Lack of Difference in Neonatal Mortality Between Blacks and Whites Served by the Same Medical Care System

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To study the influence of health care systems on racial differences in low birthweight and neonatal mortality, an historical cohort analysis was conducted using birth and linked birth and death certificates of infants delivered in Pierce County, Washington, between 1982 and 1985.

Overall, black infants had significantly higher rates of low birthweight than white infants. Black infants served by civilian medical care had approximately twice the neonatal mortality of white infants; however, black infants born in the military hospital had a neonatal mortality rate comparable to white infants. Controlling for marital status, age, parity, and income status did not appreciably change these patterns.

Military care appeared to be associated with a protective effect for neonatal mortality for blacks. This effect was not due to differences in birthweight distribution or to the quantity of prenatal care received. The effect was most prominent for normal weight black infants, especially for those from low-income census tracts. The findings have possible implications for pediatric access issues for the poor and for the family practice model of perinatal care continuity. **J Fam Pract 1990; 30:281-288**

One of the most disturbing observations in American public health has been the persistent differences in the rates of adverse perinatal outcomes between whites and blacks.[1] Rates of low birthweight and neonatal mortality are twice as high in blacks as in whites, and this difference has been increasing in recent decades.[2] Studies [3–5] have indicated that the primary components of the difference in neonatal mortality are the higher percentages of low birthweight (<2500 g) and premature births among blacks and the higher mortality rate of normal-weight black neonates.

Numerous sociodemographic variables have been found to be associated with low birthweight, prematurity, and neonatal mortality, including maternal age (especially adverse combinations of age and parity),[6–10] marital status,[6,8,11,12] and income.[10–13]

Although black infants are more likely to be of low birthweight, black infants have more favorable death rates than whites in lower weight categories.[3,4] Moreover, Paneth and colleagues[14] have shown that birthweight-specific mortality for lower weight infants is less sensitive to socioeconomic influence and more likely reflects the level of available tertiary care. He suggests that the major influence of socioeconomic risk factors on black neonatal mortality is through their effect on birthweight and prematurity. Other studies,[10,13] however, have documented that socioeconomic risk factors may also affect neonatal mortality among normal weight neonates. Birthweight, therefore, may not be the only outcome sensitive to socioeconomic risk.

Many authors[15–18] have demonstrated that the amount and timing of prenatal care can influence the risk of prematurity and low birthweight. Prenatal care, however, is only part of the spectrum of the health care system that may influence neonatal mortality. For example, access to and the quality of obstetric, neonatal, and early pediatric care may also influence survival.

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TABLE 1. SUMMARY OF PERINATAL OUTCOMES: PIERCE COUNTY, WASHINGTON 1982–1985

Outcomes	Civilian		Military	
	White (N = 20,159) No. (%)	Black (N = 2044) No. (%)	White (N = 5550) No. (%)	Black (N = 2095) No. (%)
Very low birthweight (<1501 g)	134 (0.7)	29 (1.4)	38 (0.7)	31 (1.5)
Low birthweight (<2501 g)	865 (4.3)	184 (9.0)	256 (4.6)	183 (8.7)
Neonatal mortality (rate)*	109 (5.4)	25 (12.23)	34 (6.13)	15 (7.16)

*Number of deaths per 1000 live births

Although a few studies have attempted to examine the effect of Medicaid,[19–21] enrollment in health maintenance organizations,[22,23] and other payment mechanisms[24–26] on neonatal outcomes, the effect of a system of care on black and white differences in neonatal mortality has not been well studied.[1]

The purpose of this study was to assess the effect of system of care (in this case military care) on differences in low birthweight and neonatal mortality between blacks and whites. The underlying hypothesis was that a comprehensive, coordinated, and universally accessible system of perinatal, obstetric, neonatal, and pediatric care should reduce differences in these outcomes between blacks and whites. Furthermore, it should have its maximal effect on those outcomes documented to be most vulnerable to socioeconomic and demographic disadvantage: (1) low birthweight, and (2) neonatal mortality for normal weight infants.

METHODS

Computer tapes of Washington State birth certificates were used to select the study population: black or white singleton live births whose mothers resided in Pierce County, Washington (estimated 1984 population 520,000[27], at the time of delivery and who were delivered in a medical facility in Pierce County during the period January 1, 1982, to November 30, 1985. Birth records of the 29,848 neonates meeting these criteria were subdivided into four groups based on the infant's recorded race (black vs white) and place of delivery (military vs civilian facility). Blacks comprised the largest minority group in Pierce County, accounting for 11% of births, approximately one half of which occurred at the military hospital.

Neonatal deaths of study infants were identified through the linked birth-infant death files maintained by the Health Data Section of Washington State's Department of Social and Health Services. All recorded deaths of study patients younger than 28 days of age were included in the study regardless of whether they occurred within or outside Pierce County or Washington State. These deaths, therefore, occurred between January 1, 1982, and December 27, 1985.

Several variables were extracted from the birth and linked birth-infant death certificates, including maternal age, parity, an age-parity risk index that was utilized by Peoples and Siegel[28] and based on data from several studies,[6–8,29,30] maternal marital status, prenatal care, birthweight, and an indirect measure of income that was ascribed by categorizing each birth by the median family income of the census tract of maternal residence.[31] (The categorization of these variables is detailed further in the Results section below.)

Neonatal death rates were computed for each cohort (defined as the number of deaths of infants less than 28 days of age from any cause per 1000 live births).

Using the HP-41CV Programmable Calculator and programs detailed by Rothman and Boice,[32] crude risk ratios with 95% confidence intervals were calculated for all relevant risk comparisons among the four groups.

Analysis was then performed, controlling for individual potentially confounding variables (not reported here). Based on these results, Mantel-Haenszel weighted risk ratios[32] were computed to measure the impact of race and health care system, controlling for age-parity risk, marital status, and income.

RESULTS

Low birthweight rates were approximately two times greater for blacks than whites regardless of system of care (95% confidence intervals on the risk ratios for all black-white comparisons excluded 1.0) (Table 1). Civilian blacks had approximately twice the neonatal death rates of civilian whites (risk ratio [RR] = 2.26, 95% confidence interval [CI] = 1.5, 3.45), military whites (RR = 1.99, 95% CI = 1.2, 3.3), and military blacks (RR = 1.71, 95% CI = .9, 3.2). The neonatal mortality rates for military blacks, however, did not differ significantly from either group of whites.

TABLE 2. BIRTHWEIGHT-SPECIFIC NEONATAL MORTALITY RATE (DEATHS/1000 LIVE BIRTHS)

Birthweight Group	Civilian		Military		*P* value
	White	Black	White	Black	
<1501 g					
Rate	350	448	500	323	$.2 < P < .3$
CI	270,431	267,629	341,659	158,487	
Neonatal deaths (No.)	47	13	19	10	
1501–2500 g					
Rate	26	19	32	13	$.6 < P < .7$
CI	15,37	0,41	9,55	0,32	
Neonatal deaths (No.)	19	3	7	2	
>2500 g					
Rate	2.07	4.8	1.51	1.57	.05
CI	1.4,2.7	1.7,8.0	.46,2.6	0,3.3	
Neonatal deaths (No.)	.40	.9	.8	.3	

CI denotes 95% confidence intervals.
P value is derived by χ^2 *for r × c contingency table for each birthweight group*

Table 2 shows the birthweight-specific neonatal mortality for each cohort. For birthweight <2501 g, birthweight-specific mortality did not differ significantly among the cohorts; however, for birthweight >2500 g, there was a marked excess in neonatal mortality for civilian blacks in comparisons with the three other cohorts ($P = .05$). For infants over 2500 g (Table 3) civilian blacks were clearly at a disadvantage in all comparisons with whites and in the comparison with military blacks. By contrast, military blacks had no such disadvantage in comparisons with whites.

Study groups were compared with regard to maternal age, parity, age-parity risk combinations, marital status, income status, and various measures of prenatal care. Results are summarized in Table 4.

The military mothers were generally younger and were more often nulliparous than civilian mothers. There was a larger percentage of military mothers residing in low-income census tracts in comparison with civilians.

On the other hand, there was a greater percentage of high-risk age-parity combinations in the civilian population, especially among civilian blacks. There was also a notably higher percentage of single mothers in the civilian community.

TABLE 3. NEONATAL MORTALITY FOR INFANTS OVER 2500 G

Groups Compared	Crude Risk Ratio	95% Confidence Interval
Civilian blacks vs civilian whites	2.33	1.15,4.7
Civilian blacks vs military blacks	3.08	0.89,10.8
Military blacks vs military whites	1.04	0.27,3.9

Prenatal care measures included gestational month that care began and total number of prenatal visits. Prenatal care in the military tended to start later, with military blacks receiving the fewest number of prenatal visits, and civilian whites the largest number.

Based on this analysis, the adverse effects of high-risk combinations of age and parity and single marital status would be expected to have most influence on the civilian black community. On the other hand, the military community would be expected to be adversely influenced by the high percentage of mothers living in low-income census tracts. As noted earlier, birthweight distribution would have an adverse impact on both black cohorts. The quantity of prenatal care might be expected to adversely influence military and black cohorts.

Table 5 demonstrates the differences in neonatal mortality and birthweight outcomes after controlling for marital status, age-parity risk, and income. (Because of coding problems with gestational age on the civilian charts, prenatal care could not be reliably included as a control variable.) The same risk trends identified in the unadjusted analysis are still apparent. For neonatal death, civilian blacks were at the greatest disadvantage, and military blacks did well in all comparisons. Birthweight outcomes, likewise, reveal the same risk trend identified in the overall analysis. It appears, therefore, that controlling for marital status, age-parity risk, and income did not have a significant impact on the crude risk ratios of neonatal death and low birthweight.

When birthweight was added to the other control vari-

TABLE 4. SOCIODEMOGRAPHIC CHARACTERISTICS AND PRENATAL CARE FOR STUDY COHORTS

Demographic Characteristics	Civilian		Military		*P* value
	White	Black	White	Black	
Mean maternal age (y)	25.62	24.325	23.44	23.19	<.001*
Parity (%)					
Nulliparous	30.3	25.2	38.2	35.5	
1 or 2	52.2	48.3	49.3	51	<.001†
3 or more	17.5	26.5	12.4	13.5	
Age-parity risk (%)					
High risk	25.6	38.4	20.5	21.7	<.001†
Marital status (%)					
Single	18.5	50.1	5.3	14.9	<.001†
Median income by census tract (%)					
<$15,001	9.3	28.7	48.9	62.3	
$15,000–$25,000	81	62.5	43.6	33.5	<.001†
>$25,000	8.7	8.3	7.2	4.0	
Birthweight					
Mean (g)	3458.8	3232.02	3453.14	3221.68	<.001*
<1501 g (%)	0.7	1.4	0.7	1.5	
1501–2500 g (%)	3.6	7.6	3.9	7.2	<.001†
>2500 g (%)	95.7	91.0	95.3	91.2	
Prenatal care					
Month of gestation visits began					
Mode	2	2	3	3	
Median	1.432	1.507	2.404	2.466	<.001‡
Number of prenatal visits					
Mean	10.998	10.5	10.74	9.955	<.001*
No prenatal care					
(%)	0.4	1.0	0.5	1.1	<.001†

NOTE: All variables had dissimilar distributions across the four groups (P < .001).
**P value is calculated using ANOVA.*
†P value is calculated using χ^2.
‡P value is calculated by using Kruskal-Wallis.

TABLE 5. COMPARISON OF OUTCOMES AMONG COHORTS, CONTROLLING FOR MARITAL STATUS, AGE-PARITY RISK, AND INCOME

Outcomes and Groups Compared	cRR	wRR	95% CI
Neonatal mortality (Number of deaths/1000 live births)			
Civilian blacks vs civilian whites	2.26	1.91	(1.2,3.05)
Civilian blacks vs military blacks	1.71	1.88	(.9,3.9)
Military blacks vs military whites	1.17	1.08	(.6,2.0)
Very low birthweight (% <1501 g)			
Civilian blacks vs civilian whites	2.13	1.78	(1.2,2.7)
Civilian blacks vs military blacks	.96	.975	(.55,1.7)
Military blacks vs military whites	2.16	1.93	(1.2,3.1)
Low birthweight (% <2500 g)			
Civilian blacks vs civilian whites	2.09	1.64	(1.4,1.9)
Civilian blacks vs military blacks	1.03	1.02	(.8,1.3)
Military blacks vs military whites	1.89	1.803	(1.5,2.2)

cRR denotes crude risk ratio, wRR indicates Mantel-Haenszel weighted risk ratio, and CI is 95% confidence interval of wRR.

ables, risks were diminished in all black-white comparisons, as might be expected. Importantly, the control of the sociodemographic risk factors plus birthweight had an opposite effect on the military black-civilian black comparison. An increased risk ratio resulted from the adjustment, and the difference between the military and civilian blacks became statistically significant (Mantel-Haenszel weighted risk ratio = 1.99, 95% CI = 1.01, 4.0).

To illustrate more clearly the differences in outcomes between the normal-weight black infants in the military and civilian cohorts, a comparison of neonatal mortality risk within different risk factor categories among normal-weight black infants was performed. While military blacks had favorable ratios in all comparisons, the effect of military care appeared to be most significant among infants of low-income women (RR = 7.8, 95% CI = 4.1, 14.9).

DISCUSSION

This analysis suggests that, compared with civilian care, the military system of care was associated with a lower neonatal mortality for black infants. Several other results may help interpret this finding.

First, the percentages of low and very low birthweight in both black cohorts were comparable and were similar to national data.[33] The military system, therefore, did not affect low birthweight rates.

Second, there appeared to be less use of prenatal care among the military community. Reducing financial barriers to prenatal care did not guarantee greater use of prenatal care. This lower use in the military suggests that the similar or superior outcomes in the military community were not a consequence of quantity of prenatal care received. If the amount of prenatal care could have been reliably controlled in this study, the favorable comparison of military blacks with civilian blacks might have been even more pronounced.

Third, controlling for demographic and socioeconomic factors did not substantially affect the risk patterns for neonatal mortality or low birthweight, and therefore these factors are probably not related to the military-civilian differences. Nevertheless, the potential impact of various unmeasured sociodemographic and cultural variables must be acknowledged. Drug and alcohol use, smoking, housing, commissary privileges, transportation, and geographic proximity to health care are other potential factors that were not measured or used in the study and that could have had an impact on differences between the civilian and military communities. Indeed, the high prevalence of single mothers and high-risk age-parity demographics in the civilian black community suggest that the two communities may be very different and those families who find their way into the military may be at lower risk of adverse outcomes. It is not obvious, however, that the potential differences in communities all favor the military. Indeed, separation from the extended family for generally younger military mothers, often frequent separation from the spouse because of military necessities, and frequent destabilizing moves for these young, vulnerable families all certainly increase the environmental stress. When these stressors are superimposed on the generally lower income status of many of these families, their vulnerability is increased.

It must also be acknowledged that the measure of income status, the median family income in the census tract of maternal residence, was at best an approximate measure. As an indirect estimator it could potentially underestimate the direct impact of income on a given neonatal outcome, and it could be substantially confounded by other unmeasured sociodemographic and cultural variables, as mentioned above, associated with the neighborhoods (census tracts). It is important to note, however, that according to sources at the US Census Bureau, income data collected from the Fort Lewis (military) census tract in 1980 were collected and calculated for families in the same manner as for civilian census tracts. In addition, an equal majority of military blacks and whites lived off post (approximately 75% of both groups) in the neighborhoods of their civilian counterparts.

While there may be sociodemographic and environmental differences between civilian and military blacks, there is no obvious evidence that these differences are profound enough to account for the apparent outcome differences in the two communities. Indeed, much of the impact of socioeconomic variables is felt at the level of prenatal care and birthweight percentage. According to Paneth et al,[14] most of the impact of socioeconomic disadvantage is reflected through low birthweight. The similarities of the civilian and military communities in birthweight suggest that they may be exposed to a similar degree of socioeconomic and environmental risk.

Fourth, detailed analysis of the civilian and military black cohorts revealed that the greatest difference in mortality was with normal birthweight infants. Indeed, 52.5% of the excess neonatal deaths among civilian blacks (relative to military blacks) occurred in infants >2500 g. The analysis of normal-weight black infants revealed that neonatal mortality among infants receiving military care compared favorably with civilian infant mortality in all measured demographic strata and was highly statistically significant among low-income blacks. This analysis of normal-weight infants suggests that the low-income, normal-weight black group may be the most sensitive to the protective effect of the military system. Indeed, 47.4% of the excess neonatal deaths in civilian blacks (relative to military blacks) were among normal-weight, low-income births, and 77.8% of the excess deaths in civilian blacks were among low-income births of any birthweight.

Fifth, review of the causes of death listed for normal-weight black infants revealed that a major component of the difference between the civilian and military cohorts was in the number of deaths due to infectious causes, that is, deaths that were potentially preventable. Furthermore, when deaths from lethal malformations (which are generally unrelated to race and medical care[34]) were deleted from the analyses reported above, the differences in neonatal death rates between civilian and military blacks increased significantly (Mantel-Haenszel RR = 2.8, 95% CI = 1.1-7.1). This cause of death analysis suggests that the timeliness and quality of postnatal medical care may have been related to the difference in mortality rates.

In summary, the differences in normal-weight infant mortality, particularly among low-income blacks, appear to be the critical differences in the two communities. Perhaps the protective effect of the military was related to the timeliness and quality (rather than quantity) of military prenatal care; but the comparability of birthweight distributions between civilian and military blacks argues against prenatal care being the important factor. Perhaps the effect was due to the quality of the tertiary neonatal care received at the military facility. Here again, however, the absence of significant differences in the birthweight-specific mortalities of lower weight infants argues against this mechanism as well. Further analyses should concentrate on identifying those elements of the military system that may be particularly advantageous to low-income, normal-birthweight blacks.

These findings suggest that infant mortality prevention programs should focus not only on low birthweight prevention, but also on comprehensive care for all pregnancies among the poor, particularly the black poor. It may well be that the military system is protective because it allows for lowered access barriers and continuity for both maternal and pediatric care for its low-income beneficiaries. A comprehensive approach to the vulnerable low-income black families that involves not only social, medical, and nutritional maternity care, but also pediatric care, child nutritional support, and close follow-up of at-risk families, is indicated. Indeed, the potential benefit of a family practice model of perinatal care that emphasizes continuity and access throughout the perinatal period and beyond is an important consideration. It may be argued that such a model could most benefit those at greatest socioeconomic risk. Future studies that test this argument should be seriously considered.

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Commentary

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Myron E. Wegman[1] stated in his annual summary of vital statistics that the final data for 1987 showed an increasingly wide discrepancy between white and black infant mortality, particularly neonatal mortality.

The United States ranks 21st worldwide in infant mortality, but the difference between the black and white infant mortality rates is great and continues to widen. The ratio of black to white infant mortality in 1987 was 2:1 (25% higher than in 1940).

Many factors known to influence neonatal mortality are biased against the black population. For example, 5.7% of white infants are low birthweight infants vs 12.7% of black infants; 79% of white mothers received prenatal care in the first trimester vs 61% of black mothers; and 20% of all white births are to unmarried mothers vs 60% of all black births.

Kugler and his colleagues,[2] in the preceding paper describing neonatal mortality between blacks and whites, conclude that while differences in the rate of low birthweight between white and black civilian and military populations appear to be associated with a host of factors and not necessarily with access to prenatal care, differences in neonatal mortality, particularly for normal weight infants, are associated with access to pediatric care.

This article is timely and important, although the paper suffers from some problems that are unavoidable in such studies. The self-selection bias in this paper cannot be erased, that is, the families who join the military are self-selected and, therefore, different from other families. Another serious problem is the lack of important variables to control for that selection bias. The authors made a bold attempt at controlling for income. While it is important to try to do so, the measure chosen by the authors is not very good. They have categorized each family by the median family income of the census tract of maternal residents. There are, however, many variations in income within the census tract that are not represented by this measure. In addition, the income of military families is understated because they receive access to the commissary, on-post housing or a housing allowance, and medical care in addition to the basic salary.

An additional confounding factor is that the military population was composed of both active-duty mothers and mothers married to active-duty servicemen. The Uniformed Services University of the Health Sciences has pulled together the birth tapes for all babies born at military hospitals (Jacqueline Horton, personal communication). Data suggest that active-duty mothers are at greater risk for every complication studied.

There are many other aspects of military life that may have affected the results. The military has a drug-screening program, and a major effort is made in no-smoking programs. In addition, routine physical fitness tests and weight standards are adhered to, and most recruits must have a high school diploma.

In spite of these problems, the study indicates that the neonatal mortality difference between black and white can be eliminated with improved access to care in a controlled care system such as the military. There is no acceptable societal excuse for a difference in access to

medical care between the races. Equal access may equate to equal mortality, but the same is not true for morbidity. If it is true that neonatal mortality can be improved with access to care, then the next issue to be addressed is the incidence of low birthweight. The prevention of low birthweight would certainly be the optimal way of preventing mortality.

Research efforts need to focus on the cause of low birthweight. The military care model—with its highly selected population and its emphasis on preventive health care—might have been expected to have a lower incidence of low birthweight infants. This study has suggested that mortality rates can be improved with medical care. The factors associated with low birthweight are well known, but are not as readily ameliorated with medical care.

Innovative studies such as this one are needed to look further at all pieces of the puzzle. Future studies should focus on not only mortality but on morbidity—both infant and maternal—if additional insight is to be gained.

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