Declining Perinatal Mortality in a Region of Finland, 1968–82

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Abstract: Perinatal mortality (PNM) in the catchment area of the University Central Hospital of Turku (UCHT), Finland, was investigated during a 15-year period from 1968 to 1982. During the study period, 82,151 babies were born, there were 531 fetal deaths and 505 cases of early neonatal death. The PNM rate declined during the study period from 17.9 in 1968 to 7.0 in 1982, or from 14.8 to 4.6 when infants weighing less than 1000 grams were excluded. Significant declines occurred in PNM due to maternal illness, placental and umbilical cord complications, other asphyxias and respiratory distress syndrome. We believe the centralization of obstetric and neonatal services for risk cases, the introduction of modern obstetric and neonatal management, and continuing education of personnel at every level of maternity and neonatal care accounted for the decline. (*Am J Public Health* 1985; 75:156–160.)

Introduction

The perinatal mortality (PNM) rate in Finland has declined from 37.2 per 1,000 total births in 1945 to 7.9 in 1981.[1] In the United States, this development has been chiefly ascribed by some authors to advances in maternal health care and in obstetric and neonatal management.[2–4] Socioeconomic factors, maternal illness, age and parity, undernutrition and smoking also affect PNM.[5,6] Low birthweight—including both prematurity and fetal growth retardation—is the principal predictor of PNM.[7,8]

The organization of maternal health care in Finland is based on the Primary Health Care Act, 1972. Maternal health care is available to all pregnant women free of charge and is managed by public health nurses or midwives and health center physicians. In Finland, tertiary care hospitals are responsible for the quality of health care in each region for which they serve as a referral center.

The purpose of this paper is to report the changes in PNM during 15 years in one such region.

Background

The University Central Hospital of Turku (UCHT) serves as a referral center for mothers and neonates in need of special care in an area with 450,000 people and about 5,500 deliveries a year, nearly 10 per cent of the Finnish population and annual births. The Department of Obstetrics of UCHT also serves low-risk patients and about half of all deliveries in the region took place at UCHT throughout the 15 years. Although the centralization of high-risk mothers has been recommended throughout the 15-year period (1968–82), the principle did not become fully accepted until the latter third of this period.

Several changes occurred in obstetric management during this 15-year period. The cesarean section rate increased from 4.2 per cent to 11.7 per cent; vaginal breech deliveries decreased from 4.0 per cent to 1.1 per cent. Amniotic fluid surfactant determination and consequent corticosteroid therapy, when indicated, have been applied since 1976. Antepartum cardiotocographic tests have become routine, and the rate of intrapartum monitoring increased from zero to 80–90 per cent of all vaginal deliveries.

The UCHT Department of Pediatrics has had a highly qualified neonatal intensive care unit since 1980 and changes have occurred in respiratory therapy, neonatal monitoring, and fluid and nutritional therapy. In the early 1970s, first generation respirators were used, and it was not until 1978 that second generation respirators were introduced. Transcutaneous oxygen as well as heart and respiratory rate monitoring have been routinely available since 1978.

There are eight local hospitals in the region of UCHT, taking care of low-risk pregnancies. None of these hospitals offers neonatal intensive care services; five of them have a pediatrician of their own and two have had a consultant pediatrician since 1978.

Methods

Table 1 displays the live births, fetal deaths with birthweights of 500 gm or more, and neonatal deaths under seven days between the years 1968 and 1982: 82,151 babies were born in the region and there were 531 fetal and 505 early neonatal deaths. The material for this study consists of 1,036 perinatal deaths weighing 500 gm or more.

Data were collected from the death certificates, hospital charts, and autopsy records of all perinatal deaths by two of the authors. All cases were autopsied. The causes of death were based on both the clinical condition and the autopsy findings. The primary causes of death were grouped into eight categories:

1. Lethal congenital malformations;
2. Maternal illnesses, including both pregnancy-associated and other diseases;
3. Placental and umbilical cord complications, including abruption, placental infarcts, placenta previa, abnormal insertion, compression and prolapse of the cord, thrombosis of the intervillous space or the umbilical vessels;
4. Asphyxia due to other reasons not mentioned above;
5. Respiratory distress syndrome (RDS) or hyaline membrane disease;
6. Fetal malnutrition with fetal growth retardation below the 10th percentile, not included in any other categories;
7. Other known causes, such as infection, hemolytic disease, extreme prematurity (with no other reason), intracranial hemorrhage, and birth injuries;
8. Unknown causes.

The immediate or secondary causes were also recorded.

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TABLE 1—Live Births, Fetal Deaths, Early Neonatal and Perinatal Deaths in a Region of Finland, 1968–82

Year	Live Births	Fetal Deaths	Early Neonatal Deaths	Perinatal Deaths
1968	5996	42	66	108
1969	5515	48	61	109
1970	5357	49	47	96
1971	5103	39	38	77
1972	4947	47	37	84
1973	4763	28	32	60
1974	5293	37	34	71
1975	5613	35	36	71
1976	5648	37	25	62
1977	5742	33	45	78
1978	5760	21	13	34
1979	5508	41	21	62
1980	5481	29	23	52
1981	5484	21	13	34
1982	5410	24	14	38
Total	81620	531	505	1036

Due to the low annual number of perinatal deaths, the study period was divided into five consecutive three-year periods, with some 16,500 births during each period.

Results

The annual PNM rates for all births as well as for babies weighing 1000 gm or more and without lethal malformations are shown in Table 2. Despite annual fluctuations, there is a constant decrease in PNM rates.

Throughout the study period, low birthweight infants (<2500 gm) accounted for about two-thirds of total PNM and the decline in their PNM was greater than that among infants of 2500 gm or more. The birthweight-specific PNM by 500 gm groups is shown for the last two three-year periods; births have been filed by 500 gm birthweight category only since 1977 (Table 3).

The PNM rates by primary cause of death are shown in Table 4. There is a very slight decrease in PNM caused by congenital malformations. In contrast, the declines in PNM caused by maternal illness, and by placental and cord complications are significant when the periods preceding and following 1977 are compared; other asphyxias and RDS show significant decreases throughout the study period. In 1982, malformations and placental and cord complications were the leading causes of death whereas, at the beginning of the study, RDS and other asphyxias were more important.

The incidence of intrapartum deaths, excluding malformations, declined during the study period by 50 per cent (Table 5). While placental and umbilical cord complications and other asphyxias associated with difficult labor accounted for two-thirds of intrapartum mortality during the first two three-year periods, in 1980–82 the incidence of such deaths was only 22 per cent of all intrapartum deaths.

The move toward centralization of care is illustrated by the increasing share of perinatal deaths and births of low birthweight infants which occurred at UCHT during the study period (Table 6).

Discussion

There was some inaccuracy in registering fetal deaths and, to a lesser extent, neonatal deaths in the Official

TABLE 2—Annual PNM Rates (per 1000 Births) in a Region of Finland, 1968–82

	PNM Rates			
Year	Total	Birthweight <1000 gm Excluded	Lethal Congenital Malformations Excluded	Birthweight <1000 gm and Lethal Malformations Excluded
1968	17.9	14.8	16.6	13.5
1969	19.6	15.0	16.6	12.0
1970	17.8	13.9	15.9	12.3
1971	15.0	11.5	12.3	9.2
1972	16.8	15.2	14.3	12.7
1973	12.5	10.7	10.0	8.2
1974	13.3	10.7	10.7	8.1
1975	12.6	10.1	10.6	8.2
1976	10.9	8.1	9.5	6.7
1977	13.5	10.3	10.8	8.2
1978	5.9	4.5	4.5	3.1
1979	11.2	7.8	10.1	6.9
1980	9.4	7.8	7.1	5.6
1981	6.2	5.1	5.1	4.2
1982	7.0	4.6	5.5	3.3

TABLE 3—Birthweight-Specific PNM Rates (per 1000 Births) in a Region of Finland, 1977–79 and 1980–82

Birthweight (gm)	Period 1977–79	Period 1980–82
	Total PNM	
500–999	867.9 (46/53)	518.5 (28/54)
1000–1499	400.0 (34/85)	318.2 (28/88)
1500–1999	143.7 (25/174)	93.8 (15/160)
2000–2499	34.6 (15/434)	19.3 (8/415)
Subtotal <2500	160.9 (120/746)	110.2 (79/717)
≥2500	3.3 (54/16359)	2.9 (45/15732)
TOTAL	10.2 (174/17105)	7.5 (124/16449)
	Lethal Malformations Excluded	
500–999	854.2 (41/48)	490.2 (25/51)
1000–1499	392.9 (33/84)	268.3 (22/82)
1500–1999	118.3 (20/169)	82.3 (13/158)
2000–2499	32.3 (14/433)	9.7 (4/411)
Subtotal <2500	147.1 (108/734)	91.2 (64/702)
≥2500	2.2 (36/16341)	2.1 (33/15720)
TOTAL	8.4 (144/17075)	5.9 (97/16422)

Statistics. The multiple sources of data assured the completeness and reliability of the material collected.

In Finland as a whole, the PNM rate was 19.9 in 1968 and declined to 7.4 by 1982 when the cutoff weight is 1000 gm. With the same cutoff, the PNM rate in Sweden was 7.7 in 1981.* The facilities for maternity and neonatal care and the principles in management are equivalent in different parts of Finland. In the UCHT area, the decline in PNM was 61 per cent during the study period. In Sweden, the PNM rate declined during the 1970s by 50 per cent.[9] Williams and Chen found a 48 per cent decline in PNM during 1960–77 in California.[4] They also found, as we did, that neonatal mortality declined twice as fast as fetal mortality. In recent years, fetal deaths have been reported to account for 50–55 per cent of the perinatal mortality.[10,11] In the present study fetal mortality accounted for a third of perinatal mortality in the beginning of the study period and for two-thirds at the end of the period.

The low birthweight rate in the UCHT region was 4.5 per cent in 1968** and 3.8 in 1981–82** and cannot explain the decline in PNM. The greatest declines in PNM occurred in the low birthweight categories, and early neonatal mortality declined faster than fetal mortality in every birthweight category. Swedish birthweight-specific PNM rates are very similar.[9]

Some shifting of early to late neonatal deaths may have occurred in the lowest birthweight categories: in 1977–79, 15 per cent of all neonatal deaths occurred after the first week as compared to 19 per cent in 1980–82; the low birthweight categories accounted for the increase. However, between these two periods of time, total neonatal mortality declined in all low birthweight groups.***

Malformations have remained a major cause of PNM.[12] Most of such cases cannot be salvaged. The incidence of neural tube defects in Finland is low;[13] fetal karyotypes, alphafetoprotein or enzyme defects are routinely assessed only for the elderly mothers or mothers with previous infants with chromosomal aberrations, neural tube defects, congenital nephrosis, or inborn errors of metabolism. Thus second trimester abortions due to these conditions cannot have had a significant effect on the PNM.

Maternal illness as a cause of PNM showed a significant decrease when the first three and the last two periods were compared. Many of the advances in perinatal care in the UCHT region occurred after 1977–78 when the delivery of a premature infant on maternal indications improved the chances of mothers with chronic illness to have a healthy baby.

Fetal malnutrition with fetal growth retardation not arising from maternal illness or placental or cord complications has not decreased as a cause of perinatal death. In addition to malnutrition, these cases often involve hypoxia, but it is difficult to detect the characteristics of chronic asphyxia in a macerated fetus.

Erkkola, *et al,*[14] have found routine electronic fetal monitoring beneficial in reducing intrapartum mortality as certain causes of PNM, placental and umbilical cord complications, especially during labor, have decreased significantly. Prolonged and difficult deliveries and asphyxia can be avoided both by elective abdominal delivery of breech presentations and very large and small fetuses and by monitoring the fetus during labor and intervening when indicated.

Severe RDS as a cause of death has declined with the assessment of lung maturity, maternal cortocosteroid thera-

*Source: The Swedish National Board of Health.

**Erkkola R: Personal communication.

***From 806 to 378 per 1,000 in the 500–999 gm group, from 265 to 192 per 1,000 in the 1000–1499 gm group, from 69 to 65 per 1,000 in the 1500–1999 gm group, and from 11.8 to 9.8 per 1,000 in the 2000–2499 gm group. Tenovuo A, *et. al.*: Unpublished observations.

TABLE 4—PNM Rates per 1000 Births by Primary Causes of Death in a Region of Finland, 1968–82

Primary Cause of Death	Period 1968–70	1971–73	1974–76	1977–79	1980–82
Lethal Congenital Malformations	2.1	2.6	2.0	1.8	1.6
Maternal Illness	2.0	1.9	2.2	1.3	0.9
Fetal Malnutrition	1.2	0.8	0.5	0.5	0.6
Placental and Cord Complications	2.5	2.6	2.3	1.8	1.4
Other Asphyxias	3.0	2.5	1.0	0.7	0.2
Respiratory Syndrome	4.4	3.1	2.4	1.8	1.2
Other Causes	2.1	0.5	1.2	1.1	0.9
Unknown	1.1	0.6	0.7	1.2	0.7

TABLE 5—Intrapartum PNM Rates per 1000 Births in a Region of Finland, 1968–82

Categories	Period				
	1968–70	1971–73	1974–76	1977–79	1980–82
Total	1.3	2.1	2.0	1.6	0.9
Birthweight <1000gm Excluded	1.0	2.0	1.7	1.2	0.8
Lethal Malformations Excluded	1.0	1.9	1.4	1.2	0.5
Birthweight <1000gm and Lethal Malformations Excluded	0.8	1.7	1.1	0.9	0.4

TABLE 6—Percentage Distribution of Perinatal Deaths and Births of Low Birthweight Infants (UCHT vs other hospitals) 1968–82

	Period				
	68–70	71–73	74–76	77–79	80–82
All Perinatal Deaths					
UCHT	48	55	54	66	75
Other Hospitals	52	45	46	34	25
Maternal Illness as a Cause of Death					
UCHT	73	69	69	91	100
Other Hospitals	27	31	31	9	—
RDS as a Cause of Death					
UCHT	58	54	68	68	90
Other Hospitals	42	46	32	32	10
Births of Low Birthweight Infants					
UCHT	48	58	63	65	76
Other Hospitals	52	42	37	35	24

py, and optimal timing of delivery.† The contribution of RDS to early neonatal deaths, however, has remained about 40 per cent throughout the study period—reflecting the unchanged proportion of very low birthweight infants.

Declines also occurred in fetal intracranial hemorrhages and erythroblastosis fetalis, while infections showed a slight increase as the cause of death.

The category "unknown" cause of death included only fetal deaths and remained unchanged during the study period. The cause of death is difficult to determine in a macerated fetus without maternal illness, evidence of placental or umbilical cord disturbance, signs of asphyxia or fetal growth retardation. "Unknown" causes of death have been reported to account for 3.4 to 20 per cent of perinatal deaths.[15–17]

The costs and benefits of centralization and neonatal intensive care have been widely investigated and discussed.[3,10,18–24] Many of these studies concern very low birthweight infants and are based on cohorts treated at certain tertiary centers. The present study deals with all births in the catchment area of UCHT.

During the whole study period, more than 99 per cent of all pregnancies were registered at maternity health centers and the average number of examinations during pregnancy remained at 15, including 3.5 examinations by health center physicians.[1] The number of teenage mothers has decreased and the number of mothers aged 30–39 years has increased. At present, the majority of Finnish women work outside home, and more than half of the university students are female. The influence of maternal age, education, and socioeconomic status on PNM could not be investigated in the present study. The effects of these factors cannot be totally ignored, but we believe them to be minimal.

During the study period, the proportion of births at UCHT varied from 42 per cent in 1977 to 52 per cent in 1982 with a slight increase during the last years. These figures, when compared with the other data in Table 5, indicate that centralization of high-risk cases has increased during the study period. As antenatal transport has proved superior to neonatal transport,[25–27] maternal referral has been strongly recommended. Most of the referrals are elective, e.g., the mother will visit the maternity outpatient clinic when the risk factors have been recognized and the mode of delivery will be pre-selected when possible.

Much attention has been paid in this area to the continuing education of all personnel at every level of maternity and neonatal care. The number of available personnel has not changed during the study period. Lack of nurses is a continuous problem in the neonatal intensive care unit, especially as the technical equipment becomes more complex. Education of personnel is an essential part of centralized care.

The effects of changes in management and centralization of care cannot be identified separately, because there were no clearly separated periods of time that distinguished them. The process is multifactorial and continual. We believe that the reduction in PNM is due to a combination of improved quality of prenatal and neonatal care, enhanced by centralization of care in high-risk cases. The quality of the survivors is of concern to us. A regional follow-up program was begun in 1981 in the area of UCHT, but no results have yet been reported. The conclusions of other studies indicate that success in reducing PNM has not been achieved at the expense of the health of the survivors.[28,29]

†Kero P: Personal communication.

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International Conference on AIDS Set for April

An International Conference on Acquired Immunodeficiency Syndrome (AIDS) will be held April 15–17, 1985, at the World Congress Center, Atlanta, Georgia, sponsored by the Centers for Disease Control; the National Institutes of Health; the Food and Drug Administration; the Alcohol, Drug Abuse, and Mental Health Administration; the Health Resources and Services Administration; and the World Health Organization.

The purpose of the meeting is to review strategies for the prevention and control of AIDS and to exchange information on screening and diagnostic tests for AIDS and on the epidemiology, virology, immunology, clinical manifestations, and treatment of AIDS. Seating will be available for 1,800 participants. For further information and future announcements, please contact: AIDS Conference, Building 1, Room 2047, Centers for Disease Control, Atlanta, GA 30333.