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Studies on Infant Mortality Rates in Korea (1993 and 1996 birth cohort)

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Young Ja Han(Senior Researcher)

Korea Institute for Health and Social Affairs

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Korea Institute for Health and Social Affairs

Korea Institute for Health and Social Affairs
San 42-14, Bulkwang-dong, eunpyung-ku,
Seoul 122-040, Korea
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1. Introduction

Korea's infant mortality rate was produced either by sample survey or indirect estimations from vital registration(Han SH 1989; Kim IH 1988; Kim JK 1989, 1992; Kim KS 1968, 1969; Kong SK 1983; Kwon EH 1968; Lee DW 1975; Park CB 1981; Park HJ 1962). However, these statistics were not deemed reliable because they were under-reported and under-represented. Indirect estimation does not only lack reliability but also is unable to provide detailed information for MCH policy. It was understood that neither vital registration nor survey was appropriate for producing IMR in Korea. Therefore, there was need for developing a new method that would eliminate these limitations.

Korea Institute for Health and Social Affairs (KIHASA) has developed a research strategy to produce IMR based on real data on population(Han YJ, 1995). This study used the fact that 99% of deliveries have taken place in medical facilities under the national medical insurance system. The new method was applied to the infant mortality study on both 1993 and 1996 birth cohorts, and the study of 1999 birth cohort was conducted in December 2001.

Objectives of study

- To produce reliable infant mortality rate through a survey of the whole population
- To find out causes of infant death
- To provide basic statistics for formulating and evaluating MCH policies and programs

Definitions(Han YJ, 1996)

- Live birth: Live birth is the complete expulsion or extraction from the mother's womb as a product of human conception, which shows any evidence of life.

- In this report, live birth defines 20 weeks (22 weeks from the third infant mortality survey in 2001) or more of pregnancy or 500g or more of birth weight
- Infant Death: Infant death is the death of an infant which occurs before his or her first birthday.

2. The infant mortality survey (1993, 1996 birth cohort)

The study subjects are a cohort of infants who were born during the period of Jan. 1~Dec. 31, both in 1993 and 1996, and who died before their first birthday(Han 1996, Han 1998).

Gathering existing data

The existing data was collected before conducting the survey at the medical facilities. Since the majority of data sources on infant death were deficient, information on infant death was gathered from various sources and integrated into a single set of data. The data set includes health insurance data (the record of health insurance beneficiaries, maternity benefit data, funeral grant), resident registration record and vital registration and the report of infant deaths from the medical and health facilities.

It was assumed that all of these data were in some way inadequate and therefore needed to be supplemented by other data. The most serious defect in the existing data was the fact that neonatal deaths were rarely reported. Therefore, one alternative method was to conduct an investigation at medical facilities to identify cases of neonatal death, which had been generally omitted from all records, by tracking down the maternity benefit data.

The existing data were collected to identify neonatal death cases, which are generally omitted from all records, to tracking down the maternity benefit data, and also to identify infant

death cases for further investigation at the medical facilities.

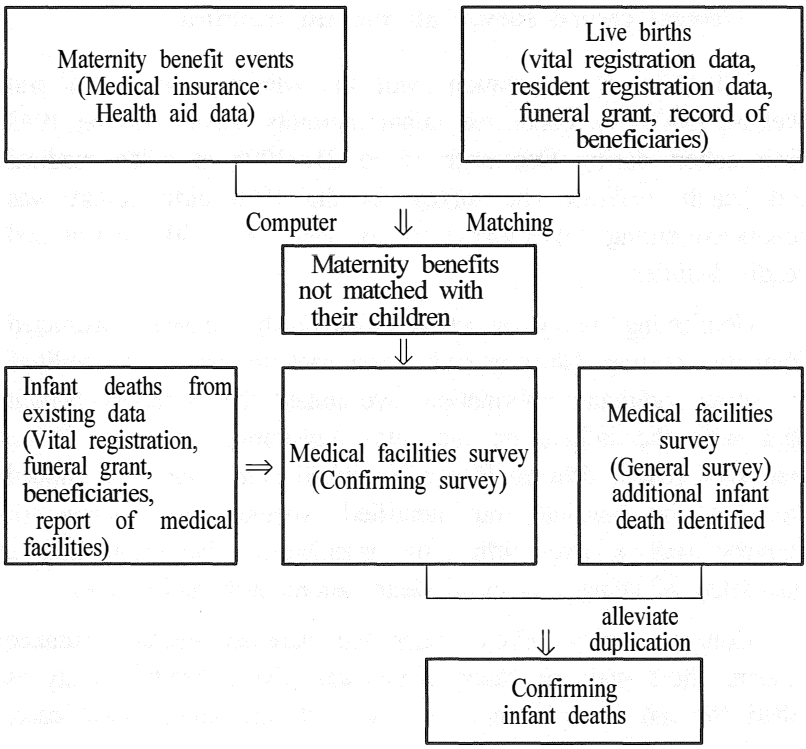
Medical record survey at medical facilities

KIHASA, in cooperation with the Ministry of Health and Welfare (MOHW), conducted infant mortality survey for the 1993 birth cohort during December 15 to 21, 1995 at 6,766 medical and health facilities. The survey for the 1996 birth cohort was conducted during November 1 to 14, 1998 at 3,930 medical and health facilities

Confirming survey: A set of infant death file was constructed from the existing data sets and traced back to the health facilities to gather additional information. We linked the maternity benefit data with the infants on the vital registration data set. When maternity benefit data could not be linked with infants, we traced them at the hospital and identified whether the outcome of delivery was a live birth. An unregistered live birth had a possibility of being a neonatal death before birth registration.

General survey: Even under the national health insurance system, there may be cases overlooked. Every health facility is sifted through in order not to leave out any infant death case.

Figure 1. Process of identifying infant deaths



3. Results of Investigation

A. IMR (Infant Mortality Rate)

Mortality rates were calculated as follows.

IMR (Infant mortality rate)

$$= \frac{\text{No. of infant deaths}}{\text{No. of live births}} \times 1,000$$

NMR (Neonatal mortality rate)

$$= \frac{\text{No. of neonatal deaths}}{\text{No. of live births}} \times 1,000$$

PNMR (Postneonatal mortality rate)

$$= \frac{\text{No. of post} - \text{neonatal deaths}}{\text{No. of live births}} \times 1,000$$

IMR Trends

The number of infant deaths among the 1993 birth cohort by the above method was 7,088 and that among the 1996 birth cohort was 5,371. The proportion of neonatal deaths decreased from 66.2% in 1993 to 53.2% in 1996. IMR was also decreased from 9.9 in 1993 to 7.7 in 1996 (See Table 1).

Table 1. IMR of the 1993 and 1996 Birth Cohorts

	1993			1996		
	Male	Female	Total	Male	Female	Total
Neonatal	7.0	6.1	6.6	4.4	3.8	4.1
Post-neonatal	3.6	3.1	3.3	3.7	3.6	3.6
Infant	10.5	9.2	9.9	8.0	7.4	7.7

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.
Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

IMR by age of mother

IMR by age of mother showed a U-shape curve that represents the high IMRs among teenagers and mothers over 30 years of age. IMR of the teen-age mothers may be higher than the figure on the table because a considerable proportion of mothers of unknown age may belong to this group (See Table 2).

Table 2. IMR by Age of Mother

Age of Mother	1993	1996
14~19	7.4	8.8
20~24	7.2	6.3
25~29	8.6	6.8
30~34	11.3	9.4
35~39	17.8	13.5
40 and over	34.8	21.9
Total	9.9	7.7

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.
Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

IMR by region

There are regional differences in IMR, and the regions of different IMRs are classified into three groups. The cities and provinces of an IMR lower than the national average (7.7) include Seoul (6.6), Incheon (7.4) and Kyonggi Province (7.2), Chunbuk (7.6), Cheju (6.9) and Kwangju (7.0). The next group has an IMR slightly higher than the national average, which inclues Taejon (7.8), Chonbuk (8.2), Chunnam (8.3), Taegu (8.3), Busan (8.4) and Kyongnam (8.6). The regions with the highest IMRs are Kangwon (9.7), Chonnam (9.5) and Kyongbuk (9.3). The regional differences are assumed to reflect the differences in socioeconomic status and in accessability to medical facilities. However, the fact that Taegu and Busan, two of the most populous metropolitan cities in Korea, had high IMRs suggests the need for an exhaustive study for identifying the determinants of IMR.

Table 3. Infant Mortality Rate by Region (1996 birth cohort)

(Unit: Person, per thousand person)

	No. of Live Births[2)]	No. of Infant Deaths[3)]	IMR
Metropolitan Cities			
Seoul	153,475	1,011	6.6
Pusan	50,569	424	8.4
Taegu	37,289	309	8.3
Incheon	39,604	293	7.4
Kwangju	22,002	153	7.0
Taejon	21,217	166	7.8
Provinces			
Kyonggi	143,456	1,026	7.2
Kangwon	19,520	189	9.7
Chungbuk	21,116	160	7.6
Chungnam	23,524	196	8.3
Chonbuk	26,960	221	8.2
Chonnam	27,809	264	9.5
Kyongbuk	36,904	345	9.3
Kyongnam	64,719	554	8.6
Cheju	8,654	60	6.9
Total	696,818	5,371	7.7

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

B. Infant Deaths by Socio-demographic Characteristics

Table 4 shows infant deaths by sex. Among the total deaths in 1993, 66.2% are known to have occurred during the neonatal period, and 52.3% during the first week after birth. The proportion of neonatal death in the total infant deaths in 1996 was 53.2%, and those who died during the first week after birth occupied 38.6%.

Table 4. Infant Deaths by Sex and Age at Death (1993 cohort)

(Unit: person, %)

	1993			1996		
	Male	Female	Total	Male	Female	Total
Neonatal	66.2	66.2	66.2	54.5	51.5	53.2
0~6days	(52.9)	(51.5)	(52.3)	(39.4)	(37.5)	(38.6)
7~27days	(13.3)	(14.7)	(13.9)	(15.1)	(14.0)	(14.6)
Post-neonatal	33.8	33.8	33.8	45.5	48.5	46.8
Infant	100.0 (4,029)	100.0 (3,059)	100.0 (7,088)	100.0 (2,946)	100.0 (2,425)	100.0 (5,371)

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.

It was revealed that 17.8% of the total infant deaths and 20.7% of the total neonatal deaths were caused by congenital malformation. The proportion of the post-neonatal deaths caused by congenital malformation was 14.6% (See Table 5).

Table 5. Distribution of Infant Deaths by Congenital Malformation (1996 Birth Cohort)

(Unit: person, %)

Duration of Survival	No		Yes		Total	
	No.	%	No.	%	No.	%
Neonate(0~27 days)	2,266	79.3	590	20.7	2,856	100.0
0~ 6 days	1,673	80.7	399	19.3	2,072	100.0
7~27 days	593	71.1	191	22.9	834	100.0
Post-neonates (28~364 days)	2,148	85.4	367	14.6	2,515	100.0
Total Infant	4,414	82.2	957	17.8	5,371	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Among the infant deaths, the first birth order occupied 42.1%, the second 43.1%, the third 10.7% and the fourth birth order and over, 4.1%(See Table 6).

Table 6. Distribution of Infant Deaths by Birth Order (1996 Birth Cohort)

(Unit: person, %)

Age at Death(days)	1	2	3	4+	Total
Neonates (0～27)	919 (42.7)	888 (41.3)	244 (11.3)	101 (4.7)	2,152 (100.0)
Post-neonates (28～364)	511 (41.0)	578 (46.3)	118 (9.5)	40 (3.2)	1,247 (100.0)
Infant (0～364)	1,430 (42.1)	1,466 (43.1)	362 (10.7)	141 (4.1)	3,399 (100.0)

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.
Note: Excluded 1,972 cases without information of birth order.

Infant deaths by gestation period showed that 20.1% of the total infants deaths had a gestation period under 28 weeks. More baby girls died during this period than baby boys did (See Table 7).

Table 7. Infant Deaths by Gestation Period (1996 Birth Cohort)

(Unit: person, %)

Gestation weeks	M		F		Total	
	No.	%	No.	%	No.	%
less than 28	403	18.4	381	22.3	784	20.1
28～31	393	18.0	263	15.4	656	16.9
32～36	349	16.0	251	14.7	600	15.4
37～41	1,000	45.7	782	45.9	1,782	45.8
more than 42	42	1.9	28	1.6	70	1.8
Total	2,187	100.0	1,705	100.0	3,892	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.
Note: Excluded 1,479 cases without information on gestation period

It is well known that infant mortality is high among underweight births. Low birth weight (less than 2,500g) occupied 54.0% of the total infant deaths and very low birth weight (less than 1,500g), 35.4%. More female infant deaths (56.8%) belonged to the low birth weight category than male infant deaths (51.8%) did (See Table 8).

Table 8. Distribution of Infant Deaths by Birth Weight (1996 Birth Cohort)

(Unit: person, %)

	M		F		Total	
	No	%	No	%	No	%
< 1,500g	744	33.5	650	37.8	1,394	35.4
1,500 ~ 2,499g	407	18.3	327	19.0	734	18.6
2,500 ~ 3,999g	1,019	45.9	715	41.6	1,734	44.0
4,000g and over	50	2.3	28	1.6	78	2.0
Total	2,220	100.0	1,720	100.0	3,940	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 1,431 cases without information on birth weight.

There seems to be a close relationship between the birth weight of infants and their survival. The less the birth weight, the shorter the survival duration. Among the dead infant with birth weight under 1,500g, 36.4% died on the first day of birth, a rate more than four times that for infants weighing 2,500 ~ 3,999g (See Table 9).

Table 9. Distribution of Infant Deaths by Duration of Survival and by Birth Weight (1996 Birth Cohort)

(Unit: person, %)

Duration of survival (days)	< 1,500g		1,500 ~ 2,499		2,500 ~ 3,999		4,000g ≤		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	507	36.4	127	17.3	137	7.9	10	12.8	781	19.8
1 ~ 6	502	36.0	266	36.2	297	17.1	9	11.5	1,074	27.3
7 ~ 27	223	16.0	159	21.7	227	13.1	8	10.3	617	15.7
28 ~ 90	108	7.7	90	12.3	399	23.0	11	14.1	608	15.4
91 ~ 184	29	2.1	55	7.5	365	21.0	23	29.5	472	12.0
185 ~ 364	25	1.8	37	5.0	309	17.8	17	21.8	388	9.8
Total	1,394	100.0	734	100.0	1,734	100.0	78	100.0	3,940	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 1,431 cases without information on birth weight

Multiple births had a high neonatal death rate, and it was found that 68.9% of the infant deaths among the multiple pregnancy occurred within a week after birth. This is a higher rate than that of singleton birth at 45.9% (See Table 10).

Table 10. Distribution of Infant Deaths by Multiple Pregnancy (1996 Birth Cohort)

(Unit: person, %)

Duration of survival(days)	Singleton		Multiple pregnancy		Total	
	No.	%	No.	%	No.	%
Neonates (0 ~ 27)	2,228	61.4	170	80.2	2,398	62.4
0 ~ 6	1,666	45.9	146	68.9	1,812	47.2
7 ~ 27	562	15.5	24	11.3	586	15.2
Post-neonates (28 ~ 364)	1,400	38.6	42	19.8	1,442	37.6
Infant (0 ~ 364)	3,628	100.0	212	100.0	3,840	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 1,531 cases without information on multiple pregnancy.

Among the total infant deaths at the medical facilities, 87.7% occurred at general hospitals in 1993. The rate increased to 92.4% in 1996 (See Table 11). This suggests that more infants at risk might have been transferred to general hospitals due to the increased accessibility to medical facilities since the introduction of the national medical insurance system in 1989.

Table 11. Infant Deaths by Type of Medical Facility

(Unit: %, person)

Medical Facilities	1993	1996
General Hospital	87.7	92.4
Hospital	5.9	4.1
Clinic	5.1	3.1
Others (Midwifery Clinic Health Facilities)	1.3	0.4
Total	100.0 (5,194[1])	100.0 (3,230[2])

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.
Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: 1) Number of infant deaths based on the medical facilities survey
2) 2,141 cases those without information of death occur were excluded

There were significant differences in the infant death rates across the types of medical facilities by region. More than 90% of infant deaths occurred at general hospitals in the six metropolitan areas and two other provinces(Kangwon, Jeju), while the other provinces showed much lower rates (60.0～86.0%) (See Table 12).

Table 12. Infant Deaths by Region and by Type of Medical Facility (1993 cohort)

(Unit: %, Person)

	General Hospital	Hospital	Clinic	Midwifery Clinic	Health Facilities	Total
Total	87.7	5.9	5.1	0.1	1.2	100.0(5,194)
Metropolitan areas						
Seoul	90.8	3.3	5.8	0.1	-	100.0(1,540)
Pusan	92.1	6.5	1.4	-	-	100.0(571)
Taegu	92.7	4.7	2.6	-	-	100.0(386)
Inchon	97.3	-	2.7	-	-	100.0(259)
Kwangju	94.6	4.7	0.7	-	-	100.0(296)
Taejon	97.1	-	2.9	-	-	100.0(239)
Provinces						
Kyonggi	83.1	7.2	9.1	-	0.6	100.0(528)
Kangwon	95.6	1.3	3.1	-	-	100.0(160)
Chungbuk	84.3	0.8	13.4	-	1.6	100.0(127)
Chungnam	74.4	3.1	6.2	-	16.3	100.0(129)
Chonbuk	86.0	1.9	7.6	-	4.5	100.0(157)
Chonnam	60.0	27.0	7.8	-	5.2	100.0(115)
Kyongbuk	82.2	4.3	1.6	0.5	11.4	100.0(185)
Kyongnam	68.3	21.9	8.4	1.1	0.2	100.0(439)
Cheju	90.5	9.5	-	-	-	100.0(63)

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.

Note: Number of infant deaths based on the medical facilities survey.

85.8% of total infant deaths occurred at medical facilities, 7.6% at home and 6.6% at other places. Those who had short survival duration were more likely die at hospitals. More than 90% of the total deaths occurred at medical facilities during neonatal period(0～27days). On the other hand, death occurred at home or other places increased during the period 1～5 months after birth.

Table 13. Duration of Survival and Place of Death (1996 birth cohort)

(Unit: person, %)

Duration of survive	Medical facilities		Home		Others		Total	
	No.	%	No.	%	No.	%	No.	%
less than 24 hours	720	94.4	29	3.8	14	1.8	763	100.0
1~ 6 days	990	93.7	48	4.5	19	1.8	1,057	100.0
7~27 days	591	88.9	46	6.9	28	4.2	665	100.0
28 days~ 2 months	635	78.7	90	11.2	82	10.2	807	100.0
3~5 months	459	74.2	75	12.1	85	13.7	619	100.0
6 months~1 year	375	78.0	46	9.6	60	12.5	481	100.0
Total	3,770	85.8	334	7.6	288	6.6	4,392	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 979 cases without information on place of death

C. Causes of Infant Death

The causes of infant deaths were classified in accordance with ICD-10 (International Classification of Diseases 10).

Causes of Infant Death by Sex

Among the 10 major causes of infant death, the first was 'congenital malformation of the heart', constituting 11.2% of the total infant deaths. The second was 'sepsis of the newborn', constituting 10.3% of infant deaths. The third was 'respiratory distress of the newborn' at 10.2% and the fourth was 'fetal growth disorder' at 9.8%(See Table 14). Table 15 shows major causes of death by sex.

Table 14. 10 Major Causes of Infant Deaths (1996 birth cohort)

	Infant (0~364 days)	%
1	Congenital heart malformation	11.2
2	Newborn sepsis	10.3
3	Respiratory distress of newborn	10.2
4	Fetal growth disorder	9.8
5	Other symptoms	8.8
6	Other respiratory disease of newborn	7.0
7	Other congenital malformation	4.6
8	Birth asphyxia	4.3
9	Other perinatal disease	4.2
10	Neonatal hemorrhagic disease	3.9
	Others	25.7
	Total	100.0 (4,372)

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 999 cases with unknown causes

Table 15. 10 Major Causes of Infant Deaths by Sex (1996 birth cohort)

	M	%	F	%
1	Congenital heart malformation	11.2	Congenital malformation of the heart	11.2
2	Respiratory distress of newborn	10.7	Sepsis of the newborn	10.5
3	Newborn sepsis	10.1	Fetal growth disorder	10.2
4	Fetal growth disorder	9.5	Respiratory distress of the newborn	9.7
5	Other symptoms	8.3	Other symptoms and signs	9.5
6	Other respiratory disease of newborn	6.5	Other respiratory disease of the newborn	7.5
7	Other congenital malformation	4.8	Other congenital malformation	4.3
8	Birth asphyxia	4.5	All other external causes	4.3
9	Other perinatal disease	4.4	Other perinatal disease	4.0
10	Neonata hemorrhagic disease	3.8	Birth asphyxia	4.0
	Others	26.2	Others	24.8
	Total	100.0 (2,449)	Total	100.0 (1,923)

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 999 cases of unknown cause (Male 497 cases, Female 502 cases).

Causes of Infant Death by Age at Death

The causes of infant death varied widely across age at death. The first cause of neonatal death was 'respiratory distress of the newborn', occupying 17.1% of the total neonatal deaths. The second cause was 'fetal growth disorder' and the third cause was 'newborn sepsis'. For post-neonatal deaths, the first cause of death was 'congenital heart malformation', which accounted for 17.5% of the total post-neonatal deaths (See Table 16).

Table 16. 10 Major Causes of Infant Deaths by Age at Death (1996 birth cohort)

	Neonatal(0～27 days)	%	Post-neonatal(28～364 days)	%
1	Respiratory distress of the newborn	17.1	Congenital malformation of the heart	17.5
2	Fetal growth disorder	15.6	Other symptoms and signs	15.6
3	Sepsis of the newborn	14.8	All other external causes	8.3
4	Other respiratory disease of the newborn	11.0	Sudden infant death syndrome	4.9
5	Birth asphyxia	7.1	Sepsis of the newborn	4.6
6	Congenital malformation of the heart	6.2	Remainder of diseases of the nervous system	4.1
7	Other congenital malformation	5.3	Other congenital malformation	3.8
8	Neonatal hemorrhagic disease	5.1	Sepsis	3.7
9	Other perinatal disease	5.1	Pneumonia	3.4
10	Other symptoms and signs	3.4	Diseases of the circulatory system	3.2
	Others	9.3	Others	30.9
	Total	100.0 (2,432)	Total	100.0 (1,940)

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Note: Excluded 999 cases of death with unknown causes (424 neonatal cases and 572 post-neonatal cases).

Infant Death due to Congenital Malformation

The major cause of death among the congenital malformation was the 'congenital malformations fo the heart', occupying 55.8% of the total congenital malformation cases and female has higher proportion (58.7%) than male (53.7%) (See Table 17).

Table 17. Distribution of Infant Deaths by Congenital Malformation (1996 birth cohort)

(Unit: person, %)

	M		F		Total	
	No.	%	No.	%	No.	%
Congenital hydrocephalus & spina bifida	21	4.1	17	4.6	38	4.3
Other congenital malformations of the nervous system	19	3.7	8	2.2	27	3.1
Congenital malformations of the heart	274	53.7	215	58.7	489	55.8
Other congenital malformations of the circulatory system	50	9.8	31	8.5	81	9.2
Down's syndrome and other chromosomal abnormalities	27	5.3	12	3.3	39	4.5
Other congenital malformations	119	23.3	83	22.7	202	23.1
Total	510	100.0	366	100.0	876	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

Infant Deaths due to Perinatal Disease

The following illustrates a more detailed classification of the cause of death that originate during perinatal period. 'Bacterial sepsis of newborn' and 'Respiratory distress of newborn' were major perinatal diseases, occupying 20.5% and 20.2%, respectively, of the total perinatal disease cases (See Table 18).

Table 18. Distribution of Infant Death by Perinatal Diseases (1996 birth cohort)

(Unit: person, %)

	M		F		Total	
	No.	%	No.	%	No.	%
Fetus and newborn affected by maternal factors and by complications of pregnancy, labour and delivery	-	-	1	0.1	1	0.0
Disorders relating to length of gestation and fetal growth	232	18.8	197	20.5	429	19.6
Birth trauma	1	0.1	4	0.4	5	0.2
Intrauterine hypoxia and birth asphyxia	111	9.0	77	8.0	188	8.6
Respiratory distress of newborn	261	21.1	186	19.4	447	20.2
Congenital pneumonia	25	2.0	16	1.7	41	1.9
Other respiratory conditions of newborn	159	12.9	144	15.0	303	13.8
Bacterial sepsis of newborn	247	20.0	202	21.0	449	20.5
Haemorrhagic and haematological disorders of fetus and newborn	94	7.6	56	5.8	150	6.8
Remainder of perinatal condition	107	8.6	78	8.1	185	8.4
Total	1,237	100.0	961	100.0	2,198	100.0

Source: Han YJ. et al, Infant Mortality and Perinatal Mortality and Causes of Death in 1996, KIHASA, 1998.

D. Infant Deaths by Source of Data

The numbers of infant deaths varied across different data sets (See Table 19). The largest number of infant deaths was obtained from the medical facilities survey data (5,194) and the second largest was from the health facilities report (2,341). The funeral grant data revealed 1,714 infant deaths, which was similar to the 1,689 cases from the record of beneficiaries.

The differences in infant deaths among the various sources of data are shown not only by numbers, but also by distribution of deaths by age. The proportion of neonatal deaths (0~27 days) was 81.5% in the medical facilities survey data, whereas it was only 7.0% for the resident registration. This reflects that each

source of data covers only a part of the total number and therefore varies by age.

Table 19. Infant Deaths by Age (Days) and Source of Data (1993 cohort)

(Unit: person, %)

Duration of survival	Medical facilities survey	Health facilities report	Funeral grant	Record of beneficiaries	Resident registration
Total	100.0 (5,194)	100.0 (2,341)	100.0 (1,714)	100.0 (1,689)	100.0 (2,057)
0～ 27 days	81.5	92.3	34.0	24.3	7.0
28～365 days	18.9	7.7	66.0	75.7	93.0
1 week	66.7	73.7	21.2	14.0	0.7
2 weeks	8.1	9.8	5.7	4.1	1.3
3 weeks	4.3	6.5	4.4	3.5	2.3
4 weeks	2.3	2.3	2.7	2.6	2.8
5 wks.～3 mon.	9.4	2.5	27.8	28.3	36.6
4～ 6 months	5.3	4.6	21.8	23.0	29.8
7～ 9 months	2.5	0.3	9.6	13.6	14.9
10～12 months	1.7	0.3	6.8	10.8	11.7

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.

E. Coverage Rates of Infant Deaths

Table 20 shows the proportion of each data source in the total number of infant deaths that was estimated in this project. Medical facilities survey data represents neonatal deaths quite well, indicating 90.2% of all neonatal deaths. However, only 41.0% of post-neonatal deaths period are covered. The resident registration data covers only 3.1% of the total number of neonatal deaths, but the data for the post-neonatal period was somewhat tolerable at a coverage of 79.8%.

Table 20. Proportion of Infant Deaths in the Total Infant Deaths by Source of Data (1993 cohort)

(Unit: person, %)

Duration of survival	Total infant deaths		Medical facilities survey	Medical facilities report	Funeral grant	Record benefi.	Resident regist.
Total	100.0	(7,088)	73.3	33.0	24.2	23.8	29.0
1~ 28 days	100.0	(4,692)	90.2	46.1	12.4	8.7	3.1
29~365 days	100.0	(2,396)	41.0	7.5	47.2	53.4	79.8
1 week	100.0	(3,705)	93.5	46.6	9.8	6.4	0.4
2 weeks	100.0	(514)	82.1	44.6	19.1	13.6	5.1
3 weeks	100.0	(285)	78.6	53.7	26.3	20.7	16.5
4 weeks	100.0	(188)	63.8	29.3	24.5	23.4	30.9
5 wks.~3 mon.	100.0	(1,051)	46.2	5.5	45.4	45.5	71.2
4~ 6 months	100.0	(717)	38.6	15.1	52.0	54.1	85.6
7~ 9 months	100.0	(358)	36.0	2.0	45.8	64.2	85.5
10~12months	100.0	(270)	33.3	2.2	43.3	67.8	88.9

Source: Han YJ. et al, A Study on Infant Mortality Rate and Causes of Infant Death, KIHASA, 1996.

Note: Due to some overlapping of infant deaths among the data, the total percentage of each source of data can exceed 100%.

4. Conclusions

An alternative way to estimate the infant deaths was developed and tested because there had not been a reliable infant mortality rate in Korea. Existing data from various sources on infant deaths was gathered and integrated, and then overlapping cases were excluded. Data on neonatal deaths, which had been largely omitted, was secured by probing the health insurance data on maternal benefits.

Since there had been a development of new survey method applied to the 1993 birth cohort in 1995, the second survey was conducted for the 1996 birth cohort in 1998. The third survey was conducted in Dec. 2001 to investigate both infant mortality and maternal mortality. The third survey result will be analyzed

at the end of 2002.

From the first two surveys, the followings are identified.

- The infant mortality for Korea has decreased to less than 10 per thousand live births, which is comparable to that for other developed countries.
- The infant mortality rate has been decreased rapidly from 9.9 for the 1993 birth cohort to 7.7 for the 1996 birth cohort. The proportion of neonatal deaths among the total infant deaths decreased from 66.2% for the 1993 birth cohort to 53.2% for the 1996 birth cohort.
- Many questions were raised over the quality of the survey result for the rapid decline of infant mortality rate and the dramatic change in the proportion of neonatal deaths among the infant deaths.
- There are several explanations for the change in the proportion of neonatal deaths.

It can be assumed that the quality of the survey was secured because both surveys took the same method and process. These surveys were conducted extensively and comprehensively by the Ministry of Health and Welfare with well-trained one thousand survey workers from 14 cities and provinces and 245 health centers across the country.

The rapid decline in infant mortality rate may be traceable to the development of medical technology, particularly the introduction of surfactant treatment for low birth weight infants. The high cost of surfactant was covered by health insurance by that time. Another possibility is that therapeutic abortion was widely practiced for fetal anomaly cases, and this might have been conducive to preventing births that could otherwise lead to infant death. Recently, sonogram has been widely used, and the demand for abortion has increased among pregnant women who have a fetal defect.

- There should be more effort to decrease infant mortality rate from 7.7 to less than 5, which is a level shown in some developed countries.
- Through the comprehensive process of gathering and comparing the information on infant deaths from the various sources, we recognized that even all the existing data sets and a thorough investigation into health facilities are not without problems. Therefore, the next step we must take is to review the current situation, identify problems and develop systems to improve the quality of data.
- The usefulness of health insurance benefit data will be increased if one column of code is given to the maternity benefit request form for live birth, still birth, abortion, and death soon after a live birth.
- Deaths can also easily be identified if doctors fill out the coding form for death to the classification of diseases on requesting health benefit grant.

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