R, Berendes H. Deaths attributable to injuries in infants, United States, 1983-1991. *Pediatrics*. 1999;103:968-974.
- ²¹ Hauck FR, Herman SM, Donovan M, Iyasu S, Moore CM, Donoghue E, Kirschner RH, Willinger M. Sleep environment and the risk of sudden infant death syndrome in an urban population: The Chicago infant mortality study. *Pediatrics*. 2003;111:1207-1214.
- ²² Unger B, Kemp JS, Wilkins D, Psara R, Ledbetter T, Graham M, Case M, Thach BT. Racial disparity and modifiable risk factors among infants dying suddenly and unexpectedly. *Pediatrics*. 2003;111:e127-e139.
- ²³ Vemulapalli C, Grady K, Kemp JS. Use of safe cribs and bedroom size among African Americans with a high rate of bed sharing. *Arch Pediatr Adolesc Med*. 2004;158:286-289.
- ²⁴ Brenner RA, Simons-Morton BG, Bhaskar B, Revenis M, Das A, Clemens JD. Infant-parent bed sharing in an inner-city population. *Arch Pediatr Adolesc Med*. 2003;157:33-39.
- ²⁵ Willinger M, Ko C, Hoffman HJ, Kessler RC, Corwin MJ. Trends in infant bed sharing in the United States, 1993-2000 The national infant sleep position study. *Arch Pediatr Adolesc Med*. 2003;157:43-49.
- ²⁶ Wisborg k, Kesmodel U, Henriksen TB, Olsen SF, Secher NJ. A prospective study of smoking during pregnancy and SIDS. *Arch Dis Child*. 2000;83:203-206.
- ²⁷ Anderson ME, Johnson DC, Batal HA. Sudden infant death syndrome and prenatal smoking: rising attributed risk in the Back to Sleep era. *BioMed Central J*. 2005; 3:4
- ²⁸ American Academy of Pediatrics Task Force on Infant Sleep Position and Sudden Infant Death Syndrome. Changing concepts of sudden infant death syndrome: Implications for infant sleeping environment and sleep position. *Pediatrics*. 2000;105:650-656.
- ²⁹ Goldenberg RL, Rouse DJ. Prevention of premature birth. *N Engl J of Med*. 1998;339:313-320.
- ³⁰ Korenbrot CC, Steinberg A, Bender C, Newberry S. Preconception care: A systematic review. *Maternal Child Health J*. 2002;6:75-88.
- ³¹ March of Dimes Birth Defects Foundation. March of Dimes Update: Is early prenatal care too late? *ContemporaryOB/GYN*.2002; <http://www.contemporaryobgyn.net>
- ³² CDC. Healthier mothers and babies. *MMWR*. 1999;48:849-859.
- ³³ Kogan MD, Alexander GA, Kotelchuck M, MacDorman MF, Buekens P, Martin J, Papiernik E. Trends in twin birth outcomes and prenatal care utilization in the United States, 1981-1997. *JAMA*. 2000;284:335-341.
- ³⁴ CDC. Infant mortality and low birth weight among black and white infants—United States, 1980-2000. *MMWR*.2002;51:589-592.