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## COMPARISON OF THE CAUSES OF STILLBIRTHS AND NEONATAL DEATHS

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The 390 neonatal and stillbirth records of the five-year period 1949 through 1953 are shown in Table I. There were 217 stillbirths and 173 neonatal deaths. These numbers are large enough to indicate the comparative causes of death in the two groups. There are in many cases, if not indeed in each one, three factors contributing to the death, a maternal factor, a delivery factor, and an infant factor, one of which is primary. Evaluation of these, and estimation of the primary one is important and often difficult, and has been done after careful review of each

TABLE I. STATISTICS FROM THE OBSTETRICAL AND PEDIATRIC SERVICES OF THE HENRY FORD HOSPITAL

Five Year Period	Totals for 5 Yrs.	Yr. 1949	Yr. 1950	Yr. 1951	Yr. 1952	Yr. 1953
Deliveries	11,145	2070	2233	2409	2360	2073
Stillbirths	217	44	45	33	59	36
Live Births	10,928	2026	2189	2376	2301	2037
Neonatal Deaths	173	30	44	37	36	26
Stillbirths per 1000 live births	19.7	21.7	15.5	13.8	25.6	17.7
Neonatal deaths per 1000 live births	15.9	14.8	25.1	15.5	15.6	12.7

maternal-child history. Primary maternal factors seemed at fault in 14.4% of the stillbirths, 5.1% of the neonatal deaths; primary delivery factors in 36.0% of the stillbirths, 4.4% of the neonatal deaths; and primary infantile factors in 49.6% of the stillbirths, and 90.5% of the neonatal deaths. The details of this classification are shown in Table II, A and II B.

### MATERNAL FACTORS

Six maternal factors were considered a primary cause of death. The first was previous premature infants or abortions, and here is classed habitual abortion. Bundesen (1) found that 35% of multigravid mothers of previable prematures reported previous abortions. This condition must be controlled by maternal care, and in this series of 390 perinatal deaths was responsible for 11 of them. The second maternal factor was toxemia of pregnancy, responsible for 15 perinatal deaths. Twelve stillbirths and 3 neonatal deaths were caused by this disease. Bundesen (2) showed that the neonatal death rate was 50.2 per 1000 live births in toxemic mothers. Thus toxemia quadrupled the normal neonatal death rate. Toxemia obviously ranks high as a cause of both stillbirth and neonatal death.

The third maternal factor was heart disease, which caused 2 stillbirths, or 1.0% of them, but no neonatal deaths. Bundesen's (3) investigation showed that heart disease was present in 1.3% of neonatal deaths, but was not a primary cause of death in any.

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the necessity of constant diabetic control during pregnancy. In Bundesen's (4) series 0.5% of the neonatal deaths were due to maternal diabetes.

TABLE IIA—PERINATAL MORTALITY FOR 1949 THROUGH 1953 RELATED TO MATERNAL, DELIVERY, AND INFANTILE FACTORS

	Stillbirth		Neonatal Death	
	No.	%	No.	%
Maternal Factors	31	14.4	9	5.1
Delivery Factors	78	36.0	8	4.4
Infantile Factors	108	49.6	156	90.5
Total	217	100.	173	100.

TABLE IIB—NEONATAL DEATHS AND STILLBIRTHS FOR 1949 THROUGH 1953 RELATED TO MATERNAL FACTORS, DELIVERY FACTORS, AND INFANTILE FACTORS

	Stillbirth		Neonatal Death	
	No.	%	No.	%
<b>A. Maternal Factors</b>				
1. Previous Premature Infants or Abortions (Habitual Abortion)	7	32	4	2.3
2. Toxemia	12	5.5	3	1.7
3. Heart Disease	2	1.	0	
4. Diabetes	6	2.8	0	
5. Infections	3	1.4	2	1.1
6. Hypofibrogenemia	1	.5	0	
<b>B. Delivery Factors</b>				
Complicated Deliveries				
1. Mid or High Forceps	6	2.8	1	0.5
2. Breech Extractions	7	3.2	2	1.1
3. Caesarean Operations	8	3.7	1	0.5
4. Placenta-Separation, Previa, Infection, and Cord Compression	52	23.9	4	2.3
5. Ruptured Uterus, or Abd. Cyst	3	1.4	0	
6. Length of Labor	2	1.	0	
<b>C. Infant Factors</b>				
1. Abnormal Pulmonary Ventilation	0		77	44.5
2. Injuries at Birth	4	1.9	16	10.0
3. Malformations	26	12.0	47	27.0
4. Infections	1	.5	2	1.1
5. Erythroblastosis Fetalis	27	12.5	7	4.0
6. Anoxia	48	22.2	4	2.2
7. Miscellaneous				
1. Endocrine Gland Disease	0		0	
2. Intestinal Obstruction not Malformation	0		0	
3. Liver Disease	1	.5	3	1.7
4. Trauma other than Birth	0		0	
5. Others	0		0	
Totals	217	100	173	100

The fifth maternal factor was infection, including endometritis, Guillain-Barre disease, influenza with septaemia, and all other infection. Here was found the cause of 3 stillbirths, and 2 neonatal deaths, the later immediate deaths of small

premature infants, with delivery precipitated by infection. Bundesen (5) does not list maternal infection as a direct cause of neonatal death, but notes that infection of the mother was present in 8.3% of neonatal deaths. The associated listing of stillbirths, some of which were certainly caused by maternal infection, points to its recognition as an important factor in perinatal mortality.

The sixth maternal factor hypofibrinogenemia is listed only because it actually appeared as the cause of one stillbirth. The condition when present leads to the most serious if not fatal hemorrhage, and must be controlled by massive injections of fibrinogen (6)

The fourth maternal factor was diabetes which caused 6 stillbirths and no neonatal deaths in this group. This was 2.8% of the stillbirths, and indicates

### DELIVERY FACTORS

Six delivery factors were considered to be primary, but whereas delivery factors are often the cause of stillbirth, shown here as 36.0%, they are seldom an acceptable cause of neonatal death, shown here as 4.4%. If the infant is born alive, an improved opportunity is afforded to assess it as an individual, and to classify it as pulmonary failure. In the event of stillbirth, clearly anoxia has supervened, and it is a practical help in actually understanding the cause of death, to consider with care such a complication of delivery as is found.

The first delivery factor considered was mid or high forceps extraction judged to be the cause of 6 stillbirths, and one neonatal death. The second delivery factor was breech delivery judged to be the cause of 7 stillbirths, and 2 neonatal deaths. The third such factor was Caesarian delivery found to be the cause of 8 stillbirths and one neonatal death. It is well realised that these might be called birth injury, and in a special study shown in Table III all the neonatal deaths are reclassified solely on the basis of the infant's autopsy findings. Nevertheless, these were especially severe, complicated deliveries in each case.

The fourth delivery factor is one which can hardly be controlled in our present state of knowledge, placental and umbilical cord conditions. Here are classified 23.9% of the stillbirths and 2.3% of the neonatal deaths. If there was clear evidence of premature separation, of placenta previa, of umbilical cord infection, compression or rupture, the condition was listed here. It forms the largest group of stillbirth causes.

The fifth delivery factor was rupture of the uterus, and one abdominal cyst, causing 3 stillbirths. The sixth delivery factor was length of labor, the mother having in each of 2 cases precipitated a term stillbirth.

In view of the obvious fact that complicated, especially Caesarian deliveries, are often necessary as the clearly indicated treatment of toxemia premature separation, abruptio placenta, placenta previa, and diabetes, there is certain to be a high rate of fetal and infant loss here, and difficulty in deciding the primary factor.

### INFANTILE FACTORS

Seven primary infantile factors, following the analysis of Bundesen (1) were considered. The first infantile factor was abnormal pulmonary ventilation. No

stillbirths were classed here, as the cause of anoxia in them, must be some previous step interfering with the oxygen supply from the maternal circulation. Seventy-seven (44.0%) of the neonatal deaths were classified here, this being the largest single group of deaths. This group includes most of the premature infants, as their death is very often due to atelectasis, and occasionally to pulmonary hyaline membrane disease. The Bundesen (7) group found this factor in 43.7% of neonatal deaths.

The second infantile factor was injuries at birth. Here are classified 4 (1.9%) stillbirths and 16 (10.0%) neonatal deaths. Bundesen (8) showed 16.6% neonatal deaths due to birth injury when all such deaths were considered as to infantile pathology. The neonatal deaths which were classified as birth injuries, had seven prematures among them, 2 under 1000 grams at birth, one 1410 grams, one 1580 grams, and three between 2000 and 2500 grams; eight of normal term weights, and one of 4315 grams. The types of deliveries were Caesarians 2, mid-forceps 1, induced normal 1, spontaneous prematures 6, and spontaneous term 6. In each case there was associated central nervous system injury and intracranial hemorrhage. There were examples of subdural hematoma, subarachnoid hemorrhage, ventricular hemorrhage, tearing of the falx and general petechial hemorrhages. These are samples of the difficulty encountered in any obstetrical service, and 16 is a small number in 173 neonatal deaths and in a series of 10,928 consecutive live births.

The third infantile factor was malformations, which caused stillbirth in 26 (12.0%) cases and was the cause of neonatal death in 45 (26%) instances. A partial answer to the question why does malformation appear less often in stillbirths than in neonatal deaths is found in Bundesen's (9) analysis where it is stated "mortality rates from malformation among previables (400 grams-1000 grams in birth weight) was 15 times that among term infants." The incidence then of malformation has a relation to size at birth.

The fourth infantile factor was infection of the infant which appeared in 1 (0.5%) stillbirth and 2 (1.1%) neonatal deaths. It was very rare as a complication and is becoming more exceptional with the general competent use of antibiotics.

The fifth infantile factor was erythroblastosis fetalis which caused 27 (12.5%) stillbirths, and 7 (4.0%) neonatal deaths. This condition is a serious threat as the fetal loss is so high. Bundesen (10) found 2.8% of neonatal deaths due to this cause.

The sixth infantile factor was anoxia and has been used for spontaneous normal deliveries where no pathology was found, or where the general petechial hemorrhage characteristic of anoxia was found. The 48 (22.2%) stillbirths were from normal gestations and deliveries except that some were premature. Intrauterine anoxia and spontaneous premature delivery are a major group of serious conditions. Four (2.3%) of the neonatal deaths were listed here as caused by anoxia, in each case a term infant, showing no other characteristic pathology. Bundesen (11) showed 3.8% of neonatal death in this group, his diagnosis being based on history of interference with oxygen supply, or subserous multiple petechial hemorrhages. The classification has been used in this study where no other localized pathologic process could be found.



The seventh infantile factor is a group of causes altogether responsible for one (0.5%) stillbirth and for 3 (1.7%) neonatal deaths. In our group of 390 perinatal losses, the only one of these conditions which appeared was liver disease.

In order to make our statistics as nearly comparable as possible to Bundesen's (1) Table III, has been prepared in which all neonatal deaths were classified on the

TABLE III—NEONATAL DEATHS CLASSIFIED BY SEVEN PRIMARY INFANTILE FACTORS\*

	H.F.H.	Bundesen
1. Abnormal Pulmonary Ventilation	48.3	43.7
2. Injuries at Birth	15.6	16.6
3. Malformations	26.0	15.8
4. Infections	2.2	13.4
5. Blood Dyscrasia	4.0	5.3
6. Anoxia	2.2	3.8
7. Miscellaneous	1.7	1.4

\*Bundesen.

basis of autopsy findings alone. There are only slight differences, a few more malformations and a few less infections appeared in our series. Other than these two groups, our percentages agreed with his to within five percent. This is understood as the Chicago study was based on 8905 autopsies on neonatal deaths, where ours was on 217 stillbirths and 173 neonatal deaths.

#### SUMMARY

Comparative figures have been kept of the causes of stillbirth and neonatal death, where the patients were under the direction of the same group of obstetricians and pediatricians, and over the same 5 year period. The primary cause of death has been classified as to maternal factor, delivery factor and infantile factor. In stillbirths the maternal factor was found responsible in 14.4%, the delivery in 36.0%, and the infantile in 49.6%. In neonatal deaths the maternal factor was found responsible in 5.1% the delivery in 4.4%, and the infantile 90.5%.

This classification of the two groups aids our understanding of where effort must be concentrated in the eternal effort to lower the percent of stillbirth and neonatal deaths.

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