

Risk of Infant Mortality by Race/Ethnicity among Preterm Infants at Different Gestational Ages

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Abstract

Background: Preterm infants born at earlier gestational ages are at greater risk for mortality compared to late-preterm or term infants. There is a strong association between infant mortality and an infant's race/ethnicity at all gestational ages. This study assessed infant mortality relative to race/ethnicity among preterm infants in three gestational age groups. A secondary analysis evaluated mortality by race/ethnicity relative to the timing of death (neonatal vs. post-neonatal mortality).

Methods: Washington State linked Birth and Death Certificates for infants born between 1984 and 2009 were used to identify cases, defined as live-born infants who died within the first 364 days, and controls, defined as infants who did not die in the first year. Controls were matched to cases on gestational age and year of birth. Subjects were stratified by gestational age at birth into three groups: 24-27 weeks, 28-32 weeks, and 33-36 weeks. Logistic regression was used to calculate odds ratios for mortality by race/ethnicity within each gestational age group.

Results: Among infants born at 24-27 weeks and 28-32 weeks, Black infants were less likely to die in the first year compared to White infants (OR: 0.69, 95% CI: 0.56, 0.86 and OR: 0.69, 95% CI: 0.53, 0.91 respectively). Hispanic and Asian/Pacific Islander infants born at 33-36 weeks were less likely to experience infant mortality compared with White infants (OR: 0.72, 95% CI: 0.56, 0.91 and OR: 0.69, 95% CI: 0.52, 0.91, respectively). Evaluation of timing of death indicated that Black infants born at 24-27 weeks were more likely to experience post-neonatal mortality relative to neonatal mortality, compared with White infants in that gestational age range (OR: 2.15, 95% CI: 1.46, 3.17). Hispanic infants born at 33-36 weeks were less likely to experience post-neonatal mortality relative to neonatal mortality compared with White infants (OR: 0.57, 95% CI: 0.37, 0.87).

Conclusions: The results of this study suggest that interventions to prevent infant mortality among preterm infants must consider both the gestational age at birth and the race/ethnicity of the infant. Infants at increased risk of post-neonatal mortality require continued support and services following hospital discharge.

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Introduction

The United States infant mortality rate declined rapidly in the 1990's; however, since 2000, the rate of decline has slowed significantly. Between 1990 and 2000 the infant mortality rate decreased from 9.2 deaths to 6.9 deaths per 1,000 live births.^{1,2} Through 2009, however, the infant mortality rate declined only minimally to 6.5/1,000 live births.³ This apparent plateau is believed to be partially attributable to the increase in preterm birth in the United States.⁴ The rate of preterm birth, defined as birth between 22 and 36 weeks gestational age, has increased in the United States by more than 20%, from 9.4% of all live births in 1981 to 12.0% in 2010.^{5,6} Achieving continued reduction in infant mortality rates in the United States requires increased emphasis on reducing preterm birth and improving outcomes for preterm infants.

Preterm infants born at earlier gestational ages are at greater risk for mortality than late-preterm or term infants.^{7,8} In 2007, the infant mortality rate in Washington State for infants born between 24 and 27 weeks gestation was 190.7/1,000 live births, 36.6/1,000 for infants born between 28-32 weeks, and 6.8/1,000 live births for infants born between 34 and 36 weeks gestation.⁹ Studies have shown a strong association between infant mortality and an infant's race/ethnicity at all gestational ages, including term infants.¹⁰⁻¹⁵ In 2009, White infants accounted for 81.7% of live births in Washington State, Black infants accounted for 5.0%, Native American infants 2.2%, and Hispanic infants 19.2% of all births.¹⁶ In 2009, the infant mortality rate in Washington State for all non-Hispanic black infants was 7.9/1,000 live births and Native American infants 9.9/1,000 live births, whereas the infant mortality rate was 4.6/1,000 for White infants and 5.2/1,000 for Hispanic infants.¹⁷ Given these disparate infant mortality rates, it is important to understand the impact of race/ethnicity on infant mortality among infants born at different gestational ages.

Studies also suggest that the timing of infant death within the first year varies by infant race/ethnicity.^{11,15,18-20} A study in North Carolina reported that, compared to White infants, Black infants

were at increased risk for post-neonatal mortality (death between 28 and 364 days of life) and Hispanic infants were at decreased risk for post-neonatal mortality.¹⁵ The authors concluded that, in order to reduce infant mortality rates in North Carolina, attention should be given to underlying socioeconomic factors that contribute to the increased risks for post-neonatal mortality among Black infants.¹⁵

The purpose of the present study was to assess infant mortality relative to race/ethnicity among premature infants within three preterm gestational age groups, while controlling for known risk factors. A secondary analysis evaluated infant mortality by race/ethnicity relative to time of infant death within the first year of life. We hypothesized that the differential impact of race/ethnicity on infant mortality would be more pronounced in older preterm gestational age groups (33-36 weeks) than in the earlier preterm age groups (24-27 weeks and 28-32 weeks). Given the complex medical needs of extremely preterm infants, care in the neonatal period is provided in specialized hospitals and is not likely to not vary by race. Late preterm infants, however, are less likely to receive specialized medical care, so infant outcome can be influenced by socioeconomic factors of home and community environment which may vary by race.

Methods

Subjects:

Subjects were infants born between 1984 and 2009, selected from the Washington State linked Birth and Death Certificates. Cases were defined as infants born between 24-36 weeks gestation who died within 364 days of birth and were identified through linked birth and death certificate records. Controls were randomly selected from birth certificate data of infants who did not have a record of death in the first year in the linked death certificate file. Controls were frequency matched to cases on week of gestational age at birth and year of birth in a 2:1 ratio of controls to cases with the exception of infants born between 24-27 weeks gestation, where all surviving infants were included as controls.

Subjects were categorized into three gestational age groups at birth: 24-27 weeks, 28-32 weeks, and 33-36 weeks. Use of the data was approved by the Institutional Review Boards for Human Subjects at the University of Washington.

Study Variables:

Standardized methods were used to determine gestational age at birth. Gestational age was estimated using the date of last menstrual period and confirmed using first trimester ultrasound data as recorded on the birth certificate. If gestational age based on last menstrual period and first trimester ultrasound differed by more than two weeks, gestational age based on ultrasound was used. If gestational age based on the last menstrual period and first trimester ultrasound differed by less than two weeks, last menstrual period data was used to estimate gestational age. If last menstrual period information was not available, ultrasound estimate were used. If no first trimester ultrasound data was available, last menstrual period was used. Infants with implausible birth weights relative to gestational age were excluded based on the algorithm developed by Alexander et. al.²¹

Infant's race/ethnicity was determined by maternal self-report documented on the birth certificate. Infants were classified as: White, Black, Hispanic, Native Indian/Alaska Native, Asian/Pacific Islander, or Other/Mixed. If the infant's race/ethnicity was missing from the birth certificate data, the maternal race/ethnicity was used. Due to high levels of missing data, paternal race/ethnicity was not used in determining an infant's race/ethnicity categorization.

Data on potential confounders, including maternal marital status, parity, prenatal care, and insurance type, were abstracted from the birth certificate records. Maternal age was categorized as <20, 20-24, 25-29, 30-34, or 35+ years of age. Marital status and parity were dichotomous variables categorized as "married" or "not married" and "primiparous" or "multiparous." Adequacy of prenatal care was categorized using the Kotelchuck index as "inadequate", "intermediate", "adequate", and

“adequate plus” based on the month of prenatal care initiation and the expected number of prenatal care visits given the timing of initiation.²² Insurance status was categorized as: “public insurance” (Medicaid, Champus/Tricare), “private insurance” (including self-pay), “other government insurance” (other government insurance that is not Medicaid, or Champus/Tricare), and “other.” Individuals without insurance information on the birth certificate were included in the public insurance group if they received Women, Infants and Children (WIC) benefits during pregnancy. For the analysis of timing of death relative to race/ethnicity, infants were categorized based on the number of days between birth and death. In the logistic regression analysis, “neonatal mortality,” deaths occurring up to 29 days after birth, defined controls and “post-neonatal mortality,” death occurring between 29-364 days after birth, defined cases.

Analysis:

Analyses were conducted independently for each of the three gestational age groups. Descriptive statistics using chi-squared tests identified differences in racial/ethnic distributions of infant mortality. Chi-squared tests were also used to identify potential confounding factors, based on the strength of their association with infant mortality and race/ethnicity independently. Confounders were included in the final models if they changed the risk estimate by more than 10%. Maternal age was identified *a priori* as a confounding factor and was included in all models. Logistic regression was used to evaluate associations between infant mortality at differing gestational ages relative to infant race/ethnicity, and to evaluate the association between infant mortality and race/ethnicity relative to the timing of death. White infants were always the referent group. Statistical analysis was completed using STATA version 12.1.²³

Results

Between 1984 and 2009, Washington State recorded the deaths of 3,946 infants born between 24 and 36 weeks gestational age. Of these, 613 infants were excluded from this analysis due to

implausible birth weights relative to gestational age.²¹ Thus, the final sample comprised 3,445 infants born between 24-27 weeks (1,452 cases and 1,993 controls), 2,955 infants born between 28-32 weeks (1,047 cases and 1,908 controls), and 4,133 infants born between 33-36 weeks gestational age (1,373 cases, 2,760 controls).

The distribution of potential confounders differed by case-control status when evaluated within the three gestational age group categories (Table 1). In all three gestational age groups (24-27 weeks, 28-32 weeks, 33-36 weeks), differences in maternal age ($p=0.004, 0.026, <0.0001$) and marital status ($p=0.025, 0.029, <0.0001$) were statistically significant. In all gestational age groups, a higher proportion of cases were in the <20 year old group compared to controls, and controls were more likely to be married. In the 28-32 week and 33-36 week groups, mothers of controls were more likely to be primiparous ($p=0.0008$ and <0.0001). The distribution of the adequacy of prenatal care differed significantly between case-control status for the 24-27 and 33-36 week gestational age groups ($p=0.047$ and 0.003). In all three gestational age groups, cases were more likely to be born to mothers who received inadequate prenatal care than controls. In the 33-36 week group, the distribution of insurance type at the time of delivery differed by case-control status ($p <0.0001$), with a higher proportion of cases using public insurance.

The distribution of potential confounders by infant race/ethnicity was fairly consistent across all gestational age groups (Table 2a-c). In general, mothers of Black, Hispanic and Native Indian/Alaska Native infants were more likely to be younger, single, multiparous, and to use public insurance at the time of birth, compared to White infants ($p <0.0001$ across all gestational age groups). Mothers of Asian/Pacific Islander infants were more likely to be older, married and use private insurance at the time of birth, compared to mothers of White infants ($p <0.0001$). Black, Hispanic, and Native Indian/Alaska Natives infants were more likely to have multiparous mothers ($p=0.003, <0.0001, <0.0001$, by ascending

gestational age group), while the mothers of Asian/Pacific Islander infants did not differ in parity from those of White infants. While many of the potential confounders were statistically associated with both exposure and outcome, inclusion of the variables in the logistic models did not change the odds ratios by more than 10%. All the odds ratios presented in this analysis were adjusted for maternal age.

In the 24-27 week and 28-32 week gestational age groups, infants who died were less likely to be Black than White (OR: 0.69, 95% CI: 0.56, 0.86 and OR: 0.69, 95% CI: 0.53, 0.91, respectively) (Table 3). In the 33-36 week gestational age group, both Hispanic and Asian/Pacific Islander infants had a decreased likelihood of mortality compared with White infants (OR: 0.72 95% CI: 0.56, 0.91 and OR:0.69, 95% CI: 0.52, 0.91, respectively). Native Indian/Alaska Native infants, in the 33-36 week gestational age group, were more likely to die than White infants but the association was not statistically significant (OR: 1.32, 95% 0.98, 1.78) (Table 3).

In the secondary analysis, Black infants in the 24-27 week gestational age group were almost twice as likely to experience post-neonatal mortality relative to neonatal mortality compared with White infants (OR: 2.15, 95% CI:1.46, 3.17). Among the 33-36 week gestational age group, Hispanic infants were less likely than White infants to die in the post-neonatal period compared with the neonatal period (OR: 0.57, 95% CI: 0.37, 0.87). The opposite was true for Native Indian/Alaskan Natives infants who had higher proportion of post-neonatal mortality compared to White infants (OR: 2.11, 95% CI: 1.29, 3.44) (Table 4).

Discussion

While many studies have investigated the relationship between infant race/ethnicity and mortality, few have stratified by gestational age at preterm birth.^{15,24} This study examined the risk of infant mortality among preterm infants in three gestational age groups: 24-27 weeks, 28-32 weeks, and 33-36 weeks gestational age. Among infants born at 24-32 weeks, Black infants were less likely to die in

the first year of life compared to White infants, and among infants born at 33-36 weeks, Hispanic and Asian/Pacific Islander infants were less likely to die in the first year of life compared to White infants.

The results of this study show that within specific preterm gestational age groups, Black infants are less likely to die than White infants. While previous studies have demonstrated reduced risk of mortality among early preterm Black infants, none have definitively explained the basis of this association.^{25,26} In a 2003 study using national linked birth/infant death data from 1995-1997, Alexander et. al. reported that preterm Black infants were at a decreased risk of neonatal mortality compared with White infants within comparable gestational age groups.²⁶ Black infants have consistently been shown to have higher overall infant mortality rates compared with White infants,^{4,10,15,24,27} and Black infants have an increased likelihood of preterm birth.^{25,28,29} Nonetheless, when compared to White infants at the same low birth weight or gestational age group, Black infants demonstrate a lower risk of mortality.^{25,26} This suggests that the high mortality rate for Black infants may be due to the increased rate of preterm birth, as opposed to an increased risk of mortality within a given gestational age.

In this study, within the 33-36 week gestational age groups, Hispanic infants had a 30% lower likelihood of infant mortality compared to White infants. This finding is consistent with other research describing a “Hispanic Paradox” in which the mortality rates for Hispanics are lower than those of non-Hispanic Blacks and Whites despite comparable socioeconomic factors.^{30,31} A study by Jenny et. al. found that Mexican-American infants born in counties with higher proportions of Mexican births had better birth outcomes, suggesting that access to strong culturally relevant support systems may improve birth outcomes.³² This theory may explain why the lower likelihood of infant mortality for Hispanic infants was observed only in the oldest gestational age group in this study. While preterm infants born between 33 and 36 weeks have a higher mortality rate than infants born at term, they face fewer medical complications at birth than preterm infants born at earlier ages.^{7,8,33} The high rates of medical

complication in earlier gestational age groups may result in an attenuation of the impact of family and social support on risk of infant mortality among very preterm infants.

Asian/Pacific Islander infants in the 33-36 week gestational age group in this study also had decreased likelihood of infant mortality compared to White infants. Some studies have shown decreased rates for Asian/Pacific Islander infant mortality among term infants, while others have demonstrated null associations.^{4,10,34,35} Using the classification system defined by the U.S. Government, our sample included infants from 20 Asian and 29 Pacific Island countries in a single category. The impact of the resulting heterogeneity of the Asian/Pacific Islander group has not been adequately quantified.³⁶ Studies have shown that infant mortality rates among Japanese and Korean infants were generally lower than those of White infants; however, other ethnic groups within the Asian/Pacific Islander categorization have higher infant mortality rates.^{10,35,37} While Washington State has a larger proportional Asian/Pacific Islander population than many states, sample sizes were not sufficient to disaggregate by ethnicity within this group. However, 2010 infant mortality data from Washington State demonstrates that the overall infant mortality rate for Asian infants was 2.6/1,000 live births compared with 6.7/1,000 live births for Pacific Islander Infants.³⁸ The different rates for infant mortality by ethnic group within this racial categorization make it difficult to quantify an overall risk of mortality for such a heterogeneous group.

More detailed analysis of the cause of preterm delivery may explain some of the differences in likelihood of mortality in these results. The increase in rates of preterm birth among singleton White infants between 1989 and 2000 is largely attributable to increases in medically indicated preterm birth, whereas among Black infants, an overall decline in the rate of preterm birth in the same period was associated with a decrease in rates of premature rupture of membranes.²⁹ This may have a significant impact on risk of infant mortality within these subgroups, as medically indicated preterm birth has been

associated with a reduction in perinatal mortality.²⁹ Given that a specific subtype of preterm birth is associated with lower risk of mortality, future studies may consider type of preterm birth as a potential confounder in the relationship between race/ethnicity and infant mortality among preterm infants.

For all gestational age groups, the results of the secondary analysis in this study suggest that Black infants have a greater likelihood for post-neonatal mortality relative to neonatal mortality compared to White infants. While the association was only statistically significant in the 24-27 weeks gestational age group, the association in the 28-32 week group approached statistical significance. Other studies have demonstrated that Black infants are at greater risk of post-neonatal mortality than White infants, with the association partly attributable to socioeconomic status.^{14,15} A study of post-Neonatal Intensive Care Unit discharge outcomes among extremely low birth weight infants found that Black race was a significant risk factor for mortality, in addition to a number of factors related to socioeconomic status including maternal education and use of Medicaid.²⁰ The increased likelihood of post-neonatal mortality among Black infants in this study may be due to similar socioeconomic factors.

In the 33-36 week gestational age group in this study, Native Indian/Alaska Native infants had an increased likelihood of post-neonatal mortality relative to neonatal mortality compared to White infants. These findings are consistent with an Alaskan Division of Public Health Report using Alaskan data from 1989-2009.³⁹ That report found that the overall post-neonatal mortality rate in Alaska declined significantly between 1989 and 2009; however, among Alaska Native infants, there was no significant change in post-neonatal mortality rates. That study identified a number of risk factors for post-neonatal mortality, largely associated with socioeconomic status including maternal education and marital status.³⁹ In 2009, Sparks et. al. found that socioeconomic status accounted for some urban/rural differences in neonatal and post-neonatal mortality.⁴⁰ This association was stronger for post-neonatal mortality than neonatal mortality.⁴⁰ While that study did not include infant race/ethnicity in their

analyses, it provided a partial explanation for the increased likelihood of post-neonatal mortality in the Native Indian/Alaska Native group. In Washington State, Native Indians tend to live in rural locations. This, in conjunction with lowered socioeconomic status of Native Indians, may increase risk for post-neonatal mortality. Additionally, Native Indian infants in Washington State are more likely to sleep in lateral positions, a known risk factor for Sudden Infant Death Syndrome, which could contribute to their increased likelihood of post-neonatal mortality compared with neonatal mortality.⁴¹

Strengths of this study include the large number of infants, use of data from population-based registries, and minimal missing data with regard to race/ethnicity, gestational age and infant mortality. Given the use of a population-based linked birth and death certificate, we were able to identify all preterm infants who were born and died in Washington State within the study period. The registry allows for nearly complete case ascertainment and provided the large sample size required to detect small differences between groups. In some cases, infants may have moved out of the state, in which case they would not be included as cases if they died. If migration out of state was more common in one racial/ethnic group than another, this could lead to a distortion of the odds ratios for this group.

This study has several limitations. The findings ultimately depend on the quality of birth certificate data available in Washington State. Information collected on birth certificates, particularly for certain variables, may be incomplete, inaccurate, or missing. Two confounders evaluated in this study, adequacy of prenatal care and insurance status, had relatively large numbers of missing data, whereas other variables (age, parity, marital status) had relatively little missing data (< 10%). If missing information was more or less likely in one racial/ethnic group than another, or associated with case-control status, our ability to assess these factors as true confounders was diminished.

While we cannot rule out differential misclassification within the race/ethnicity categorizations, the overall level of missingness is low (2.4%). A study from the California state registries showed that the

sensitivity and specificity of birth certificate race/ethnicity data is greater than 90% for Caucasian, Black and Hispanic infants, and that data quality did not appear to vary greatly by race/ethnicity.⁴² Studies from other states have demonstrated similar levels of agreement in classifications of Hispanic, Black and Caucasian infants.^{43,44} The low numbers of infants listed as being from multiple racial/ethnic groups suggests that some of the infants may have been recorded as being from a single racial/ethnic group when, in reality, more multiple racial/ethnic descriptors might apply.

Certain congenital malformations have been strongly associated with infant mortality at all gestational ages.⁴⁵ Black infants are more likely to be born with congenital malformations than White infants.¹⁹ However, the infant mortality rate attributable to congenital malformations does not vary significantly between Black and White infants.¹⁹ Congenital malformation data on birth certificates have been shown to be problematic in a number of studies, although linking to ICD-9 codes can improve the data quality.^{46,47} Future studies of preterm infant mortality should incorporate hospital records in order to exclude infants with congenital malformations incompatible with life at all gestational ages.

This study evaluated infant mortality over a long time period in order to include a sufficient number of cases to power an evaluation of the impact of race/ethnicity on infant mortality among preterm infants. In the 25-year period covered by this study, the survivability of preterm infants improved dramatically. While this temporal change was partially addressed in our study by frequency matching controls to cases on the year of birth, it is possible that trends seen in the results reflect characteristics of infant mortality in the earlier years of the study period. Due to sample-size limitations, we were not able to stratify by early and late time periods to assess the impact of temporal changes.

The generalizability of this study is limited as Washington State is distinct in racial/ethnic population distribution and urban/rural residency which may impact infant mortality rates. Between 2006 and 2008, the national rate ratio of Black / White infant mortality rates was 2.35, while the rate

ratio in Washington State was the lowest of any state at 1.77.¹⁸ Black families in Washington State are more likely to live in urban centers whereas the rural areas of Washington State are predominantly Hispanic and White populations.^{48,49} Given a higher percentage of Black individuals living in urban Washington, it is possible that Black infants born preterm in Washington State had better access to Neonatal Intensive Care Units and other specialized health services compared to Black infants in other regions of the United States. .

A final consideration when interpreting the results of this study is the case-control study design in which true infant mortality rates and relative risks cannot be calculated. Odds ratios approximate relative risks for rare outcomes. In our study, particularly among the earliest gestational age groups, infant mortality is not a rare outcome. With an infant mortality rate of 190.7/1,000 live births in the 24-27 week gestational age group, the odds ratios should not be interpreted as relative risks.⁹

This study demonstrated differences in the likelihood of infant mortality by race/ethnicity among preterm infants born at different gestational ages. As we work towards achieving the Healthy People 2020 goal of reducing infant mortality rates, it is imperative that racial/ethnic differences in the risks of infant mortality among preterm infants at differing gestational ages are considered. This study also emphasizes preterm infants as a population that requires further study. The results of this and future studies can inform interventions to ensure that those infants and families requiring additional support throughout the first year of life are identified and resources established to achieve improved outcomes in the first year of life.

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Appendix A: Tables

Table 1: Maternal and infant characteristics among preterm infants who died (cases) and those who survived (controls) in the first year, in Washington State, 1984-2009*

	24-27 Weeks Gestational Age		28-32 Weeks Gestational Age		33-36 Weeks Gestational Age	
	Case N=1,452 N (%)	Control N=1,993 N (%)	Case N=1,047 N (%)	Control N=1,908 N (%)	Case N=1,373 N (%)	Control N=2,760 N (%)
Maternal Age	p-value: 0.004		p-value: 0.026		p-value: <0.0001	
≤20	279 (19.2)	280 (14.1)	175 (16.7)	295 (15.5)	219 (15.9)	343 (12.4)
20-24	373 (25.7)	518 (26.0)	310 (29.6)	491 (25.7)	398 (29.0)	740 (26.8)
25-29	341 (23.5)	502 (25.2)	250 (23.9)	494 (25.9)	333 (24.3)	689 (25.0)
30-34	276 (19.0)	414 (20.8)	166 (15.8)	377 (19.8)	239 (17.4)	638 (23.1)
>35	177 (12.2)	276 (13.8)	141 (13.5)	248 (13.0)	179 (13.1)	346 (12.5)
Maternal Marital Status	p-value: 0.025		p-value: 0.029		p-value: <0.0001	
Married	823 (56.7)	1141 (57.2)	620 (59.2)	1183 (62.0)	848 (61.8)	1870 (67.8)
Single	612 (42.1)	844 (42.3)	415 (39.6)	717 (37.6)	510 (37.2)	875 (31.7)
Missing	17 (1.2)	8 (0.4)	12 (1.2)	8 (0.4)	13 (0.9)	15 (0.5)
Parity	p-value: 0.33		p-value: 0.008		p-value: <0.0001	
0	688 (47.4)	984 (49.4)	432 (41.3)	919 (48.2)	504 (36.8)	1212 (43.9)
1+	683 (47.0)	906 (45.5)	550 (52.5)	888 (46.5)	791 (57.7)	1447 (52.4)
Adequacy of prenatal care	p-value: 0.047		p-value: 0.57		p-value: 0.003	
Inadequate	107 (4.7)	141 (7.1)	83 (7.9)	137 (7.2)	122 (8.9)	200 (7.2)
Intermediate	49 (3.4)	72 (3.6)	36 (3.4)	58 (3.0)	81 (5.9)	170 (6.2)
Adequate	116 (8.0)	231 (11.6)	98 (9.4)	187 (9.8)	152 (11.1)	351 (12.7)
Adequate plus	281 (19.3)	435 (21.8)	171 (16.3)	366 (19.2)	231 (16.8)	578 (20.9)
Insurance Status	p-value: 0.091		p-value: 0.12		p-value: <0.0001	
Public Insurance	450 (31.0)	671 (33.7)	291 (27.8)	503 (26.4)	449(32.8)	830 (30.1)
Private Insurance	270 (18.6)	459 (23.0)	181 (17.3)	390 (20.4)	242 (17.6)	671 (24.3)
Other-Government	95 (6.5)	148 (7.4)	56 (5.3)	128 (6.7)	102 (7.4)	166 (6.0)
Other	32 (2.2)	34 (1.7)	23 (2.2)	33 (1.7)	17 (1.2)	27 (1.0)
Time to Death						
<24 hours	541 (37.2)	-	288 (27.5)	-	267 (19.5)	-
1-7 Days	382 (26.3)	-	263 (25.1)	-	287 (20.9)	-
8-28 Days	246 (16.9)	-	186 (17.8)	-	185 (13.5)	-
<365 Days	283 (19.5)	-	305 (19.1)	-	628 (45.8)	-

*Totals may vary due to missing values.

Table 2a: Maternal and infant characteristics among preterm infants born between 24 and 27 weeks gestational age by race/ethnicity in Washington State, 1984-2009*

	White n (%)	Black n (%)	Hispanic n (%)	Asian/Pacific Islander n (%)	Native Indian/ Alaska Native n (%)
Maternal Age	p-value: <0.0001				
≤20	329 (15.1)	68 (16.3)	88 (23.8)	30 (12.8)	30 (19.6)
20-24	583 (26.7)	115 (27.6)	96 (26.0)	38 (16.2)	43 (28.1)
25-29	540 (24.7)	111 (26.6)	84 (22.8)	51 (21.7)	37 (24.2)
30-34	449 (20.5)	73 (17.5)	64 (17.3)	60 (25.5)	25 (16.3)
>35	278 (12.7)	49 (11.1)	37 (10.0)	56 (23.8)	18 (11.8)
Maternal Marital Status	p-value: <0.0001				
Married	1,349 (61.7)	170 (40.8)	176 (47.7)	168 (71.5)	54 (35.3)
Single	823 (37.7)	244 (58.5)	191 (51.8)	67 (28.5)	99 (64.7)
Parity	p-value: 0.003				
0	1,121 (51.3)	181 (43.4)	179 (48.5)	103 (43.8)	51 (33.3)
1+	959 (43.9)	212 (50.8)	166 (45.0)	117 (49.8)	93 (60.8)
Adequacy of prenatal care	p-value: 0.002				
Inadequate	127 (5.8)	41 (9.8)	37 (10.0)	15 (6.4)	16 (10.5)
Intermediate	63 (2.9)	17 (4.1)	19 (5.1)	13 (5.5)	6 (3.9)
Adequate	223 (10.2)	33 (7.9)	45 (12.2)	21 (8.9)	16 (10.5)
Adequate plus	455 (20.8)	80 (19.2)	86 (23.3)	49 (20.8)	30 (19.6)
Insurance Status	p-value: <0.0001				
Public Insurance	608 (27.8)	162 (38.8)	204 (55.3)	60 (25.5)	62 (40.5)
Private Insurance	500 (22.9)	64 (15.3)	52 (14.1)	79 (33.6)	20 (13.1)
Other- Government	157 (7.2)	37 (8.9)	11 (3.0)	16 (6.8)	16 (10.5)
Other	37 (1.7)	5 (1.2)	5 (1.4)	6 (2.5)	4 (2.6)
Time to Death	p-value: <0.0001				
<24 hours	364 (38.3)	47 (32.0)	53 (35.8)	24 (27.0)	20 (29.8)
1-7 Days	256 (26.9)	29 (19.7)	41 (27.7)	28 (31.5)	23 (34.3)
8-28 Days	163 (17.1)	24 (16.3)	26 (17.6)	17 (19.1)	10 (14.9)
<365 Days	168 (17.7)	47 (32.0)	28 (18.9)	20 (22.5)	14 (20.9)

* Totals may vary due to missing values.

Table 2b: Maternal and infant characteristics among preterm infants born between 28 and 32 weeks gestational age by race/ethnicity in Washington State, 1984-2009*

	White n (%)	Black n (%)	Hispanic n (%)	Asian/Pacific Islander n (%)	Native Indian/ Alaska Native n (%)
Maternal Age	p-value: <0.0001				
≤20	286 (14.6)	44 (14.6)	75 (26.0)	21 (11.0)	31 (23.5)
20-24	513 (26.2)	112 (37.1)	77 (26.7)	32 (16.7)	45 (34.1)
25-29	520 (26.5)	74 (24.5)	57 (19.8)	48 (25.1)	30 (22.7)
30-34	369 (18.8)	51 (16.9)	43 (14.9)	46 (24.1)	17 (12.9)
>35	265 (13.5)	21 (6.9)	36 (12.5)	43 (22.5)	8 (6.1)
Maternal Marital Status	p-value: <0.0001				
Married	1,284 (65.5)	121 (40.1)	147 (51.0)	149 (78.0)	52 (39.4)
Single	663 (33.8)	180 (59.6)	140 (48.6)	40 (20.9)	79 (59.8)
Parity	p-value: <0.0001				
0	955 (48.7)	115 (38.1)	105 (36.5)	94 (49.2)	44 (33.3)
1+	908 (46.3)	170 (56.3)	172 (59.7)	79 (41.4)	79 (59.8)
Adequacy of prenatal care	p-value: <0.0001				
Inadequate	125 (6.4)	23 (7.6)	38 (13.2)	18 (9.4)	11 (8.3)
Intermediate	60 (3.1)	15 (5.0)	10 (3.5)	5 (2.6)	3 (2.3)
Adequate	199 (10.1)	13 (4.3)	36 (12.5)	23 (12.0)	10 (7.6)
Adequate plus	371 (18.9)	48 (15.9)	57 (19.8)	28 (14.7)	13 (9.8)
Insurance Status	p-value: <0.0001				
Public Insurance	430 (21.9)	87 (28.8)	166 (57.6)	49 (25.6)	40 (30.3)
Private Insurance	414 (21.1)	35 (11.6)	28 (9.7)	67 (35.1)	17 (12.9)
Other- Government	124 (6.3)	24 (7.9)	13 (4.5)	9 (4.7)	3 (6.8)
Other	31 (1.6)	13 (4.3)	0 (0)	6 (3.1)	2 (1.5)
Time to Death	p-value: 0.004				
<24 hours	198 (28.8)	13 (15.7)	34 (29.1)	20 (28.6)	6 (11.8)
1-7 Days	176 (25.6)	19 (22.9)	36 (30.8)	13 (18.6)	13 (25.5)
8-28 Days	114 (16.6)	19 (22.9)	17 (14.5)	21 (30.0)	11 (21.57)
<365 Days	196 (28.5)	32 (38.5)	29 (24.8)	16 (22.9)	21 (41.2)

*Totals may vary due to missing values

Table 2c: Maternal and infant characteristics among preterm infants born between 33 and 36 weeks gestational age by race/ethnicity in Washington State, 1984-2009*

	White n (%)	Black n (%)	Hispanic n (%)	Asian/Pacific Islander n (%)	Native Indian/ Alaska Native n (%)
Maternal Age	p-value: <0.0001				
≤20	349 (12.2)	50 (16.3)	80 (20.7)	23 (8.2)	44 (22.4)
20-24	781 (27.3)	97 (31.7)	125 (32.3)	58 (20.6)	53 (27.0)
25-29	705 (24.7)	73 (23.9)	93 (24.0)	69 (24.6)	60 (30.6)
30-34	640 (22.4)	61 (19.9)	55 (14.2)	72 (25.6)	29 (14.8)
>35	377 (13.2)	25 (8.2)	34 (8.8)	57 (20.3)	10 (5.1)
Maternal Marital Status	p-value: <0.0001				
Married	2,008 (70.3)	145 (47.4)	230 (59.4)	207 (73.7)	70 (35.7)
Single	839 (29.4)	159 (52.0)	154 (39.8)	70 (24.9)	125 (63.8)
Parity	p-value: <0.0001				
0	1,235 (43.2)	113 (36.9)	152 (39.3)	121 (43.1)	64 (32.6)
1+	1,501 (52.6)	180 (58.8)	227 (58.7)	154 (54.8)	128 (65.3)
Adequacy of prenatal care	p-value: <0.0001				
Inadequate	196 (6.9)	24 (7.8)	50 (12.9)	23 (8.2)	20 (10.2)
Intermediate	150 (5.2)	28 (9.1)	41 (10.6)	19 (6.8)	11 (5.6)
Adequate	364 (12.7)	24 (7.8)	54 (13.9)	39 (13.9)	18 (9.2)
Adequate plus	602 (21.1)	54 (17.6)	79 (20.4)	42 (14.9)	18 (9.2)
Insurance Status	p-value: <0.0001				
Public Insurance	747 (26.2)	118 (38.6)	243 (62.8)	74 (26.3)	65 (33.2)
Private Insurance	709 (24.8)	41 (13.4)	43 (11.1)	76 (27.0)	28 (14.3)
Other- Government	192 (6.7)	35 (11.4)	12 (3.1)	20 (7.1)	8 (4.1)
Other	21 (0.7)	4 (1.3)	7 (1.8)	7 (2.5)	1 (0.5)
Time to Death	p-value: <0.0001				
<24 hours	182 (19.0)	16 (14.3)	31 (29.5)	12 (17.1)	11 (13.7)
1-7 Days	205 (21.4)	19 (17.0)	22 (20.9)	23 (32.9)	9 (11.2)
8-28 Days	126 (13.2)	17 (15.2)	16 (15.2)	11 (15.7)	6 (7.5)
<365 Days	439 (45.9)	60 (53.6)	36 (34.3)	24 (34.3)	54 (67.5)

*Totals may vary due to missing values

Table 3: Odds Ratios for infant mortality among preterm infants by race among those who died within the first year (cases) and those who survived (controls) born in Washington State from 1984-2009 by gestational age at birth, adjusted for maternal age.*

Maternal Race	24-27 Weeks Gestational Age				28-32 Weeks Gestational Age				33-36 Weeks Gestational Age			
	Case	Control	Odds Ratio	CI	Case	Control	Odds Ratio	CI	Case	Control	Odds Ratio	CI
White	951	1234	1 (ref)	--	688	1271	1 (ref)	--	958	1900	1 (ref)	--
Black	148	270	0.69	(0.56, 0.86)	83	219	0.69	(0.53, 0.91)	112	194	1.12	(0.88, 1.44)
Hispanic	148	221	0.85	(0.68, 1.06)	117	171	1.25	(0.97, 1.61)	105	282	0.72	(0.56, 0.91)
Asian/ Pacific Islander	90	146	0.82	(0.62, 1.09)	70	121	1.11	(0.81, 1.51)	70	211	0.69	(0.52, 0.91)
Native American/ Alaskan Native	67	86	0.99	(0.71, 1.38)	51	81	1.11	(0.77, 1.61)	80	116	1.32	(0.98, 1.78)

* Totals may vary due to missing values.

Table 4: Odds Ratios by race for time of infant mortality among preterm infants born in Washington State from 1984-2009, by gestational age at birth, adjusted for maternal age

Maternal Race	24-27 Weeks Gestational Age				28-32 Weeks Gestational Age				33-36 Weeks Gestational Age			
	Neonatal Mortality	Post-Neonatal Mortality	Odds Ratio	CI	Neonatal Mortality	Post-Neonatal Mortality	Odds Ratio	CI	Neonatal Mortality	Post-Neonatal Mortality	Odds Ratio	CI
	N (%)	N (%)			N (%)	N (%)			N (%)	N (%)		
White	773 (82.3)	168 (17.7)	1 (ref)	--	488 (71.3)	196 (28.7)	1 (ref)	--	513 (53.9)	439 (46.1)	1 (ref)	--
Black	100 (68.0)	47 (32.0)	2.15	1.46, 3.17	51 (61.4)	32 (38.6)	1.51	0.94, 2.44	52 (46.4)	60 (53.6)	1.31	0.87, 1.94
Hispanic	120 (81.0)	28 (18.9)	1.1	0.70, 1.72	87 (75.0)	29 (25.0)	0.79	0.50, 1.25	69 (65.7)	36 (34.3)	0.57	0.37, 0.87
Asian/Pacific Islander	69 (77.5)	20 (22.5)	1.34	0.79, 2.27	54 (77.1)	16 (22.9)	0.79	0.44, 1.42	46 (65.7)	24 (34.3)	0.71	0.42, 1.19
Native American/Alaskan Native	53 (79.1)	14 (20.9)	1.24	0.67, 2.28	30 (58.8)	21 (41.2)	1.48	0.82, 2.69	26 (32.5)	54 (67.5)	2.11	1.29, 3.44