The Influence of the Changes in Maternal Age, Birth Order, and Color on the Changing Perinatal Mortality, Baltimore, 1961-66

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The study was supported by general support grant No. 630–0075 A from the Ford Foundation to the center and by the National Center for Health Statistics, Health Services and Mental Health Administration.

Elizabeth Kelley, MS, of Johns Hopkins University supplied special tabulations, and Jane Renzi Hughes, MA, and Rosamund Weatherall, formerly of the center's staff, assisted in making the computations.

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FLUCTUATIONS in birth rates usually are accompanied by changes in the distribution of births according to maternal age and birth order. It has long been known that fetal and neonatal mortality rates vary by mother's age and parity; Yerushalmy and co-workers (*1*), for example, refer to Coghlan (*2*), who mentioned this variation in 1899. The question naturally arises: Given a change in these mortality rates, how much is due to the change in the maternal age and parity distribution of births? There can be no uniform answer, for the magnitude of the effect depends on (*a*) the level and distribution of the age- and parity-specific rates, (*b*) the nature of the birth distribution, and on the change in factors (*a*) and (*b*). However, it would be useful to see whether there have been significant effects.

Although it has been apparent for some time that shifts in the distribution of births may influence fetal and neonatal mortality rates (*3*), few efforts have been made to measure this effect. Using indirect standardization, Gibson and McKeown (*4*) concluded that the change in the distribution of births by maternal age and parity in England and Wales from 1906–10 to 1947 "had very little effect on stillbirth and neonatal mortality rates." However, in a more recent study using direct standardization, it was found that the shift in the birth distribution in the Netherlands accounted for 40 percent of the decline in the stillbirth rate between 1952–53 and 1962–63 (*5*). Our study seeks to add to the meager existing body of evidence regarding the influence on perinatal mortality rates of changes in the distribution of births. (Although these two are not the only studies of this kind, our reading of the literature suggests that the characterization "meager" is justified.) To this end, we have analyzed data on perinatal mortality in the city of Baltimore during the early 1960's.

Fertility declined considerably throughout the United States during this period, but by the end of the sixties, the decline had apparently ended. Whether we interpret the sharp drop during 1971–72 as a resumption of the decline or as a temporary deviation from the fairly level trend from 1968 to 1970, increasing concern that the U.S. population growth rate may be too high may lead to a further sustained fall in fertility. Studying the effects of a change in the distribution of births during a period of declining fertility may help reveal the nature of the impact of possible future declines on the perinatal mortality rate.

These data from Baltimore can also help clarify the impact of the changes in the changing color composition of urban populations on the evolution of the perinatal mortality rate in large U.S. cities. For in many such cities, Baltimore among them, the proportion of the population that is nonwhite has been increasing steadily and almost surely will continue to do so, and the perinatal mortality rate is considerably greater among nonwhite than white infants. In addition, since nonwhite fertility is substantially higher, implying a different distribution of births, these data provide an opportunity to ascertain how much the color differential in birth distribution influences the color differential in perinatal mortality.

Data and Method

We obtained special tabulations of matched births (single and multiple) and deaths, cross-classified by color, single year of mother's age, and single birth order, that occurred to residents of Baltimore City in the years 1960–62 and 1965–67. Multiple births were excluded, and the events in which the mother's age or the parity were unknown were distributed proportionately. Ages were grouped into five categories: under 20, 20–24, 25–29, 30–34, and 35 and over. Parity, however, was grouped only at the upper end, combining sixth and higher order births. To reduce the influence of chance fluctuations and to increase the number of births and deaths among young multipara and old primipara in the study data, 3-year averages (1960–62 and 1965–67) centering on 1961 and 1966 were calculated.

The term "fetal deaths" refers to fetuses of 20 or more weeks of gestation, while neonatal deaths are those occurring less than 28 days after birth. The pattern of mortality rates in relation to age and parity during the first week is fairly similar to that between weeks 1 and 4 (*6*). Perinatal deaths are the sum of fetal and neonatal deaths, and the perinatal mortality rate is expressed per 1,000 live births. We are aware that this rate is frequently expressed per 1,000 total (live and still) births, but the use of live births only in the base is consistent with our purpose of studying the effect of

changes in the distribution of liveborn infants on the perinatal mortality rate. Moreover, Spiegelman noted that "there is no generally accepted convention for computing this rate," and "the deaths are divided by either live births alone or by the sum of live births and fetal deaths" (*7*). Parity is regarded in this paper as being synonymous with birth order, as in the paper by Heady and Morris (*6*).

Direct standardization has been used to measure the influence of variations over time and between color groups in the distribution of births by maternal age and parity. To measure change over time, the perinatal mortality rates (specific to the cross-classification of mother's age and birth order) for 1961 were applied to the appropriate distribution of live births for 1966. The earlier rates were preferred because they were more stable, since the number of births and deaths were greater in 1961 than in 1966. Similarly, in analyzing the influence of differences in the distribution of live births on the color differentials in perinatal mortality, the nonwhite rates were preferred since their numerators were larger and hence less subject to chance fluctuations.

Background

In the United States, mortality under 28 days fell between 1935 and 1951 among white and nonwhite infants by an average of more than 3 percent per year. During the fifties and early sixties, the drop decelerated sharply to less than 1 percent, more so among nonwhite than white babies. Somewhat similar patterns of decline occurred in respect to fetal and perinatal mortality. During the 1950's, neonatal mortality decreased less in metropolitan counties than in nonmetropolitan counties (*8*).

The color differential in neonatal mortality increased from a 42-percent excess in the 1950 rate for nonwhite infants over the rate for white infants to a 64-percent excess in 1964. Between 1955–57 and 1960–62, the excess in the fetal mortality rate increased from 84 to 88 percent and that in the perinatal rate, from 67 to 69 percent. These trends were less marked in urban areas, particularly in the 21 cities of 500,000 or more. For the period 1960–62 in these cities, the excess in mortality rates for nonwhites was about 55 percent for fetal, neonatal, and perinatal mortality. The differentials in Baltimore were virtually the same as the 21-city differentials (*9*).

Findings

During the 5 years covered by this analysis, there were large declines in the number of single births and of deaths (table 1). Births fell by a sixth and perinatal deaths by a quarter. Not surprisingly, neonatal deaths decreased more rapidly than fetal deaths. Declines in births and deaths of white infants were considerably greater than those of nonwhite infants. In particular, among white infants, fetal deaths fell almost as rapidly as neonatal deaths. With deaths dropping more swiftly than births, the perinatal rate declined (9.3 percent), again more quickly among whites (14.5 percent) than among nonwhites (9.0 percent). As a result, the excess of the rate for nonwhites over the rate for whites increased from 57 to 67 percent.

The birth rate dropped during this period from 23.8 for 1960–62 to 20.3 for 1965–67, a decrease of almost 15 percent, with the fall somewhat more

Table 1. Perinatal mortality, by color, Baltimore, 1961 and 1966[1]

Type of event	White		Percent decline among whites[2]	Nonwhite		Percent decline among nonwhites[2]	Both		Percent decline, total[2]
	1961	1966		1961	1966		1961	1966	
Live births[3]	34,593	26,497	23.4	32,504	29,243	10.0	67,097	55,740	16.9
Fetal deaths	503	339	32.6	754	659	12.6	1,257	998	20.6
Neonatal deaths	575	368	36.0	834	642	23.0	1,409	1,010	28.3
Perinatal deaths	1,078	707	34.4	1,588	1,301	18.1	2,666	2,008	24.7
Perinatal rate:									
Per 1,000 live births	31.2	26.7	14.5	48.9	44.5	9.0	39.7	36.0	9.3
Per 1,000 total births	30.7	26.3	14.3	47.7	43.5	8.8	39.0	35.4	9.2

[1]1961 is the average of 1960–62; 1966 is the average of 1965–67.
[2](1961 − 1966) ÷ 1961 × 100.
[3]Multiple births excluded.

Table 2. Percentage distribution of all liveborn infants, by mother's age and birth order of child, Baltimore, 1961 and 1966

Mother's age	Total	Birth order					
		1st	2d	3d	4th	5th	6th or more
1961 [1]							
Under 20	20.0	12.5	5.2	1.8	0.4	0.1	0
20–24	33.4	10.0	9.9	6.6	3.9	1.8	1.2
25–29	23.1	3.0	4.7	4.7	3.7	2.8	4.2
30–34	14.2	.9	1.9	2.5	2.5	2.0	4.4
35 or more	9.3	.5	.9	1.4	1.5	1.3	3.7
Total	100.0	26.9	22.6	17.0	12.0	8.0	13.5
1966 [2]							
Under 20	25.0	17.0	5.9	1.7	.3	.1	0
20–24	34.9	12.5	10.4	6.1	3.4	1.6	.9
25–29	21.0	3.2	4.6	4.4	3.2	2.3	3.3
30–34	11.3	.9	1.5	2.0	1.9	1.5	3.5
35 or more	7.8	.4	.7	1.0	1.1	1.1	3.5
Total	100.0	34.0	23.1	15.2	9.9	6.6	11.2
Percentage point change:							
Under 20	5.0	4.5	.7	− .1	− .1	0	0
20–24	1.5	2.5	.5	− .5	− .5	− .2	− .3
25–29	−2.1	.2	− .1	− .3	− .5	− .5	− .9
30–34	−2.9	0	− .4	− .5	− .6	− .5	− .9
35 or more	−1.5	− .1	− .2	− .4	− .4	− .2	− .2
Total	0	7.1	.5	−1.8	−2.1	−1.4	−2.3

[1]Average of 1960–62. [2]Average of 1965–67.

rapid among nonwhites than whites (*10*). Not surprisingly, this decrease meant a shift in the distribution of births toward lower parities, and along with this change, a shift toward younger maternal ages (tables 2–4). The percentage of all births that were first births increased by 7.1 points to 34.0 percent in 1966. This shift was much sharper for nonwhite births (9.1 points) than for white (5.6 points). The only other increase was for second births (one-half point), also more pronounced among nonwhite births. The relative size of all other birth orders declined.

The point increase was also concentrated in two categories of mothers (under 20 years and 20–24 years), but only for all births. The relative number of white liveborn infants increased (though just barely) to mothers 25 to 29 years old, as well as to younger mothers. But the relative number of nonwhite infants increased only among mothers under 20 years of age, by 7.6 points. These changes made the maternal age distribution in 1966 among nonwhites even younger than the distribution among whites than it had been in 1961. The modal age category in 1961 was 20–24 in each color group, but by 1966 it had shifted to those under age 20 among nonwhite mothers (31.9 percent), while the relative number of births to white mothers 20–24 years old increased from 35.1 to 39.4 percent.

In respect to all births (table 2), the only cells in the age-order matrix in which point increases occurred were among the five cells comprising first births to mothers under 30 and second births to mothers under 25. Of the remaining 25 cells, there was no change in only three and declines in the remaining 22. Thus, the declines were much less concentrated than the increases. But they were significantly greater among high-order births to mothers 25 or older than among either high-order births to mothers under 25 or low-order births to mothers 25 or more. Similar patterns of change occurred in births of both white and nonwhite infants (tables 3 and 4).

If the births to nonwhite mothers had been distributed by age and birth order jointly as were births to white women, the overall perinatal death rates for nonwhites would have been less than they actually were, but not by much—4.0 percent in 1961 and 7.9 percent in 1966. But, if subsequent changes are in the same direction, the color differential in the birth distribution might become a significant factor in accounting for the color differential in the perinatal rate.

The age-order matrices of the perinatal mortal-

Table 3. Percentage distribution of liveborn white infants, by mother's age and birth order of child, Baltimore, 1961 and 1966

Mother's age	Total	Birth order					
		1st	2d	3d	4th	5th	6th or more
1961 [1]							
Under 20	16.0	11.4	3.7	0.8	0.1	0	0
20–24	35.1	13.7	11.9	5.9	2.5	0.8	.3
25–29	23.9	4.1	6.4	5.9	3.7	2.0	1.8
30–34	15.0	1.3	2.6	3.5	3.0	2.0	2.6
35 or more	10.0	.6	1.2	1.9	1.9	1.6	2.8
Total	100.0	31.1	25.8	18.0	11.2	6.4	7.5
1966 [2]							
Under 20	17.5	13.2	3.5	.7	.1	0	0
20–24	39.4	17.3	12.8	5.7	2.4	.8	.4
25–29	24.0	4.6	6.8	5.6	3.5	1.9	1.6
30–34	11.4	1.1	1.9	2.6	2.3	1.5	2.0
35 or more	7.7	.5	1.0	1.3	1.3	1.2	2.4
Total	100.0	36.7	26.0	15.9	9.6	5.4	6.4
Percentage point change:							
Under 20	1.5	1.8	− .2	− .1	0	0	0
20–24	4.3	3.6	.9	− .2	− .1	0	.1
25–29	.1	.5	.4	− .3	− .2	− .1	− .2
30–34	−3.6	− .2	− .7	− .9	− .7	− .5	− .6
35 or more	−2.3	− .1	− .2	− .6	− .6	− .4	− .4
Total	0	5.6	.2	−2.1	−1.6	−1.0	−1.1

[1]Average of 1960–62. [2]Average of 1965–67.

Table 4. Percentage distribution of liveborn nonwhite infants, by mother's age and birth order of child, Baltimore, 1961 and 1966

Mother's age	Total	Birth order					
		1st	2d	3d	4th	5th	6th or more
1961 [1]							
Under 20	24.3	13.7	6.9	2.8	0.7	0.1	0.1
20–24	31.5	6.0	7.8	7.2	5.3	3.0	2.2
25–29	22.2	1.7	2.9	3.6	3.8	3.5	6.7
30–34	13.5	.6	1.1	1.7	1.9	1.9	6.3
35 or more	8.5	.3	.6	.8	1.1	1.1	4.6
Total	100.0	22.3	19.3	16.1	12.8	9.6	19.9
1966 [2]							
Under 20	31.9	20.5	8.0	2.7	.6	.1	0
20–24	30.9	8.0	8.2	6.5	4.3	2.4	1.5
25–29	18.2	2.0	2.8	3.2	2.8	2.6	4.8
30–34	11.1	.6	1.2	1.3	1.6	1.6	4.8
35 or more	7.9	.3	.5	.8	.9	1.0	4.4
Total	100.0	31.4	20.7	14.5	10.2	7.7	15.5
Percentage point change:							
Under 20	7.6	6.8	1.1	− .1	− .1	0	− .1
20–24	− .6	2.0	.4	− .7	−1.0	− .6	− .7
25–29	−4.0	.3	− .1	− .4	−1.0	− .9	−1.9
30–34	−2.4	0	.1	− .4	− .3	− .3	−1.5
35 or more	− .6	0	− .1	0	− .2	− .1	− .2
Total	.0	9.1	1.4	−1.6	−2.6	−1.9	−4.4

[1]Average of 1960–62. [2]Average of 1965–67.

Table 5. Observed and adjusted perinatal mortality rates per 1,000 live births, by mother's age and birth order, 1961 and 1966

Mother's age	Adjusted for birth order	All orders	Birth order					
			1st	2d	3d	4th	5th	6th or more
	Rates for all infants							
1961								
Adjusted for age [1]	38.8	39.2	36.0	32.5	36.6	37.4	50.7	58.0
All ages	38.9	39.7	36.3	32.5	36.8	37.8	50.8	57.6
Under 20	40.4	40.7	38.7	45.5	39.1	(2)	(2)	(2)
20–24	32.9	33.8	29.4	28.3	37.0	36.4	47.2	66.2
25–29	34.4	35.0	37.5	22.3	30.2	30.8	43.9	50.8
30–34	46.1	46.1	56.7	30.2	41.3	41.7	49.1	54.4
35 and over	61.9	61.0	65.5	56.9	47.3	55.2	69.4	65.8
1966								
All ages		36.0	33.1	34.3	32.8	32.5	45.0	50.7
Under 20		37.8	35.3	45.3	35.0	(2)	(2)	(2)
20–24		30.5	26.1	30.1	29.6	32.3	54.1	53.2
25–29		33.3	40.4	23.8	34.9	25.8	33.4	44.1
30–34		41.6	45.8	42.1	27.5	38.8	39.8	50.4
35 and over		54.3	[3]63.7	54.0	48.1	36.8	63.9	56.8
	Rates for white infants							
1961								
Adjusted for age [1]	30.2	30.5	27.3	24.3	30.2	33.3	48.2	51.5
All ages	30.6	31.2	27.8	24.4	30.6	33.9	48.6	50.8
Under 20	28.9	29.2	27.9	33.4	(2)	(2)	(2)	(2)
20–24	27.3	27.6	25.0	25.2	32.8	30.3	[3] 40.7	(2)
25–29	27.7	28.2	26.7	18.2	24.3	29.6	48.0	54.6
30–34	34.8	34.6	47.8	[3] 17.8	36.3	33.8	41.7	37.6
35 and over	49.2	48.8	[3] 50.4	[3] 34.4	35.8	47.1	60.3	58.1
1966								
All ages		26.7	24.9	24.8	25.3	26.0	41.4	36.9
Under 20		24.8	24.0	25.7	(2)	(2)	(2)	(2)
20–24		24.9	22.4	25.4	22.5	31.0	[3] 57.9	(2)
25–29		25.2	28.5	17.7	29.7	21.6	[3] 25.0	[3] 38.7
30–34		28.5	[3] 43.9	[3] 37.3	(2)	[3] 22.0	[3] 41.5	[3] 28.9
35 and over		41.9	(2)	(2)	[3] 36.2	[3] 36.3	[3] 58.0	40.5
	Rates for nonwhite infants							
1961								
Adjusted for age [1]	48.5	48.7	48.3	44.0	44.2	41.9	53.5	61.0
All ages	48.5	48.9	48.8	43.9	44.3	41.5	52.5	60.4
Under 20	48.8	48.8	48.4	52.3	44.1	(2)	(2)	(2)
20–24	40.2	41.1	40.0	33.4	40.7	39.6	49.1	64.9
25–29	43.2	42.9	64.9	32.3	40.5	32.1	41.4	49.7
30–34	59.7	59.7	76.9	60.6	52.9	55.1	57.2	61.8
35 and over	76.5	76.3	(2)	107.1	74.9	70.2	83.8	70.7
1966								
All ages		44.5	41.9	45.0	40.2	38.1	47.2	56.0
Under 20		44.2	41.8	53.1	34.4	(2)	(2)	(2)
20–24		37.0	33.3	36.6	35.3	32.9	53.0	53.9
25–29		43.0	65.6	37.4	43.2	30.6	39.2	45.7
30–34		53.8	(2)	[3] 49.2	52.3	59.9	[3] 38.3	58.8
35 and over		65.3	(2)	[3] 84.4	[3] 67.5	[3] 37.5	70.0	64.9

[1] Adjusted by direct standardization, by applying the 1961 rates to the 1966 live births.

[2] No rate shown because the number of deaths is less than 10.

[3] Less than 20 deaths but more than 10.

NOTE: 1961 is the average of 1960–62; 1966 is the average of 1965–67.

ity rates are shown in table 5. In some cells in the matrices, because the number of deaths is less than 10, the rates are not shown. (Rates for these cells, however, were calculated and used in the standardization procedure for obtaining adjusted rates.) Consequently, change can be measured in 27 cells for all infants, 22 cells for white infants, and 25 cells for nonwhite infants, and in each case the rate increased in only seven cells. Clearly, although the detailed changes do not appear to

Table 6. Absolute and relative change in the perinatal mortality rate per 1,000 live births, Baltimore, 1961–66, by color

Mother's age and infant's birth order	Absolute change (percent)			Relative change (percent) [1]		
	All births	White births	Nonwhite births	All births	White births	Nonwhite births
Mother's age:						
Under 20	−2.9	−4.4	−4.6	−7.2	−15.1	−9.4
20–24	−3.3	−2.7	−4.1	−9.8	−9.8	−10.0
25–29	−1.7	−3.0	.1	−4.9	−10.7	0
30–34	−4.5	−6.1	−5.9	−9.8	−17.6	−9.9
35 or more	−6.7	−6.9	−11.0	−11.0	−14.1	−14.5
All ages	−3.7	−4.5	−4.4	−9.3	−14.5	−9.0
Birth order:						
1	−3.2	−2.9	−6.9	−8.8	−10.4	−14.2
2	1.8	.4	1.1	5.6	1.6	2.6
3	−4.0	−5.3	−4.1	−10.9	−17.4	−9.3
4	−5.3	−7.9	−3.4	−10.4	−23.3	−8.2
5	−5.8	−7.2	−5.3	−11.5	−14.8	−10.1
6 or more	−6.9	−13.9	−4.4	−12.0	−27.4	−7.3
All orders	−3.7	−4.5	−4.4	−9.3	−14.5	−9.0

[1] $(1966-1961)\div 1961\times 100$.

NOTE: 1961 is the average of 1960–62; 1966 is the average of 1965–67.

present a pattern, there was a widespread decline by age and parity.

This general tendency is more readily apparent in table 6. There one can see that although the absolute magnitude of the decline in perinatal mortality was about the same for whites (4.5 points) as nonwhites (4.4 points), the rate for whites fell faster (14.5 percent) than the rate for nonwhites (9.0 percent) because the 48.9 rate for nonwhites in 1961 was considerably greater than the 31.2 rate for whites.

Another noteworthy feature of the change is that the 3.7 point absolute decline in the rate for all births was less than the declines in the rates for whites and nonwhites. The decline in the rate for all births would have been greater except for the increase in the relative number of nonwhite births, from 48.4 to 52.3 percent. If this change had not taken place, the perinatal rate for all births would have been 35.3 rather than 36.0, and the decline would have been 4.4 points (or 11.1 percent) instead of 3.7 points (or 9.3 percent).

The rate for whites fell more quickly than the rate for nonwhites, mainly for two reasons. The first is that the change in rates by age of mother or by birth order was more favorable among whites. The relative decline in rates for whites was greater in three of the five age groups and about equal in the other two. Similarly, in the four highest birth-order categories, rates fell considerably more rapidly among whites than did rates for nonwhites (table 6).

The second reason is that the change in the distribution of births by mother's age was also more favorable to whites. There was a decline in the relative number of births to white mothers 30 and over, relatively high-risk ages, while the major proportionate increase was to white mothers 20–24, the age category with the lowest rates. Among nonwhites, however, the substantial relative decline in births to high-risk older mothers was offset considerably by a large relative increase among mothers under age 20. The risk for those under 20 was greater than for those 20–24 and 25–29, except among whites in 1966 (tables 3–5).

There was a modest tendency for the rates to decline more at the older ages and the higher orders, that is, in the higher risk categories, than at the younger ages and the lower orders. Second order births, however, increased slightly. It is not apparent why they deviated from the trend of the other birth orders. Among births to nonwhites, those of the fourth order had the lowest perinatal rate in both years. But for births to whites, the lowest rate (though barely in 1966) was for second order births. Among all births, however, the lowest rate shifted from second order births in 1961 to those of the fourth order in 1966. The highest rate was at the highest birth order, except for births to whites in 1966, among whom the fifth order had the highest rate.

Between 1961 and 1966, the range of the rates narrowed considerably, as the following differences in percentage points make clear:

Rate	Range of—		
	All rates	*White rates*	*Nonwhite rates*
Order-specific:			
1961	25.1	26.4	18.9
1966	18.2	16.6	17.9
Age-specific:			
1961	27.2	21.2	35.2
1966	23.8	17.1	28.3
Age-order-specific:			
1961	47.1	42.5	75.0
1966	40.1	40.3	53.8

The large age-order-specific range of the nonwhite rates was mainly due to the very high perinatal rates for second order births to nonwhite women 35 years old or more, 107.1 in 1961 and 84.4 in 1966 (table 5). These births only accounted for about 0.5 percent of all nonwhite births in each year.

Now, which was more important in accounting for the decline in the perinatal mortality rates experienced by white, nonwhite, and all births—the change in the age-order-specific rates or the change in the distribution of births? From the general consistency of the declines in the specific rates with that of the overall rates (tables 5 and 6), it is clear that the change in the specific rates was more important than the shift in the distribution of births, but it is not clear how much influence the shift in distribution had. Was the shift negligible or significant, and was this equally true for nonwhites and whites? To answer these questions, the 1961 adjusted rates, obtained by applying the 1961 specific rates to the 1966 birth distributions, are compared with the observed 1961 rates and related to the differences between the observed 1961 and 1966 rates. The formula is (adjusted rate 1961 — observed rate 1961) ÷ (observed rate 1966 — observed rate 1961) × 100.

It is apparent from table 7 that almost one-quarter of the 9.3 percent decline in the perinatal mortality rate of all births between 1961 and 1966 was due to the change in the maternal age-birth order distribution of all births. The other three-fourths of the decline was accounted for by all other factors, as expressed in the changes in the age-order-specific rates. The change in the distribution of births was not nearly so influential, however, with respect to the rate for nonwhites as to the rate for whites. The shift in the birth distribution accounted for one-eleventh of the 9 percent fall in the rate for nonwhites and between a fifth and a fourth of the 14.5 percent drop in the rate for whites. Thus, the proportionate fall in the perinatal rates can be accounted for as follows:

Table 7. Influence of adjustment[1] for the change in birth distribution by maternal age and birth order of infant on the perinatal mortality rates per 1,000 live births, Baltimore, 1961–66, in percentages

Characteristics adjusted for—	All births	White births	Nonwhite births
Age and birth order	24.3	22.2	9.1
Birth order only	21.6	13.4	9.1
Age only	13.5	15.6	4.5
Maternal age for birth order:			
Under 20	10.3	6.8	0
20–24	27.3	11.1	22.0
25–29	35.3	16.7	300.0
30–34	0	− 3.3	0
35 or more	−13.4	− 5.8	− 1.8
Birth order for maternal age:			
1	9.4	17.2	7.2
2	0	−25.0	9.0
3	5.0	7.5	2.4
4	7.5	7.6	−11.8
5	1.7	5.6	−18.9
6 or more	− 5.8	− 5.0	−13.6

[1] The (adjusted rate 1961 − observed rate 1961) ÷ (observed rate 1966 − observed rate 1961) × 100 was the formula used to measure influence. Adjustment was by direct standardization, applying the 1961 rates to the 1966 live births. The rates are given in table 5.

NOTE: 1961 is the average of 1960–62; 1966 is the average of 1965–67.

Births	Percent change		
	Shift in birth distribution	*All other factors*	*Total decline*
All	2.3	7.0	9.3
White	3.3	11.2	14.5
Nonwhite	.8	8.2	9.0

Clearly, the change in the birth distribution had a significant effect on the change in the perinatal rate for all births and for white infants. The effect was hardly more than modest, however, on the rate change for nonwhite infants.

Table 7 also reveals that of the two related but far from perfectly correlated changes in birth distribution, that by maternal age and that by birth order, the change in order had stronger effects. (Wiener and Milton (*11*) report a product-moment correlation coefficient of .57, based on 100,277 of the 109,356 live births in Baltimore City from 1961 through 1965.) Birth order alone accounted for all the influence on the change in the perinatal rate for nonwhites exerted by change

in the age-order distribution and for almost all with respect to all births. As for the change in the perinatal rate for white infants, the change in the age distribution of mothers alone was a little more influential than the change in only the order distribution.

The other figures in table 7 indicate the effect of changes in the maternal age distribution on birth-order-specific perinatal rates and of changes in the order distribution of births on maternal age-specific rates. To interpret these figures properly, they need to be related to those in table 6. For example, the 300 percent influence of birth order shifts on the perinatal rate among infants of 25- to 29-year-old nonwhite mothers means little because there was virtually no change (zero in table 6) in this rate. The observed rate increased from 42.9 to 43.0, while the adjusted rate was 43.2 (table 5). Thus the formula (adjusted rate 1961 — observed rate 1961) ÷ (observed rate 1966 — observed rate 1961) gives the ratio 0.3 to 0.1, or 300 percent. If the other figures in table 7 are examined in the same fashion, no noteworthy figure or pattern appears.

Discussion

From 1955–57 to 1960–62, the perinatal mortality rate in Baltimore increased by 2.9 percent for all births and by 1.5 percent for whites. The rate for nonwhites, however, fell during this period by 2.1 percent (*9a*). Our findings show that the trend during the subsequent 5 years was reversed for the white and the overall perinatal rates and continued for the nonwhite rate, with the rate of change increasing considerably. With respect to the overall rate, the percentage of all births that were nonwhite increased less rapidly from 1961 to 1966 than during the preceding 5 years. These percentages were 41 in 1956, 48 in 1961, and 52 in 1966 (*10*).

Thus, the inflating effect on the perinatal rate of the increase in the relative number of higher risk nonwhite births was less pronounced during the early sixties than the late fifties, contributing (even if only modestly) to the reversal in the trend of the perinatal rate for the whole city. By 1969, however, 58 percent of all births were of nonwhite infants, indicating a substantial acceleration in this trend after 1966, which would have tended to dampen any further drop in the city's perinatal rate.

But the change in the distribution of births by race cannot help to explain the reversal of the trend of the perinatal rate for whites between the late fifties and the early sixties. Nor can it be relevant to the acceleration of the fall in the rate for nonwhites. What would be pertinent, however, as this study demonstrates, is the change in the age-parity distribution of births to white and nonwhite women. Aside from the data for the early sixties presented previously, we do not have this information. But the trend of the birth rate may be suggestive (*10*):

Year	*White*	*Nonwhite*
1956	20.8	32.0
1961	19.9	30.8
1966	17.0	24.9
1969	14.1	22.6

Parallel with the national trend, there was no more than a slight decline during the late fifties in the birth rate for whites and nonwhites, followed by a considerably swifter drop during the early sixties. As our previous analysis indicated, the shift in the age-parity distribution toward lower order births and younger mothers, which was associated with the drop in the birth rate during the early sixties, played a considerable part in the fall of the overall rate and of the perinatal rates for whites. It also had a modest but significant effect on the fall in the perinatal rate for nonwhites.

To judge from the much slower decline in the birth rates of each color group during the late fifties, it would appear that changes in the age-parity distribution were of considerably smaller magnitude during the late fifties than the early sixties. It is not likely, therefore, that changes in this distribution had as much effect during the earlier period. The accelerated fall in the birth rate for whites, as well as the continued quick (even if slower) decline in the birth rate for nonwhites between 1966 and 1969, suggest that change in the age-parity distribution probably continued to have substantial depressing effects on the perinatal mortality rates of both groups.

We conclude, therefore, that in analyzing changes in the rate of perinatal mortality, account should be taken of changes in the distribution of births by mothers' ages and infants' birth order. Further study might well be directed to ascertaining the conditions under which such changes have large or small impact. This examination would be facilitated by analyzing changes over different periods in the same place. Consequently, analyses similar to ours for intervals before 1961 and after

1966 in Baltimore City would be particularly helpful.

Another useful objective of further research would be to relate changes in the distribution of births according to parity and maternal age to such important determinants of infant mortality as illegitimacy and low birth weight. We know, for example, that a larger proportion of infants born out of wedlock than in it weigh less than 2,501 grams and that the percentage of all births out of wedlock is inversely related to birth order and the mother's age. It would seem, therefore, that during the early sixties the greater shift among nonwhite than white women to first births, especially among women under age 20, helps account for the slower decline during this interval in the perinatal rate for nonwhites than for whites.

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GENDELL, MURRAY (Georgetown University), and HELLEGERS, ANDRÉ E.: *The influence of the changes in maternal age, birth order, and color on the changing perinatal mortality, Baltimore, 1961–66. Health Services Reports, Vol. 88, October 1973, pp. 733–742.*

How much are declines in perinatal mortality due to improvements in clinical practice or public health programs and how much to other factors? The analysis is a partial contribution toward answering this question. It seeks to ascertain the extent of the influence on the change in the perinatal mortality rate of a change in the distribution of births by maternal age, birth order, and color. Data were obtained for the city of Baltimore for 1960–62 and 1965–67. Direct standardization was used to measure the influence of the changes in the distribution of births.

There was a decline in the city's perinatal mortality rate during this 5-year period of falling birth rates of a little more than 9 percent, with almost one-quarter of the drop attributable to the observed shift toward lower order births and younger mothers. The distribution effect was considerably stronger among whites than nonwhites. The increase in the percentage of all births that were to nonwhite mothers from 48 percent in 1961 to 52 percent in 1966 tended to offset the deflating influence of these distribution changes, but only to a modest degree.

Changes in the distribution of births by mother's age and the birth order can, therefore, have a substantial influence on changes in perinatal mortality. Thus, analyses of the trend in the perinatal mortality rate and its determinants should take such changes into account. In particular, it would be valuable to examine for the United States as a whole, as well for specific places, the influence of distribution changes on the perinatal rate during the period 1968–70, when the birth rate leveled off, and subsequently, when it fell rather sharply.
