
A Method of Estimating Infant Deaths in Korea

Youngja Han, Seungwook Lee, Serok Doh

A nationally and internationally recognized Infant Mortality Rate(IMR) has not yet been produced in Korea despite the fact that it is one of the most important statistics for measuring the health and welfare level of a population. The goal of this project was to develop a new method for estimating infant deaths in Korea.

An attempt was made to collect information on real infant death cases by using the medical insurance benefit data and by conducting a medical facilities survey, which allows us to tracing back the fate of the births from the delivery. Another strategy employed was the gathering of information on infant deaths from the various existing sources and integrating them into one set after adjusting for overlapping cases among the sources.

The number of infant deaths of the 1993 birth cohort was estimated to be 7,088, and the proportion of neonatal deaths was 66.2% of all infant deaths. The medical facilities survey covered only 73.3% of the total estimated numbers of infant deaths; however, coverage of neonatal deaths was 90.2%. On the other hand, the resident registration data covered only 29% of all infant deaths, while its coverage during the post-neonatal period was 79.8% of the total deaths during the period. If one column is given to the delivery result in the requesting form on requesting the remuneration, the production of the vital statistics will be much easier.

筆者: 韓英子 - 本院 責任究究員
李承旭 - 서울大學校 保健大學院 教授
都世綠 - 本院 責任究究員

▶ 原稿를 검독하여 주신 曹在國 研究委員과 張英植 副研究委員께 감사드립니다.

I . Introduction

1. Study Background

Infant mortality rate is one of the most important and most commonly used statistics for measuring the health level of a population, and it can be compared to the importance of GNP as an index for measuring a country's economic level. Moreover, the Korean government is required to provide accurate statistics, including infant mortality rate, as a participating OECD member country. However, a nationally and internationally recognized Infant Mortality Rate(IMR) has not yet been produced in Korea in spite of the efforts by the government and many researchers. The only way the National Statistical Office has been able to produce IMR is by using indirect methods to estimate it. The reason is that only a few cases of neonatal death(death within 27 days after birth) are ever reported despite the fact that about 70% of all infant deaths occur during this period. These cases are not registered as either a birth or a death, and there appears to be no sign of improvement in reportage in the near future. There have been some studies on infant mortality based either on sample surveys or fertility surveys. However, the results were not reliable because infant death is a rare event and only few cases could be secured in spite of the large sample population. Thus, given the inadequacies of these studies as well as the shortcomings of the NSO's attempts to estimate the number of infant deaths, we can conclude that neither registration nor survey is an appropriate method for producing IMR in Korea.

We have tried to devise an alternative method—one suitable to the

Korean situation—to estimate IMR using "Health Insurance Benefit Data" and "Registration Record of Beneficiaries." Because 99% of all deliveries are now taking place at medical and health facilities as a result of the achievement of universal coverage under the national health system in 1989, most births can be identified through maternity benefit data from health insurance records. In order to obtain medical service, babies must be placed on the "Registration Record of Beneficiaries." The fate of the infant can then be identified once he/she is registered as a beneficiary. We have developed an idea which involves combining two sets of data by matching births from the delivery benefit file with beneficiaries from the registration records on an individual level.

It is assumed that the majority of deliveries that can not be matched with an infant in the registration record may be considered instances of infant death at a very early stage of life. The next strategy is to confirm this assumption at the medical and health facilities on a case by case basis. The value of this research is that it provides us with a way to estimate the number of infant deaths based on real data from the entire population.

The aim of the study is to develop a new methodology for estimating the number of infant deaths that will be suitable to the Korean situation. In addition, the goal is to verify the reliability of data among the different sources relevant to infant death.

The study subjects are a cohort of infants who were born during the period Jan. 1~Dec. 31, 1993, and who died before reaching their first birthday.

The content of this project consists of three parts: the collection of existing data, surveys at medical facilities, and an integrating and adjusting process. The sources of existing data used in this project are

health insurance data sets(maternity benefit data, health insurance record of beneficiaries, funeral grant) and resident registration data. Health insurance data is one of the most important sources of data in this project. We requested National Federation of Medical Insurance and Korea Medical Insurance Corporation files and variables that we needed in a standardized layout form.

The survey was carried out by the Ministry of Health and Welfare at the medical facilities where the deliveries were performed and the infants were treated. The survey lasted over a period of ten days from November 13 to 22, 1995. There were four kinds of questionnaires for this survey, which was conducted by approximately 900 trained people at 6,796 medical and health facilities. The computer work was needed for matching the data and for eliminating any overlapping among the different data sets.

2. Definitions

1) Live Birth

The complete expulsion or extraction from the mother of a product of human conception, which breathes or shows any other evidence of life after expulsion or extraction. In this report, a duration of 20 weeks or more of pregnancy and 500g or more of body weight at birth are applied to the definition.

2) Infant Death

Death which occurs before an infant reaches his/her first birthday. Infant deaths are usually divided into two categories according to age. Neonatal deaths are those occurring during the first 27 days of life and Post-neonatal deaths are those occurring between 28 days and one year of age.

II. Data Collection

1. The Process of Collecting Infant Deaths

1) Gathering Existing Data

The basic premise of this report is that any one source of data on infant death is incomplete; therefore, we must gather information on infant death from various sources and integrate them into one set. The first stage of identifying infant death is to determine the appropriate sources and gather information on infant deaths from the existing data. Table 1 shows the number of infant deaths from the various sources that currently exist. The existing data sets are the record of health insurance beneficiaries, funeral grant, resident registration record and vital registration. It is assumed that every source of existing data has some kind of deficiency that needs to be supplemented in some way. The most seriously deficient area among the existing data may be neonatal death as it is rarely ever reported. In order to correct this problem, a new method needs to be developed. One of the alternatives

is to conduct an investigation at medical facilities to identify instances of neonatal death, which are generally omitted from all records, by tracking the maternity benefit data.

Table 1. Number of Births and Infant Deaths by Existing Sources of Data

(Unit: person)

	Βιρτησ	Ινφαντ δεατησ	Σουρχε οφ Δατα
Ρεχορδ οφ Βενεφιχιαριεσ	695,976	1,689	Φεδερατιον οφ Ηεαλτη Ινσυρανχε, Κορεα Μεδιχαλ Ινσυρανχε Χορπ.
Φυνεραλ Γραντ	-	1,714	Φεδερατιον οφ Ηεαλτη Ινσυρανχε, Κορεα Μεδιχαλ Ινσυρανχε Χορπ.
Ρ ε σ ι δ ε ν τ Ρεγιστρατιον	710,786	2,057	Μινιστρψ οφ Ιντεριορ
σιταλ Ρεγιστρατιον	711,129	2,160	Νατιοναλ Στατιστιχαλ Οφφιχε

2) The Sources of Existing Data

Health Insurance Record of Beneficiaries

Live births or new-born babies (registered with health insurance as beneficiaries) born during the period of Jan. 1~Dec. 31, 1993, were selected. The health insurance registration files of beneficiaries for each health insurance association unit were collected and added together regardless of whether they had lost qualification as of May, 1995. One loses the qualification of being a beneficiary when they transfer to another association or upon death.

Funeral Grant

Data was collected from each health insurance association unit concerning the funeral grants given to those who were born in 1993 and died before reaching their first birthday.

Resident Registration

The data file of registered residents who were born between Jan. 1 and Dec. 31, 1993, including those who lost qualification due to death, was collected. The Ministry of Interior keeps this data file.

Report of Infant Deaths from the Medical and Health Facilities

Data was collected on the death of infants who were born between Jan. 1 and Dec. 31, 1993. All medical and health facilities must report cases of infant death in accordance with the Maternal and Child Health Act.

Maternity Benefit Data

Maternity benefit events (codes of major and minor disease as 644, 650-669 in classification of cause of death in Korean standard of diseases) from among the bills for medical fees were selected. The criteria of selection is the beginning date of medical examination between Dec. 25, 1992, and Dec. 31, 1993. The number of maternity benefit events was 826,731 cases, and this number became 712,050 mothers after being sorted by person.

Supplementary Data

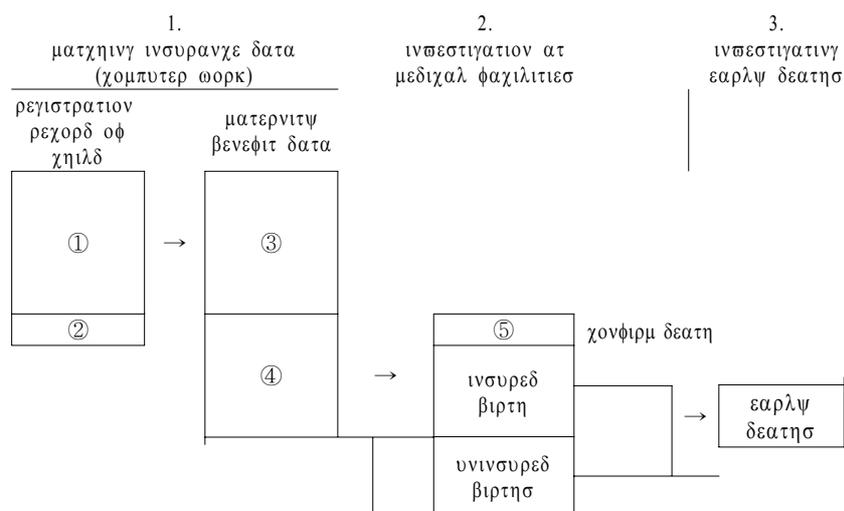
Data was also collected from adoption agencies.

3) Collection of Early Death Data

Our strategy for identifying early death, which is usually not reported as either a birth or a death, is to trace the maternity benefit data. Each delivery is matched to a mother's child in the other data file set of the registration record of beneficiaries (See Figure 1). The key to matching mother and child is the household insurance card number or resident

registration number(every Korean has a unique number).

Figure 1. Identifying Early Deaths at the Health Facilities



- Note :
- ① Children matched with their mothers
 - ② Children not matched with their mothers
 - ③ Mothers matched with their children
 - ④ Mothers not matched with their children
 - ⑤ The reason of maternity benefit were not childbirths

Among a total of 826,731 maternity benefit cases, 616,200 cases were matched with a child. The rest of the 210,531 cases were reviewed, and 77,036 cases were identified as not being related with a delivery. Finally, 133,495 cases were tracked at the health and medical facilities where the maternity benefits were requested. A follow-up investigation is necessary for deliveries not matching with a mother's children to determine whether the outcome of the delivery was a livebirth, stillbirth, or delivery-related treatment. The question of the survival status of the live birth and the occurrence of early death was asked when the investigation was carried out at the medical facilities in order to confirm

the maternity benefit results. Cases of neonatal death can be easily identified through this process of investigating medical records, such as delivery charts or maternity admission records, of maternity wards.

Information on the uninsured births is necessary and it can be identified at the medical and health facilities when tracking maternity benefit data. Even under the national health insurance system, there are a small number of women who did not observe their insurance payment obligations and are not covered by insurance. In addition, the delivery of a woman's third child was not covered by health insurance at that time, which was a part of the population control policies in effect then.

The term "early death" in this project means the death of a child before the discharge of his/her mother from the hospital after delivery. Therefore, early death can be less than one week after birth. In this way, 1,490 neonatal deaths were identified by the tracking of maternity benefit events, and 145 cases of uninsured neonatal deaths were also discovered. Therefore, 1,635 early deaths were identified at the health facilities by this process.

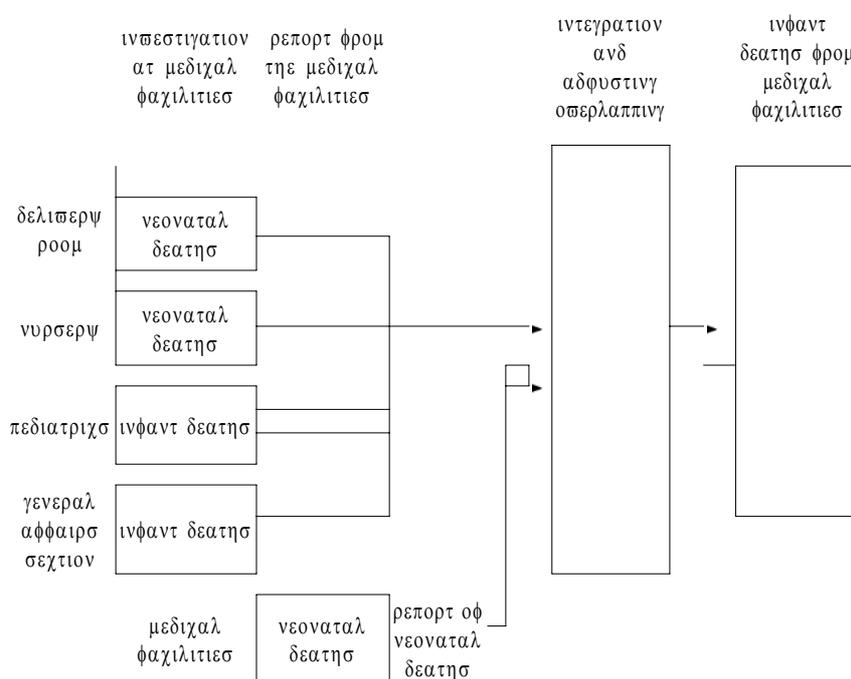
4) Collection of Data from the Various Sections of the Medical Facilities

There are various sources of infant death data, and because each source of data has its limitations, none of the existing data is perfect. Therefore, we planned to investigate all medical and health facilities where infant deaths could take place to identify cases of infant death.

The method of investigation into medical facilities has some strength because most of the infant deaths occur at hospitals. Also, information about the causes of death can be discovered from a patient's chart or a medical certificate. Infant death data are scattered throughout the

maternity ward, nursery, pediatrics and general affairs section of a hospital. Therefore, the process of gathering data from all those units and compiling that data is necessary(See Figure 2).

Figure 2. Infant Deaths From Medical Facilities



Note: Neonatal deaths at the delivery room include early deaths that were identified from the maternity benefit data.

The number of medical facilities investigated to find out about infant deaths was 6,796 facilities and 2,164 facilities among them were those where maternity benefits were requested. Through this process, 5,194 infant deaths, which includes 1,635 early deaths, were identified at the medical facilities.

III. Determining the Number of Deaths

1. The Process of Integrating and Adjusting Overlapping Infant Death Cases

We secured the total number of infant deaths by collecting the maximum number of infant deaths from all sources, compiling all data and adjusting for any overlapping by identifying identical children through information such as the resident registration number. The number of infant deaths obtained through the above process will be the most realistic data we could practically hope to provide. The steps used for determining the number of infant deaths are as follows.

Integrating existing information on infant deaths from among various data sources and alleviating the problem of overlapping by checking whether the same baby appears among different sources. The total number of registered deaths is thus estimated through this process. The lack of information in a particular source is supplemented from other data sets because each source has different information and the completeness of information is diverse. The sources of registered deaths are the record of beneficiaries, funeral grants, and resident registration file.

The matching process is first done between the record of beneficiaries and funeral grants and secondly between the result of the first process and resident registration.

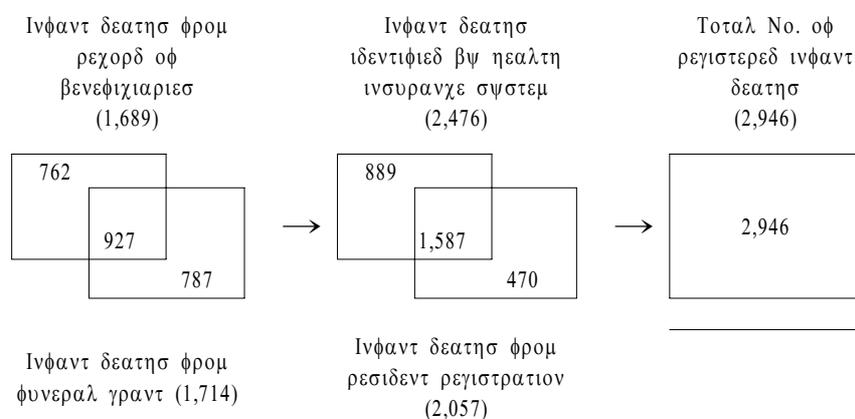
The key to matching infants among the data are:

- Resident registration number and name of an infant;
- Resident registration number and name of the mother;

- Resident registration number and name of the father;
- Resident registration number and name of the head of the household.

Figure 3 shows the process of adjusting overlapping cases. Overlapping cases between the record of beneficiaries(1,689 cases) and funeral grants(1,714 cases) accounted for 927 infant deaths. Therefore, the number of infant deaths identified within the health insurance system data was 2,476. The resulting figure is put through the same screening process with resident registration(2,057 cases), through which 1,587 overlapping cases were identified. After adjusting for overlapping cases, the total number of registered infant deaths turned out to be 2,946.

Figure 3. Process of Adjusting Overlapping Cases among the Sets of Registered Infant Deaths



The next process is matching registered infant deaths with deaths identified at the medical facilities(5,194 cases). Through this process, 1,052 overlapping cases were discovered, making the final total number of infant deaths 7,088(See Figure 4).

Figure 4. Process of Adjusting Overlapping Cases between the Registered Data and the Data from the Medical Facilities

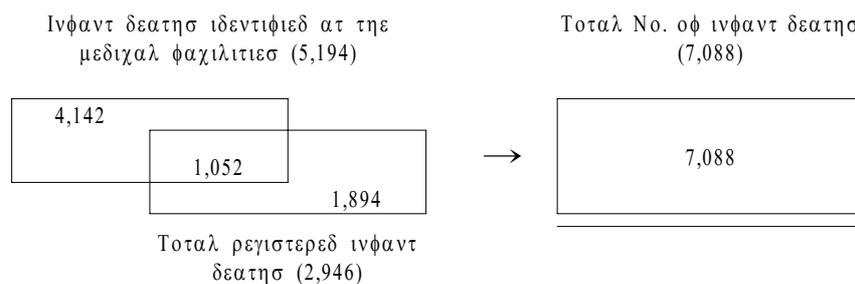


Table 2. Results of Matching Infant Deaths among Data Sources

(Unit: person)

Ρεσυλτσ οφ Ματχηινγ	Μεδιχαλ Φαχιλιτιεσ Συρπεσ(ΜΦΣ)	Φυνεραλ Γραντ (ΦΓ)	Ρεχορδ οφ Βενεφιχιαριεσ (PB)	Ρεσιδεντ Ρεγιστρατιον (PP)
No ματχηινγ	ΞΞΞΞ	228	171	332
PB+PP	ΞΞΟΟ		356	356
ΦΓ+PP	ΞΟΞΟ	250		250
ΦΓ+PB	ΞΟΟΞ	117	117	
ΦΓ+PB+PP	ΞΟΟΟ	440	440	440
ΜΦΣ+PP	ΟΞΞΟ	138		138
ΜΦΣ+PB	ΟΞΟΞ	70	70	
ΜΦΣ+PB+PP	ΟΞΟΟ	165	165	165
ΜΦΣ+ΦΓ	ΟΟΞΞ	185		
ΜΦΣ+ΦΓ+PP	ΟΟΞΟ	124		124
ΜΦΣ+ΦΓ+PB	ΟΟΟΞ	118	118	
Ματχηεδ αλλ	ΟΟΟΟ	252	252	252
Τοταλ	5,194	1,714	1,689	2,057

Note: O; Matching, X; No matching

The results of the matching process among data sources are shown on Table 2. We notice that the matching portions among sources are very small. Only 252 cases appear in all four data sets and the number of non-matching cases altogether is 4,873 (medical facilities survey, 4,142;

funeral grant, 228; record of beneficiaries, 171; and resident registration, 332). This has implications to be clarified. It may be interpreted either as representing a small number of overlapping cases in reality or very poor matching due to the inconsistencies or deficiencies in the information used in identifying infants. Nonetheless, we recognize that the small number of overlapping cases does in fact represent the real situation from further analysis. This means that the completeness of coverage by survival time period is different according to the source of data(See Table 5).

IV. Results

1. Infant Deaths by Age and Sex

Table 3 shows the distribution of infant deaths by age. the number of neonatal deaths was 4,692 and it accounts for 66.2% of all infant deaths and no difference between sex was observed.

Table 3. Infant Deaths by Age and Sex

	(Unit: person)		
	Μαλε	Φεμαλε	Τοταλ
Νεοναταλ δεατησ(0~27 δαψσ)	2,667	2,025	4,692
Ποστ-νεοναταλ δεατησ(28~364 δαψσ)	1,362	1,034	2,396
Ινφαντ δεατησ(0~364 δαψσ)	4,029	3,059	7,088

2. Infant Deaths by Source of Data

The numbers of infant deaths are diverse by source of data(See Table 4). The biggest number was found using the medical facilities

survey data(5,194) and the second largest was the resident registration data(2,057). The funeral grant data showed 1,714 infant deaths, which is similar to the 1,689 cases from the record of beneficiaries. The differences in infant deaths among the various sources of data are not limited to only the numbers, but also the distribution of deaths by age. The proportion of neonatal deaths(0~27 days) was 81.5% in the medical facilities survey data, while it was only 7.0% for the resident registration. This means that each source of data covers only part of the total number and is represented differently by age.

Table 4. Infant Deaths by Age(days) and Source of Data

(Unit: person, %)

Λαψ	Μεδικαλ Φαχλιτιεις Συρπεψ	Φυνεραλ Γραντ	Ρεχορδ οφ Βενεφιχιαριεις	Ρεσιδεντ Ρεγιστρατιον				
Τοταλ	5,194	100.0	1,714	100.0	1,689	100.0	2,057	100.0
0 ~ 27	4,232	81.5	583	34.0	410	24.3	145	7.0
28 ~ 364	982	18.9	1,131	66.0	1,279	75.7	1,912	93.0
0 ~ 6	3,446	66.7	364	21.2	237	14.0	14	0.7
7 ~ 13	422	8.1	98	5.7	70	4.1	26	1.3
14 ~ 20	224	4.3	75	4.4	59	3.5	47	2.3
21 ~ 27	120	2.3	46	2.7	44	2.6	58	2.8
28 ~ 90	486	9.4	477	27.8	478	28.3	752	36.6
91 ~ 181	277	5.3	373	21.8	388	23.0	614	29.8
182 ~ 272	129	2.5	164	9.6	230	13.6	306	14.9
273 ~ 364	90	1.7	117	6.8	183	10.8	240	11.7

3. Coverage Rates of Infant Deaths

Table 5 shows the completeness of data of each source to the total number of infant deaths that was produced in this project. Medical facilities survey data represents neonatal deaths quite well at 90.2% of all infant deaths, but the post-neonatal period covers

only 41.0% of them. The resident registration data covers only 3.1% of the total number of infant deaths in the neonatal period, but the data for the post-neonatal period is good at a coverage of 79.8%.

Table 5. Coverage Rate (completeness) of Infant Deaths to the Estimated Infant Deaths by Source of Data

(Unit: person, %)

Δαψσ	Εστιματεδ ινφαντ δεατησ	Μεδιγαλ φαχιλιτιεσ συρψεψ	Φυνεραλ γραντ	Ρεγορδ οφ βενεφιχιαριεσ	Ρεσιδεντ ρεγιστρατιον					
Τοταλ	7,088	100.0	5,194	73.3	1,714	24.2	1,689	23.8	2,057	29.0
0 ~ 27	4,692	100.0	4,232	90.2	583	12.4	410	8.7	145	3.1
28 ~ 364	2,396	100.0	982	41.0	1,131	47.2	1,279	53.4	1,912	79.8
0 ~ 6	3,705	100.0	3,446	93.5	364	9.8	237	6.4	14	0.4
7 ~ 13	514	100.0	422	82.1	98	19.1	70	13.6	26	5.1
14 ~ 20	285	100.0	224	78.6	75	26.3	59	20.7	47	16.5
21 ~ 27	188	100.0	120	63.8	46	24.5	44	23.4	58	30.9
28 ~ 90	1,051	100.0	486	46.2	477	45.4	478	45.5	752	71.2
91 ~ 181	717	100.0	277	38.6	373	52.0	388	54.1	614	85.6
182 ~ 272	358	100.0	129	36.0	164	45.8	230	64.2	306	85.5
273 ~ 364	270	100.0	90	33.3	117	43.3	183	67.8	240	88.9

Note: Due to overlapping of infant deaths among the data, the total added % of each age bracket can be more than 100.

V. Conclusions

An alternative way to estimate the infant deaths was developed and tested because a reliable infant mortality rate has not yet been produced in Korea. Existing data from various sources on infant deaths had been gathered and integrated, and then overlapping cases were excluded. Neonatal deaths, the omission of which has been extreme, were secured through the medical facilities investigation by tracking the maternal benefit data of health insurance. Among the children who were born

between Jan. 1 and Dec. 31, 1993, 7,088 infant deaths were identified. Through the comprehensive process of gathering infant deaths from the various sources and comparing them, we recognized that all existing data sets and even thorough investigations into health facilities have pitfalls. Therefore, the next step we must take is to review the current situation, identifying problems and developing systems to improve the quality of the data. The medical facilities survey covers only 73.3% of the estimated total number of infant deaths despite the tedious and complicated process involved. The funeral grant covers 24.2%, while the record of beneficiaries covers 23.8% and resident registration 29.0%. Due to overlapping of infant deaths among the data, the total added % of each age group can be more than 100. If we compare the data specified by age at death, then we can obtain better and more accurate information. The completeness of medical facilities survey on neonatal death is 90.2%, while that of resident registration data on post-neonatal death is 79.8%. The usefulness of health insurance benefit data will be increased if one column of codes is given to the maternity benefit request form for live birth, still birth, abortion, and death soon after a live birth. In that way, many of the tedious and time-consuming processes needed to find out instances of early death will be removed. Deaths can also easily be identified if one column is given for coding deaths or a number is given for death to the classification of diseases on requesting health benefit grant.

References

- Han S. H., *Recent Trends of Fetal and Infant Death Rates and Their Determinants in Korea*, Yonsei University, 1989.
- Han Y. J., S. R. Do, S. W. Lee, *A Study to Develop Methodology for Estimating Infant Mortality*, KIHASA, 1995.
- Kim I. H., B. H. Choi, "Estimation of Recent Infant Mortality Rate", *The J. of the Population of Korea*, Vol.11, No.1, 1988.
- Kim J. K., S. W. Lee, *Infant Mortality Studies in Korea*, School of Public Health, Seoul National University, 1992.
- Kim J. K., S. W. Lee, "Estimation of Mortality Rates of Infants and Children between 1~4 Years Old in Korea", *Journal of the Population of Korea*, Vol.12, No.2, 1989, pp.22~44.
- NSO, *Annual Report on the Cause of Death Statistics(based on Vital Registration)*, 1994.
- _____, *Annual Report on the Vital Statistics*, 1994.
- Park I, H., N. M. Hwang, *Direction of Maternal and Child Health Policy*, KIHASA, 1993.
- Park K. A., "The Structure of Causes of Death of Korean, 1983~1993", *Jouranl of the Population of Korea* Vol.18, No.1, 1995, pp.167~193.
- Yoon C. H., T. Y. Yoon, J. M. Choi, et al., "A Study on the Changing Patterns of the Leading Causes of Death in Korea", *Kyung Hee Univ. Med. J.*, Vol.18, No.2, 1993, pp.117~155.

요 약

韓國의 嬰兒死亡數 推定方法 研究

韓英子 · 李承旭 · 都世綠

嬰兒死亡率은 한 국가의 保健福祉 수준을 가늠하는 대표적 지표임에도 불구하고 우리나라에서는 최근까지 신뢰할 만한 嬰兒死亡率을 생산하지 못하였기 때문에 嬰兒死亡數를 推定할 새로운 방법을 개발하여 조사를 실시하였다. 본 연구는 의료보험자료를 이용하고 의료기관조사를 통해 출산에서부터 우리나라 전체 출생아의 생사를 추적하여 實際 嬰兒死亡數를 구하고자 하였다. 또한 嬰兒死亡에 관한 여러 자료원으로부터 既存資料를 수집 통합하고 동시에 重複資料를 除去하는 과정을 거쳤다.

본 연구결과 1993년도 출생코호트의 嬰兒死亡數는 7,088명으로 추정되었으며 신생아사망은 嬰兒死亡의 66.2%를 차지하였다. 의료기관조사 자료는 추정 總嬰兒死亡의 73.3% 만을 포함하고 있으나 신생아사망 부분에 있어서는 총 신생아사망의 90.2%를 포함하고 있다. 주민등록자료는 總嬰兒死亡의 29%만을 포함하고 있으나 신생아 후기사망에 있어서는 總新生兒後期死亡의 79.8%를 포함하고 있어 생존기간별로 자료의 代表性이 다른 것으로 나타났다. 의료보험 급여청구시 출생 관련 코드와 킬럼부여, 死亡時 疾病分類코드 이외에 사망에 관한 코드를 부여한다면 출생 및 사망 統計生産이 보다 용이해질 것으로 사료된다.