
A Study on Maternal Deaths in Korea (1995 · 1996)

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In 1996, WHO and UNICEF published a set of model-based country estimates of maternal mortality ratios for 1990. The estimated Korean Maternal Mortality Ratio was too high for Korean situation at 130 and the ratio was almost twice as high as North Korean rate at 70. It became a social and political issue in Korea. The Korean government has often asked WHO to correct the indices. However, the reply was that it cannot be corrected unless a result based on the internationally acceptable scientific method is submitted. Therefore, the object of this study is to produce maternal mortality indices for policy establishment and to correct deviated international maternal health statistics.

In this survey, all female deaths during reproductive period - 15~49 years of age - were selected from the death registration data and they are matched with maternity benefit data of health insurance on the computer on the basis of ID confirmation. They are traced back to the hospital where the death was occurred and confirmed the cause of death by reviewing medical records. Additionally confirmed maternal deaths at the hospital were also investigated.

The maternal mortality ratio was 20 per 100,000 live births both in 1995 and 1996. Direct obstetric cause occupied 80.9% of maternal death and indirect obstetric cause at 19.1%. The major causes of direct obstetric death were hemorrhage (25.7%), hypertension (16.3%) and embolism (15.6%). Indirect causes consisted of malignant neoplasm, heart disease, renal disease, etc. The survey result was approved by the WHO and the ratio was appeared on the international data sheet in 1999.

key word : Maternal Mortality Ratio, Causes of Maternal Death, Direct Obstetric Causes, Indirect Obstetric Causes

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『母性死亡比 推定 및 死亡原因 分析』의 내용일부를 수정·보완한 것임.

▶ 원고를 검독하여 주신 張英植·黃那美 副研究委員께 감사드립니다.

I . Introduction

1. Study Background

In 1996, WHO and UNICEF published a set of model-based country estimates of maternal mortality ratios for 1990 (UNFPA, 1998). These estimates were widely disseminated and used by international agencies and others. However, the estimates generated considerable comments from national government, most of which focused on the differences between these figures and those officially reported by the government themselves (WHO/UNICEF/UNFPA, 1998).

MMR became a social and political issue in Korea also. Politicians and mass media raised question on the high maternal mortality ratio, whether the ratio was reasonable for Korean situation. The Maternal Mortality Ratio of Korea estimated by WHO/UNICEF was recorded as 130 per 100,000 live births while the ratio suggested by Korean government was 30. The figure 130 was almost double of North Korean MMR at 70. That event urged us to study maternal deaths based on real data of the whole population.

2. Objective of Study

The object of this study is to produce reliable maternal mortality indices and to realize the causes of maternal death through a survey of the whole population. The object is also to provide basic statistics

for formulating and evaluating maternal and child health policies and programs, and correcting deviated international statistics.

3. Study Subject

The study subjects were maternal deaths that occurred from 1995. 1. 1.~1996. 12. 31.

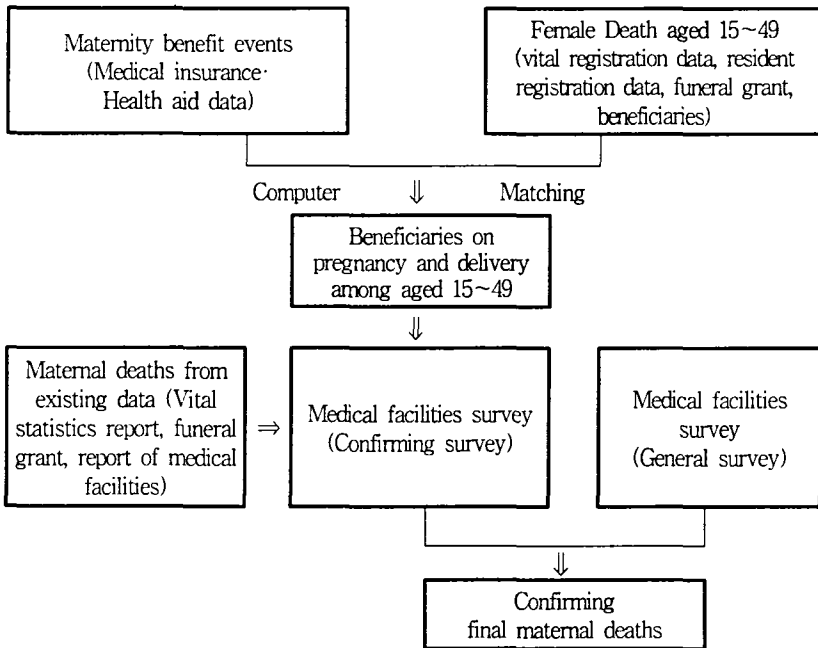
4. The Structure of Study

Estimating accurate maternal mortality statistics is difficult even in developed countries due to the limitation of finding out indirect obstetric causes of death. Therefore, the focus here was put on finding out the direct and the indirect obstetric cause of maternal deaths. Indirect obstetric deaths are rarely reported in Korea. Therefore, it was necessary to trace all female death of reproductive age 15~49. It was assumed that most deaths could be identified at medical facilities since the introduction of the national health system in 1989.

One type of medical facilities survey was a confirming survey. The information on the women treated for pregnancy and delivery were identified from the record of bills for medical fees. They were matched with the existing death records and death cases with pregnancy and delivery histories. These were then selected and surveyed at the medical facilities where the insurance reimbursement was requested to see whether or not they were maternal deaths. However, a confirming survey can not cover uninsured cases and there could be under-reported cases. Another type of survey, a general survey, complements the above problems.

Various organizations and related experts have made significant contributions to this research so as to successfully produce maternal mortality indices based on real data on the population. The Ministry of Health and Welfare provided financial and administrative support and conducted surveys at medical facilities. The Korea Institute for Health and Social Affairs designed the research, gave technical advices, and analyzed the study result.

Figure 1. Maternal Mortality Survey



The Korean Federation of Health Insurance, Korea Medical Insurance Corporation, National Statistical Office, and Ministry of Administration and Autonomy supplied us with numerous data and the local governments, health centers, medical facilities, Korean

Doctors Association, Korean Hospital Association, Korean Obstetric and Gynecology Association and Korean Medical Record Association provided with us support and advice.

5. Definitions

Maternal Death: A maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental cause.

Direct Obstetric Deaths: those resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above.

Indirect Obstetric Deaths: those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy.

II. Method of Estimation

1. Gathering and Analyzing Existing Data

Sources of Existing Data

A premise of this study was that there was not yet a perfect data

set on maternal deaths in Korea. Therefore, it seemed necessary to collect the information on maternal death from various sources and to integrate them into one set. The first step was to identify what kind of data were existing and available and the next step was to gather information from them. The major existing data sources for this study are shown in Table 1. The sources of existing data are health insurance data (medical insurance benefit data on pregnancy and delivery, health insurance records of beneficiaries, and funeral grant), vital registration data, resident registration data, and periodic reports on death by the medical and health facilities. In order to prevent the omission of maternal death cases and to find out additional maternal deaths, the total death of women aged 15~49 and medical insurance benefit data on pregnancy and delivery were secured for study. It was assumed that each data set including maternal death had flaws in some way that could be complemented.

Table 1. Sources of Collected Data Related to Maternal Deaths

Sources of data	(Unit ²⁾ : event)		
	Total	Kong-Kyeo ¹⁾	Industry-community
Beneficiaries-Funeral grant	19,290	-	-
Maternity benefit data	3,104,422	313,197	2,791,225
Medical facilities reports	40	-	-
Vital registration (Deaths)	24,832	-	-
Resident registration	30,110	-	-

Note: 1) Medical insurance data for public employees, military dependents and teachers. Medical assistance data is included in here.

2) Unit is event rather than person because identical person may get treatment more than twice.

The sources of existing data collected for this study were health insurance data (medical insurance data on pregnancy and delivery,

medical insurance record of beneficiaries, and funeral grant), vital registration data, resident registration data, and periodic reports on death by the medical and health facilities.

Maternal death data could be secured from the vital registration, funeral grant and medical facilities reports because those data included information on the causes of death. However, those data have the limitations of being under-reported and the critical flaw was that most of the indirect obstetric causes were rarely reported. Moreover, the number of maternal deaths differed among the sources of data.

One of the purposes of collecting the existing data was to integrate the data to adjust the overlapping cases among the data sets and to secure the maximum number of maternal deaths. Another purpose of it was to identify indirect obstetric death cases and all the female deaths of reproductive age were reviewed for possibility of maternal death. In order for this to happen, we collected data of female deaths aged 15~49 regardless of the cause of death and matched it with the data of pregnancy and delivery from the medical insurance data set. In this way women who were treated for pregnancy or delivery and then died were selected for further study at the medical facilities.

Criteria for selection of the maternal death data

Table 2 shows the number of female deaths of the reproductive age. The biggest number was observed from the vital registration. The number of female death of vital registration and resident registration should be the same. The gap may be due to the time when the data was collected. The resident registration data were available in September 1997 and vital registration data in November. The female deaths aged 15~49 from the medical insurance data were collected in

August 1997. This number was the smallest due to under reporting.

Table 2. Number of Female Deaths of Reproductive Age by Source of Data

Data Source ¹⁾	(Unit: person)		
	1995	1996	Total
Resident registration	11,418	12,592	24,010
Vital statistics	11,818	13,014	24,832
Record of beneficiaries and Funeral grant	8,928	9,978	18,906

Note: 1) Number of female deaths 15~49 years of age

The number of maternal death from the existing data

Some death data includes information for identifying maternal deaths. Vital registration data includes the causes of death and it was possible to identify maternal death and also played a key role in identifying the indirect causes of maternal death when combined with the information of pregnancy and delivery from the medical insurance data set. Although this existing data is very useful for estimating maternal mortality indices and we can get the maximum number of maternal deaths from this process we can not be sure these numbers are complete.

The number of maternal deaths from the existing data was shown in Table 3. The number of maternal deaths from the vital registration was 85 in 1995 and those from the medical facilities report was 19 for the same period. There was a big difference among the data sets.

Table 3. Number of Maternal Deaths among the Existing Data

Source of data	(Unit: person)		
	1995	1996	Total
Vital registration	85	73	158
Medical insurance	25	30	55
Medical facilities report	19	21	40

2. Maternal Mortality Survey (Medical Facilities Survey)

Establishing data sets for selection of study subject

The diverse sources of existing data have maternal mortality information, and some of the existing data was used as a basis for further medical facilities surveys to find out socio-demographic items for analysis. The first task was to collect deaths of women aged 15~49 regardless of the cause of death during 1995. 1. 1~1996. 12. 31. For this purpose, the deaths from the various sources were integrated into one set which alleviated duplication among the sources, and made the maximum number of deaths. The key to identifying the same person was the ID number of each person.

Selection of Subject need confirming at the medical facilities

The total number of female deaths of reproductive age during 1995 and 1996 was 27,506. In order not to omit delayed death reports, resident registration included deaths that occurred until June 30, 1997 and medical insurance data (beneficiaries and funeral grant) until March 31, 1997. That made the total 33,814 deaths and those are matched with the bills for medical fees related with pregnancy, delivery and puerperium by computer work. Events that occurred in 1994 or 1997 were excluded at the last stage of analysis.

Select Medical Facilities for Survey

The file on the medical facilities from the Korean Medical Insurance Corporation was used to identify the medical facilities where the confirm subjects were treated. From this file, names of the medical facilities, address, telephone number and the name of an executive

were collected. Even closed facilities were selected for study because tracking the cases was possible in many cases. For example, cases could be tracked when the name of the hospital changed or if a hospital was transferred to an other region. When a medical facility is closed, the medical records of the patients should be submitted to the health center of the area and by law it is the responsibility of the health center to keep the data.

The criteria for selecting medical facilities for the survey were:

- Confirming survey facilities: Medical facilities of the dead who had medical services related to pregnancy and delivery(677 posts). Dental hospital · clinic and pharmacies were excluded.
- General survey facilities:
 - All general hospitals not included in confirming survey facilities (107 posts)
 - All hospitals not included in confirming survey facilities and that requested medical bills for treating patients for pregnancy and delivery (146 posts)
 - All health center (239 posts)

The total number of medical and health facilities selected from the above criteria was 1,169 posts, 677 posts among them were confirming survey facilities.

Conduct Survey at Medical Facilities

Direct obstetric deaths from the vital registration data and other existing data were collected, however, the possibility that not all maternal deaths were recorded could not be ignored even in spite of the integration of all the existing data. Therefore, we conducted a

survey of all medical facilities where maternal deaths could occur. The survey covered maternal deaths among the population of reproductive age (15~49 years age group). The survey on maternal deaths that occurred during Jan. 1, 1995~Dec. 31, 1996 was conducted at 1,169 health and medical facilities. The survey lasted for a duration of six days from November 10 to 15, 1997.

Maternal patients of the 15~49 year age group who died during January 1, 1995~December 31, 1996 were selected and traced to the hospitals where the benefit was requested (Confirming survey). We planned to determine whether the cause of death was a maternal death by examining the medical record of the patient. A survey on maternal deaths was further conducted at all medical facilities where maternal deaths could occur (General survey). General survey means that if the medical facility identifies maternal deaths other than the confirming subject, each medical facility puts them on the survey list and fills out a questionnaire form.

The purposes of the medical facilities survey are as follows. First, to find out accurate information concerning diseases and the cause of death for those who had services for maternal causes. Second, to find out additional deaths that were not covered by the medical insurance and omitted from the existing data. Lastly, to reconfirm the deaths found from the existing data based on the medical record and to gather additional information such as socio-demographic variables. In order to minimize omissions, major hospitals were included in the survey even if there was no request of a medical bill related to maternity services.

The list of confirming subjects was made and the name and known information of each subject was put on the printed questionnaire and

distributed to each medical facility where the medical bills were requested. For the medical facilities survey, the medical doctor filled out the questionnaire according to the instructions distributed and the head of the health center then reviewed the questionnaire for its appropriateness. The principle was that the questionnaire be written by an OB-GY doctor or specialist.

For managing the survey, education to the officers of the city, provinces and health centers was provided and advice and guidance systems were established. The survey at the medical facilities was conducted during the six days of November 10~15 1997.

III. Results

The results for the survey conducted during Nov. 10~15 1997 (6 days) at the 1,169 selected medical facilities is shown on Table 4. The response rate was very high at 90.5% because the survey was managed thoroughly by the health center. We asked the health center to report the deaths that occurred at home or during transfer to the hospital. It was assumed that those who were not confirmed might be covered by the general survey and existing data.

1. Estimating the Number of Maternal Deaths

After completing the survey, all the information gathered was integrated into one set. When a person visited several facilities, her information could be dispersed among the facilities. Therefore the

information was integrated and sorted by an individual person based on the ID (resident registration) number, name, date of death and existing data were added through computer work.

It was not easy to decide if it was a maternal death or not and the process of deciding was very important because maternal death depends on evidence of pregnancy, causes of death and time of death. For this process, three professors in the field of obstetric and gynecology participated and reviewed the questionnaire and discharge summary of every death case. Their job was to classify causes of death and whether the case was maternal death or not.

Table 4. Coverage Rate of Maternal Deaths to the Estimated Maternal Death by Source of Data

(Unit: person, %)

	1995		1996		Total	
	Mat. deaths	%	Mat. deaths	%	Mat. deaths	%
Survey	98	67.1	95	66.9	193	67.0
Vital registration ¹⁾	85	58.2	73	51.4	158	54.9
Medical insurance	25	17.1	30	21.1	55	19.1
Medical facil. report	19	13.0	21	14.8	40	13.9
Total mat. deaths ²⁾	146	100.0	142	100.0	288	100.0

Note: 1) Difference of the number of maternal death with <Table 3> is due to the exclusion of deaths 42 days after termination of pregnancy which was included in the vital registration.

2) Due to overlapping of maternal deaths among the data, the total added % of each source of data can be more than 100.

Table 4 shows the coverage rate of the maternal deaths among the sources to the total number of maternal deaths. The coverage rate of maternal deaths by survey was 67.0%, vital registration at 54.9%, medical insurance at 19.1% and medical facilities report at 13.9%.

2. Maternal Deaths by Socio-demographic Characteristics

Information is gathered on the study subject not from a family interview but from the medical chart at the medical facility. Precise demographic information such as age, resident registration number, date of death, etc., is obtained. The information on socio-demographic characteristics was very limited, though. Also, the quality and quantity of information vary by the type of the medical facilities. As expected, general hospitals usually maintain more information than hospitals and clinics. Limitation of information is also due to the fact that some maternal deaths were only gathered from the existing data and we could not get socio-economic information there. For these reasons, information on the educational attainment and marriage status of the deceased were not included in the analysis.

Maternal Death by Age

Table 5 shows the distribution of maternal death by age. The rate was highest at 38.5% for those aged 25~29. The second highest rate was observed among the age group 30~34 at 26.7%.

Maternal Deaths by Type of Death

Indirect obstetric deaths occupy 19.1% of maternal deaths (see Table 6) and this figure is almost the same level as the 20% global average suggested by WHO (WHO, 1997). It was not easy to secure the number of indirect obstetric deaths because most of the physicians did not report the maternal death if a woman died from other disease causes rather than for on obstetric reason. Indirect obstetric deaths are rarely reported in the vital registration system in

Korea. It seems that this survey has been conducted successfully because we collected indirect obstetric death data that could not be found in any of the existing data sources. It could be possible by matching tracing back of the all female deaths of reproductive age (15~49) from the various data sources, matched it with the data of pregnancy and delivery from the medical insurance data set.

Table 5. Distribution of Maternal Deaths by Age Group

(Unit: person, %)

Age group	1995		1996		Total	
	Maternal deaths	%	Maternal deaths	%	Maternal deaths	%
15~19	4	2.7	2	1.4	6	2.1
20~24	20	13.7	10	7.0	30	10.4
25~29	50	34.2	61	43.0	111	38.5
30~34	43	29.5	34	24.0	77	26.7
35~39	21	14.4	27	19.0	48	16.7
40~44	7	4.8	6	4.2	13	4.5
45~49	1	0.7	2	1.4	3	1.1
Total	146	100.0	142	100.0	288	100.0

Table 6. Distribution of Maternal Deaths by Type of Death

(Unit: person, %)

Type of death	1995		1996		Total	
	Maternal deaths	%	Maternal deaths	%	Maternal deaths	%
Direct obstetric deaths	118	80.8	115	81.0	233	80.9
Indirect obstetric deaths	28	19.2	27	18.9	55	19.1
Total	146	100.0	142	100.0	288	100.0

Table 7 shows age distribution of the pregnancy related deaths by type of death. The number of deaths that occurred during pregnancy and puerperium was 308 cases for the two year period of 1995~1996

regardless of the cause of death. Among them, 233 cases (75.6%) died of a direct obstetric cause, 55 cases (17.9%) of indirect obstetric causes and 20 cases (6.5%) of non-maternity causes such as accidents.

Table 7. Pregnancy Related Death by Age and Type of Death

(Unit: person)

Age	1995			1996			Total		
	Direct	Indirect	Others	Direct	Indirect	Others	Direct	Indirect	Others
~19	3	1	0	1	1	0	4	2	0
20~24	16	4	1	7	3	1	23	7	2
25~29	37	13	6	51	10	2	88	23	8
30~34	38	5	5	28	6	2	66	11	7
35~39	17	4	2	20	7	0	37	11	2
40~44	7	0	0	6	0	1	13	0	1
45~49	0	1	0	2	0	0	2	1	0
Total	118	28	14	115	27	6	233	55	20

Maternal Deaths by Time of Death

We looked into 282 cases out of 288 maternal deaths by time of death, except for 6 cases where there was an unknown time of death and the result is shown in table 8. We could not classify by gestation period those who died before delivery because there was not enough information on it. 62.8% of maternal deaths occurred during the postpartum period, 19.5% during childbirth and only 17.7% occurred during pregnancy. It seems that risk of maternal death is very high after delivery. Maternal death during labour and two days after delivery comprised 39.7% of total maternal deaths (see Table 8).

The following presents maternal death by time of death and type of death. The proportion of direct obstetric deaths during pregnancy was 92.0% (46 cases out of 50 maternal deaths), 87.3% during labour (48 cases out of 55) and 75.1% (133 case out of 177) for puerperium.

The reason for the decreasing proportion of direct obstetric deaths after delivery needs further study (see Table 9).

Table 8. Distribution of Maternal Deaths by Time of Death

(Unit: person, %)

Time of death	1995		1996		Total	
	No.	%	No.	%	No.	%
Total	145	100.0	137	100.0	282	100.0
Pregnancy	23	15.9	27	19.7	50	17.7
Childbirth	20	13.8	35	25.5	55	19.5
Postpartum (Sub total)	102	70.3	75	54.7	177	62.8
1 day	28	19.3	16	11.7	44	15.6
2 days	6	4.1	7	5.1	13	4.6
3~ 7 days	19	13.1	6	4.4	25	8.9
8~14 days	10	6.9	6	4.4	16	5.7
15~42 days	17	11.7	21	15.3	38	13.5
Unknown	22	15.2	19	13.8	41	14.5

Note: Time of death of 6 cases out of 288 (1 case in 1995, 5 cases in 1996) were unknown and were excluded from the analysis

Table 9. Distribution of Maternal Deaths by Time of Death and Type of Death

(Unit: person)

Time of death	1995		1996		Total	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Total	117	28	110	27	227	55
Pregnancy	21	2	25	2	46	4
Childbirth	17	3	31	4	48	7
Postpartum (Sub total)	79	23	54	21	133	44
1 day	26	2	12	4	38	6
2 days	5	1	6	1	11	2
3~ 7 days	15	4	3	3	18	7
8~14 days	6	4	3	3	9	7
15~42 days	5	12	11	10	16	22
Unknown	22	0	19	0	41	0

Note: Time of death of 6 cases out of 288 (1 case in 1995, 5 cases in 1996) were unknown and excluded from the analysis.

Pregnancy-outcome of the Maternal Death

The information on pregnancy outcome was only available for the 215 cases of maternal death found in the medical facilities survey and it is shown in Table 10. Among the pregnancy outcome, live births was the highest at 73.1%, stillbirths at 9.4%, death during pregnancy at 8.0%, spontaneous abortion at 7.0% and induced abortion was at 2.5%.

Table 10. Distribution of Maternal Death by Pregnancy Outcome

(Unit: person, %)

	1995		1996		Total	
	No.	%	No.	%	No.	%
Live births	81	73.6	66	72.5	147	73.1
Still births	9	8.2	10	11.0	19	9.4
Death during pregnancy	8	7.3	8	8.8	16	8.0
Spontaneous abortion	9	8.2	5	5.5	14	7.0
Induced abortion	3	2.7	2	2.2	5	2.5
Total	110	100.0	91	100.0	201	100.0

Note: Analysis was done only on medical facilities survey data.

Pregnancy outcome of 14 cases out of 201 (4 cases in 1995, 10 cases in 1996) were unknown and excluded from the analysis.

3. Maternal Mortality Indices

The definition of maternal death applied in this report is defined according to the Tenth Revision of the International Classification of Diseases (ICD-10). Maternal mortality indices are indispensable for identifying the mortality level of a population, diversity among sub-groups, and time series trends in order to develop policy and programmes to effectively reduce maternal death. For those purposes, diverse indices are necessary to compare groups and recognize trends.

WHO and developed countries have developed and presented new indices to improve the understanding of the status and comparability of maternal death in their countries.

Maternal Mortality Ratio

The most commonly used indicator is the maternal mortality ratio (MMRatio) which was designed to express obstetric risk by expressing maternal deaths per live birth, rather than per women of reproductive age. The MMRatio overestimates obstetric risk by excluding from the denominator pregnancies which do not terminate in a live birth, but which may be responsible for a maternal death. However, in practice suitable data on pregnancies that do not result in a live birth are rarely available. Because the MMRatio is not an age-standardized measure, MMRatios across countries are not completely comparable (Cynthia Stanton, 1997).

The MMRatio estimated from this survey was 20 per 100,000 live births both in 1995 and 1996 (see Table 11). This result suggests that Korean maternal mortality reached a lower level considering that the ratio of most developing countries was higher than 100. However, this ratio is still high when compared with some of the developed countries which have a ratio of less than 10. One of the reasons of the high ratio may be due to the fact that there is no emergency maternity transfer system although the access to medical services has been improved substantially since the introduction of a national medical insurance system.

Table 12 shows the MMRatio by age. The maternal mortality ratio varies considerably according to age and it seems that the risk of maternal death is closely related to age. The ratio was high at 46 for

those aged 19 or below and the lowest at 11 among those aged 20~24, and 14 among 25~29. It increased after 30 years for the 30~34 age group at 26, among the 35~39 age group at 79 and the highest among the 40 and over age group at 233.

Table 11. Maternal Mortality Ratio

Classification	1995	1996
No. of maternal deaths	146	142
No. of live births ¹⁾	721,535	699,243
Maternal Mortality Ratio ²⁾	20	20

Note: 1) Data is based on the estimation of NSO which consider under report and delay of report ("Report on the Annual Vital Statistics", 1996).

$$2) \text{MMRatio} = \frac{\text{No. of maternal deaths}}{\text{No. of live births}} \times 100,000$$

Table 12. Maternal Mortality Ratio by Age (1995~1996)

Age group	No. of Maternal Death	No. of Live Birth ¹⁾	MMR ²⁾
15~19	6	12,931	46
20~24	30	263,838	11
25~29	111	774,006	14
30~34	77	300,598	26
35~39	48	62,221	77
40 and over	16	7,184	223

Note: 1) Data is based on the estimation of NSO which considers under-reporting and delay of report (Report on the Annual Vital Statistics, 1996).

$$2) \text{MMRatio} = \frac{\text{No. of Maternal Death}}{\text{No. of Live Birth}} \times 100,000$$

Attention should be given to those in the high risk age group and special measures should be developed to prevent complications and maternal death.

Table 13 shows that the 'Direct Obstetric Mortality Ratio' was 16 per 100,000 live births both in 1995 and 1996.

Table 13. Direct Obstetric Mortality Ratio

	1995	1996
No. of death due to direct causes	118	115
No. of Live Birth ¹⁾	721,535	699,243
Direct Obstetric Mortality Ratio ²⁾	16	16

Note: 1) Data is based on the estimation of NSO which considers under-reporting and delay-of-report ([†]Report on the Annual Vital Statistics_s, 1996).

$$2) \text{ DOMR} = \frac{\text{No. of death due to direct causes}}{\text{No. of Live Birth}} \times 100,000$$

The number of deaths occurred during pregnancy and within the 42 days postpartum period was 160 in 1995 and 148 in 1996. The Pregnancy-related Mortality Ratio was 22 in 1995 and 21 in 1996 (see Table 14).

Table 14. Pregnancy-related Mortality Ratio

	1995	1996
No. of Pregnancy-related Death ¹⁾	160	148
No. of Live Birth ²⁾	721,535	699,243
Pregnancy-related Mortality Ratio ³⁾	22	21

Note: 1) A pregnancy-related death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of cause

2) Data is based on the estimation of NSO which consider under report and delay of report ([†]Report on the Annual Vital Statistics_s, 1996).

$$3) \text{ Pregnancy-related Mortality Ratio} = \frac{\text{No. of Pregnancy-related Death}}{\text{No. of Live Birth}} \times 100,000$$

Maternal Mortality Rate

The Maternal Mortality Rate (MMRate) is an indicator of the risk of maternal death among women of reproductive age. It is the equivalent of a cause-specific death rate. This indicator conceals the effect of differing levels of fertility in cross-country comparisons. However, because it is a woman-based statistic, it provides an indication of the burden of maternal death in the adult female population. The MMRate (the number of maternal deaths per 1,000 adult female 15~49) was 0.011 both in 1995 and 1996. The rates were high for the age groups 25~29 and 30~34 at 0.024 and 0.021 respectively in 1995 and 0.029 and 0.016 in 1996 (see Table 15).

Table 15. Maternal Mortality Rates (1995~1996)

Age	1995			1996		
	No. of M. death	No. of female ¹⁾	MMRate ²⁾	No. of M. death	No. of female ¹⁾	MMRate ²⁾
15~19	4	1,886,759	0.002	2	1,909,353	0.001
20~24	20	2,132,031	0.009	10	2,063,165	0.005
25~29	50	2,090,548	0.024	61	2,128,732	0.029
30~34	43	2,092,150	0.021	34	2,062,219	0.016
35~39	21	1,996,138	0.011	27	2,055,898	0.013
40~44	7	1,467,844	0.005	6	1,579,048	0.004
45~49	1	1,192,966	0.001	2	1,227,942	0.002
Total	146	12,858,436	0.011	142	13,026,360	0.011

Note: 1) Data of female population is based on the 『Future Population Projection by NSO in 1996』

$$2) \text{ MMRate} = \frac{\text{No. of maternal death}}{\text{No. of female aged 15-49}} \times 1,000$$

Proportion Maternal among Female Deaths of Reproductive Age

The third indicator is the proportion of adult female deaths due to maternal causes, referred to here as the Proportion Maternal. The

proportion maternal was 1.2% in 1995 and 1996. Comparing the proportion maternal by age, the rate was high among the age group where most of the child births occurred. Those are 3.5% and 2.7% for those aged 25~29 and 30~34 respectively in 1995 and 4.6% and 2.3% in 1996 (see Table 16). The term 'Proportion Maternal' was used in the DHS analytical report and means proportion of maternal deaths among the adult female deaths (Cynthia Stanton, 1997).

WHO reported that the proportion maternal was less than 1% in the USA, on the other hand it ranged from 21% to 46% in Asia and Africa(Carla AbouZahr, 1991). The Korean Proportion maternal, which was 1.2%, shows that our mortality pattern is closer to that of a developed country.

Table 16. Proportion Maternal¹⁾

Age	1995			1996		
	No. of maternal death	No. of female death ¹⁾	P. M.	No. of maternal death	No. of female death ¹⁾	P. M.
15~19	4	932	0.4	2	936	0.2
20~24	20	1,267	1.6	10	1,120	0.9
25~29	50	1,416	3.5	61	1,314	4.6
30~34	43	1,588	2.7	34	1,484	2.3
35~39	21	2,062	1.0	27	2,205	1.2
40~44	7	2,238	0.3	6	2,364	0.3
45~49	1	2,686	-	2	2,663	0.1
Total	146	12,189	1.2	142	12,086	1.2

Note : 1) Proportion maternal = $\frac{\text{No. of maternal death}}{\text{No. of female death aged 15~49}} \times 100$

Source: female deaths was taken from vital statistics (NSO, 1995, 1996).

Lifetime Risk of Maternal Death (LTR)

The fourth indicator of maternal mortality is the lifetime risk (LTR) of maternal death. LTR reflects the chances of a woman

dying from maternal causes over her 35 year reproductive life span. In doing so, it accounts for the probability of a death due to maternal causes each time a woman experiences a pregnancy. For easier interpretation, the reciprocal of the LTR is more frequently used than the LTR itself. For example, an LTR of 0.028 is interpreted as: one in 35 women will experience a death from maternal causes within her reproductive lifetime (Cynthia Stanton, 1997).

The MMRate which expresses the rate of maternal death per 1,000 women, provides an indicator that is more closely comparable to other mortality indicators. The proportion of adult female deaths due to maternal causes provides a clear picture of the burden of maternal death in the population, regardless of the level. On the other hand, since MMRatio focuses attention on the risk of maternal death per birth this ignores the fact that women face this same risk numerous times over within their reproductive lifespan. By contrast, the LTR of maternal death avoids all of these shortcomings. In theory, the lifetime risk is a cohort measure but for practical reasons, it is usually calculated with period measures. It can be approximated by multiplying the maternal mortality rate by the length of the reproductive period (around 35 years). These are commonly used equations for the approximation of LTR developed by Campbell and Graham (Cynthia Stanton, 1997). Thus, the lifetime risk is calculated as

$$\text{LTR} : 1 - (1 - \text{Maternal mortality Rate}) \times 35$$

The lifetime risk can also be approximated by the product of the total fertility rate and the maternal mortality ratio. An adjustment factor of 1.2 or 1.5 is included in order to compensate for pregnancy loss.

Another way of calculating lifetime risk is

$$\text{LTR} : \text{LTR} = 1 - (1 - \text{MMRatio})\text{TFR} \times 1.2$$

$$\text{LTR} = 1.2 \times \text{TFR} \times \text{MMRatio}$$

LTR produced by the above method was 0.4152×10^{-3} (1/2,408) in 1995 and it means that one in 2,408 women will experience maternal death within her reproductive lifetime. The risk in 1996 was 0.4167×10^{-3} (1/2,399) and was one in 2,399 women (see Table 17). WHO recorded the global LTR in 1997 (WHO, 1997) and it was suggested that LTR of one in 3000 means a low maternal mortality level and one in 100 means a high maternal mortality level. LTR estimated in this study represents that the level is low and close to developed countries.

Table 17. Lifetime Risk of Maternal Death

Classification	1995	1996
LTR	0.4152×10^{-3} (1/2,408)	0.4167×10^{-3} (1/2,399)

Note: TFR applied here was 1.71(1996) (NH Cho et al, 1997).

4. Causes of Maternal Deaths

Principles of Classification of the Maternal Death

The causes of deaths are classified according to the criteria and instructions of the Korean standard classification of diseases (NSO, 1994). Guidelines are provided for application of the rules and for coding of the condition selected for tabulation. The causes of death to be entered on the medical certificate of cause of death are originating cause (antecedent cause), intermediate cause and direct cause.

When only one cause of death is recorded, this cause is selected for tabulation. However, when the recorded cause of death was not appropriate, cause of death was presumed by referring to the discharge summary of the medical chart. When more than one cause of death was recorded, selection was made for the underlying cause of death. When there were more than two underlying causes of death, three OB-GY specialists review the questionnaire and discharge summary and deduce cause of death by guidelines and rules of selection. Preventable obstetric cause was selected first. For example, if a patient has hemorrhaging due to placenta previa and gets a Cesarean section which leads to death because of hemorrhaging, the cause of death was classified as placenta previa. If the same patient instead dies of aspiration of gastric contents during anesthesia, the cause will be complication of anesthetics. An autopsy result was considered to have more priority than the clinical diagnosis when deciding on the cause of death.

When a maternal death was reported, but it was difficult to deduce the cause of death from the questionnaire or discharge summary or when the discharge summary was not attached, medical records were again referred to and the cause of death was deduced. However, for those cases where the medical record was lost, the record was kept at court for a medical dispute or where providing of the record was refused, the cause of death was classified as unspecified causes.

Causes of Maternal Deaths

The total number of deaths during pregnancy and the postpartum period was 308 cases. The number of maternal deaths becomes 288 when excluding 20 cases of traffic accidents, drowning and poisoning.

Direct obstetric cause occupied 80.9% (233 cases) of maternal death and indirect obstetric cause at 19.1% (55 cases). Indirect causes consisted of malignant neoplasm, heart disease, renal disease, etc.

The major cause of direct obstetric death was hemorrhaging at 25.7%, hypertension at 16.3%, embolism at 15.6%, and abortion which includes ectopic pregnancy at 6.2% and infection at 1.4%. Other cases are 6 cases of dystocia (2.1%) and 16 cases (5.6%) of various complications, such as, 6 cases of liver disorders, 3 cases of anesthesiology complications and 3 cases of circulatory system complications. The rest of the 23 cases (8.0%) are those with unknown causes. There was little difference in the distribution of the cause of death between 1995 and 1996.

Among the 74 deaths due to hemorrhaging, the major causes were the postpartum hemorrhage at 61 cases, abruptio placenta at 6 cases and placenta previa at 2 cases. The other 5 cases were of hemorrhage during delivery. There were 47 cases of hypertension, consisting of 21 cases of hypertensive disease of pregnancy, and 13 cases of pre-eclampsia and eclampsia respectively. There were 32 cases of amniotic fluid and 13 cases of blood clots that caused embolisms.

Death due to abortion included 10 cases of abortion complications, 7 cases of ectopic pregnancies and 1 case of a hydatidiform mole. Death due to infection included 1 case of sepsis and 1 case of a genitry tract infection. 2 cases of death due to premature rupture of the membrane were included in infection because it was thought that infection of the ruptured membrane could ultimately lead to death.

55 cases of maternal death were classified into indirect obstetric deaths. There were 11 cases of cardio-vascular disease, 11 cases of cancer, 5 cases of hepatitis, 5 cases of encephalo-hemorrhagia and 4

cases of disorders of the thyroid gland (see Table 18).

Table 18. Causes of Maternal Deaths for Selected Years(1995, 1996)

Causes of maternal deaths	(Unit: person, %)					
	1995		1996		Total	
	No.	%	No.	%	No.	%
I. Direct causes	118	80.8	115	81.0	233	80.9
1. Hypertensive disease	27	18.5	20	14.0	47	16.3
Pre-eclampsia	8	5.5	5	3.5	13	4.5
Eclampsia	6	4.1	7	4.9	13	4.5
Hypertensive disease of pregnancy	13	8.9	8	5.6	21	7.3
2. Hemorrhage	35	24.1	39	27.4	74	25.7
Postpartum	28	19.2	33	23.2	61	21.2
Intrapartum	3	2.1	2	1.4	5	1.7
Abruptio placenta	3	2.1	3	2.1	6	2.1
Placenta previa	1	0.7	1	0.7	2	0.7
3. Embolism	22	15.1	23	16.2	45	15.6
Amniotic fluid	14	9.6	18	12.7	32	11.1
Blood clot	8	5.5	5	3.5	13	4.5
4. Infection	3	2.1	1	0.7	4	1.4
Sepsis, Genital T. infection	1	0.7	1	0.7	2	0.7
Premature rupture of membranes	2	1.4	0	0	2	0.7
5. Pregnancies with abortive outcomes	9	6.1	9	6.3	18	6.2
Ectopic	5	3.4	2	1.4	7	2.4
Abortion	4	2.7	6	4.2	10	3.5
Hydatidiform mole	0	0	1	0.7	1	0.3
6. Others	22	15.0	23	16.2	45	15.7
Dystocia	5	3.4	1	0.7	6	2.1
Other complications	7	4.8	9	6.3	16	5.6
Unspecified causes	10	6.8	13	9.2	23	8.0
II. Indirect causes	28	19.2	27	19.0	55	19.1
Total	146	100.0	142	100.0	288	100.0

Comparing the maternal death by age, the highest rate was the others category at 19.5% for the age less than 24 years, which includes hypertension, other complications, dystocia and unspecified causes. The next causes were hemorrhage at 13.9% and embolism at 11.2%. For the age group of 25~29 years, hemorrhage occupied 22.5%,

hypertension 18.0%, embolism and others at 16.2% respectively. For the 30~34 age group, hemorrhage was 31.2%, embolism was 19.5% and others was 15.6%. For those over 35 years of age, hemorrhage was 31.3%, hypertension was 18.9%, embolism and others was 12.5% respectively.

Table 19. Causes of Maternal Deaths by Age; 1995, 1996

(Unit: person, %)

Causes of maternal deaths	Age								Total	
	Under 24 ¹⁾		25~29		30~34		Over 35			
	No.	%	No.	%	No.	%	No.	%	No.	%
I. Direct causes	27	75.0	89	80.2	66	85.7	51	79.7	233	80.9
1. Hypertensive disease	7	19.5	20	18.0	8	10.4	12	18.9	47	16.3
Pre-eclampsia	2	5.6	5	4.5	2	2.6	4	6.3	13	4.5
Eclampsia	2	5.6	5	4.5	2	2.6	4	6.3	13	4.5
Hypertensive disease of pregnancy	3	8.3	4	9.0	4	5.2	4	6.3	21	7.3
2. Hemorrhage	5	13.9	25	22.5	24	31.2	20	31.3	74	25.7
Postpartum	4	11.1	23	20.7	19	24.7	15	23.4	61	21.2
Intrapartum	1	2.8	0	0	3	3.9	1	1.6	5	1.7
Abruptio placenta	0	0	1	0.9	2	2.6	3	4.7	6	2.1
Placenta previa	0	0	1	0.9	0	0	1	1.6	2	0.7
3. Embolism	4	11.2	18	16.2	15	19.5	8	12.5	45	15.6
Amniotic fluid	2	5.6	12	10.8	13	16.9	5	7.8	32	11.1
Blood clot	2	5.6	6	5.4	2	2.6	3	4.7	13	4.5
4. Infection	2	5.6	2	1.8	0	0	0	0	4	1.4
Sepsis, Genital T. infection	2	5.6	0	0	0	0	0	0	2	0.7
Premature rupture of membranes	0	0	2	1.8	0	0	0	0	2	0.7
5. Pregnancies with abortive outcomes	2	5.6	6	4.5	7	9.1	3	4.7	18	6.2
Ectopic	0	0	1	0.9	4	5.2	2	3.1	7	2.4
Abortion	2	5.6	4	3.6	3	3.9	1	1.6	10	3.5
Hydatidiform mole	0	0	1	0.9	0	0	0	0	1	0.3
6. Others	7	19.5	18	16.2	12	15.6	8	12.5	45	15.7
Dystocia	2	5.6	3	2.7	0	0	1	1.6	6	2.1
Other complications	3	8.3	6	5.4	6	7.8	1	1.6	16	5.6
Unspecified causes	2	5.6	9	8.1	6	7.8	6	9.3	23	8.0
II. Indirect causes	9	25.0	22	19.8	11	14.3	13	20.3	55	19.1
Total	36	100.0	111	100.0	77	100.0	64	100.0	288	100.0

Note: 1) 6 cases of maternal death age under 19 were included.

The proportion of hypertension was similar among age groups

except it was a little bit lower among the 30~34 age group. On the other hand, the proportion of hemorrhage increases with age and others decrease with age. The proportion of embolism among 25~35 showed to have a little higher tendency when compared with the ages below 24 and the ages above 35. Abortion among the 30~34 age group was higher than other age groups, however, distribution of the cause of death was not statistically significant (see Table 19).

IV. Conclusion

The first national maternal mortality survey was conducted at the medical and health facilities where maternal death could occur. The registered female death of all reproductive age group were matched with the women treated for pregnancy and delivery identified from the record of bills for medical fees.

The total maternal deaths of the whole population were 146 and 142 cases in 1995 and 1996 respectively. The maternal mortality ratio was 20 per 100,000 live births both in 1995 and 1996. The ratio 20 is much lower than that of 130 estimated by WHO on the basis of the model estimation. The maternal mortality ratio of Korea seemed to reach the level of other developed countries.

Direct obstetric cause occupied 80.9% (233 cases) of maternal death and indirect obstetric cause at 19.1% (55 cases). The major causes of direct obstetric death were hemorrhage (25.7%), hypertension (16.3%) and embolism (15.6%). Indirect causes consisted of malignant neoplasm, heart disease, renal disease, etc.

Recently, more than 99% of the delivery was confined at medical and health facilities in Korea. It can be the issue to be solved urgently that hemorrhage is the major cause of maternal death even though access to the hospital is universal. Government should develop obstetric emergency care system because most of the maternal deaths due to hemorrhage can be preventable.

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Summary

韓國의 母性死亡 研究(1995 · 1996)

韓 英 子

모성의 건강확보와 모성사망 감소를 위한 정책수립의 기초가 되는 모성사망은 빈도가 높지 않고 자료 확보가 어려워 신뢰할 만한 측정치를 얻기가 쉽지 않다. 우리 나라는 아직까지 전국 수준의 모성사망조사를 실시한 적이 없으며, 사망신고자료는 사망진단서 첨부율이 완전하지 않고, 간접 산과적 원인에 의한 사망이 거의 신고되지 않아 지표 산출에 한계가 있는 실정이다.

WHO/UNICEF 등 국제기구에는 1996년 모성사망 추정을 위한 모델을 개발하여 1990년도 우리 나라 모성사망비를 추정하였으나 이 수치는 우리 나라 실정에 비해 너무 높은 수준으로 출생아 10만명당 70인 북한의 2배에 가까운 130으로 게재하여 정치 사회적인 문제를 야기 시킨 바 있다. 우리 나라는 수차에 걸쳐 국제기구에 시정을 요구하였으나 국제적으로 수용할 만한 조사방법에 의한 결과를 제시하기 전에는 수정이 가능하지 않다는 응답을 받았다. 따라서 이 연구는 정책수립에 기초가 되는 모성사망 지표 생산과 국제통계의 오류를 수정하기 위한 목적으로 실시되었다.

이 조사는 사망신고자료로부터 15~49세 가임기 연령층의 여성사망자 전체를 선별하여 이들을 임신과 분만으로 의료보험 급여를 받은 대상자와 ID를 중심으로 동일인을 전산상에서 연계하였다. 이들을 사망이 발생한 의료기관으로 추적하여 진료기록부를 확인하여 모성사망 여부를 확인하였으며, 이들 이외에 전국의 병원에서 추가로 확인된 모성사망자도 조사하였다.

조사 결과 우리 나라의 모성사망비는 1995년과 1996년 모두 출생아 10만명당 20인 것으로 밝혀졌으며, 직접 산과적 원인에 의한 사망은 80.9%, 간접 산과적 원인에 의한 사망은 19.1%였다. 직접 모성사망원인으로는 출혈이 25.7%로 수위를 차지하였고, 다음이 고혈압으로 16.3%, 자궁의 임신을 포함한 유산 6.2%, 감염 1.4% 순이었다. 이 조사결과는 세계보건기구로부터 인정을 받아 1999년도부터 국제 통계지표로 채택되었다.