

# Industrial Accident Compensation Insurance Benefits on Cerebrovascular and Heart Disease in Korea

The purpose of this study is to present the importance of work-related cerebrovascular and heart disease from the viewpoint of expenses. Using the insurance benefit paid for the 4,300 cases, this study estimated the burden of insurance benefits spent on work-related cerebrovascular and heart disease. The number of cases with work-related cerebrovascular and heart disease per 100,000 insured workers were 3.36 in 1995; they were increased to 13.16 in 2000. By the days of occurrence, the estimated number of cases were 1,336 in 2001 (95% CI: 1,211-1,460 cases) and 1,769 in 2005 (CI: 1,610-1,931 cases). The estimated average insurance benefits paid per person with work-related cerebrovascular and heart disease was 75-19 million won for medical care benefit and 56 million won for other benefits except medical care. By considering the increase in insurance payment and average pay, the predicted insurance benefits for work-related cerebrovascular and heart disease was 107.9 billion won for the 2001 cohort and 192.4 billion won for the 2005 cohort. From an economic perspective, the results will be used as important evidence for the prevention and management of work-related cerebrovascular and heart disease.

**Key Words :** Insurance Benefits; Occupational Diseases; Cerebrovascular Disorders; Heart Diseases

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Received : 30 April 2003  
Accepted : 2 June 2003

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## INTRODUCTION

Due to the characteristics of cerebrovascular and heart disease, the fatality rate of the disease is very high; during treatment, it needs intensive care for a short period of time, which uses high-priced equipment and expensive medicine, or long-term treatment. Therefore, the benefits of industrial accident compensation insurance for cerebrovascular and heart disease are expected to be higher than those of other occupational diseases. However, the yearly data on the benefits of industrial accident compensation insurance do not specify the amount of insurance benefits by industrial accidents; so the expenditure on work-related cerebrovascular and heart disease cannot be calculated accurately. As the proportion of work-related cerebrovascular and heart disease increases (1), the proportion of its insurance benefits to the total benefits for industrial accident compensation insurance will increase accordingly. Currently, 80% of industrial accident insurance fund is spent on insurance benefits (2), and it can greatly affect the management of industrial accident compensation insurance.

Insurance benefits are composed of the following: 1) medical care benefit (expenses spent on treatment); 2) shutdown benefit (expenses paid for unemployed period due to medical treatment); 3) disability benefit (expenses paid for uncured disabilities after the completion of treatment); 4) injury-disease compensation annuity (expenses paid for workers who have been

diagnosed as incurable cases - the grade 1-3 - even after 2 yr of treatment); 5) survivors benefit (expenses paid for surviving family members); and 6) funeral expenses (expenses paid to people who prepares a funeral. Nursing benefit (expenses paid for home care even after the completion of medical treatment) has been recently added to the list.

This study will analyze insurance benefits paid for work-related cerebrovascular and heart disease since 1995. Based on the analysis, the expenditure of industrial accident compensation insurance will be predicted. So, this study will present the importance of work-related cerebrovascular and heart disease and the need of its management in terms of medical expenses.

## DATA COLLECTION AND METHODS

### Data Collection

From the cases of cerebrovascular and heart disease, which had occurred between January 1, 1995 and December 31, 2000, the insurance benefits paid for the 4,300 cases of cerebrovascular and heart disease, approved as work-related by the law of industrial accident compensation insurance as of July 31, 2001, were used as the data for this study.

According to the current treatment status of 4,300 cases, as of July 31, 2001, there were 275 cases in 1995 (23 open cases,

106 closed cases, and 128 death cases); and 1,170 cases in 2000 (751 open cases, 97 closed cases, and 322 death cases). Open case represents the workers who are under care. Closed case represents the workers who were over care and receive disability benefits. Death represents the workers who have died from disease. Insurance benefits such as medical expenses, disability compensation, and/or funeral expenses are expected to continue to remain to open cases.

Cerebrovascular disease, which is approved as work-related disease by the law of industrial accident compensation insurance, includes subarachnoid hemorrhage, intracranial hemorrhage, cerebral infarction, and hypertensive cerebropathy. Heart disease, on the other hand, includes myocardial infarction, angina pectoris, and aortic dissection.

When there were more than 2 diagnostic names, major diagnostic name was used. Sudden deaths (Karoshi) to those who had potential risk of cerebrovascular and/or heart disease were included in this study.

Korea Labor Welfare Corporation is the sole government agency which handles all work-related compensations in Korea; it has records of insurance benefits paid to the workers with work-related diseases from the onset of care to the completion of care or death. From this data, the accumulated insurance benefits which are paid from the beginning of care to the completion of care can be calculated.

### Estimation of Approved Cases of Work-Related Cerebrovascular and Heart Disease

For approved work-related cerebrovascular and heart disease, 6 incidence year cohorts were formulated for the 6-yr period between 1995 and 2000 based on the occurrence date. As to the 6 incidence year cohorts, the number of approved cases of cerebrovascular and heart disease was calculated for every 100,000 insured workers.

A linear regression equation was obtained by using regression analysis on two variables: 1) the number of approved cases for every 100,000 insured worker during 6 yr; and 2) the time (incidence year). Then, the obtained regression equation was used to predict the anticipated number of incidence cases for next 5 yr (2001-2005) and the 95% confidence interval (CI) for the estimated approved cases. The number of insured workers was 9,465,557 in December 2000, and an assumption is made that the number will increase by 3% annually for the next 5 consecutive years, as more workers will be eligible for the benefits by the revision of labor insurance policy in Korea.

### Estimation of Insurance Benefits and Analysis of Sensitivity

Using the cases for which 90% or more insurance benefit was paid from 1995 to 1997 incidence cohort, the average insurance benefit paid per person with work-related cerebrovascular and heart disease could be estimated by differentiating

medical care benefits from other types of benefits.

Medical care benefits were estimated based on the insurance payment, whereas other benefits excluding medical care benefit were calculated based on the average pay. Increase rates for these two benefits were calculated by considering increase rates of insurance payment and average pay. For the last 10 yr, the increase rate of 7.5% for insurance payment and 7.8% for annual average pay of manufacturing industries was applied. The insurance benefits for work-related cerebrovascular and heart disease were calculated as follows:

$$\text{Total expenditure}_{\text{year}} = \text{Mean amount of medical care benefits} * N_{\text{year}} * (1 + \Delta i_{\text{year}}) + \text{Mean amount of other benefits except medical care} * N_{\text{year}} * (1 + \Delta j_{\text{year}})$$

Total expenditure<sub>year</sub>: Total insurance benefits for work-related cerebrovascular and heart disease occurred at designated time

Mean amount of medical care benefits: Average medical care benefit

Mean amount of other benefits except medical care: Average other insurance benefits excluding medical care expenses

N<sub>year</sub>: Number of approved cases of work-related cerebrovascular and heart disease at designated time

Δi<sub>year</sub>: Annual increase rate for insurance payment

Δj<sub>year</sub>: Annual increase rate for average pay

In addition, expenditure of insurance benefits can be fluctuated by the changes in the following factors: 1) average insurance benefits per person; 2) predicted incidence cases; 3) increase rate of insurance payment; and 4) increase rate of average pay. The analysis of sensitivity to these factors was performed to predict the range of estimated insurance benefits.

In the analysis of sensitivity, the following rates for the factors were used: 1) to predict average insurance benefits per person, used 10% of average insurance benefits per person was applied; 2) to predict incidence cases, used 95% CI of estimated incidence cases was applied; 3) for increase rate of insurance benefits, used 10% of increase rate of insurance payment obtained from last 10 yr was applied; and 4) for increase rate of average pay, use 10% of increase rate of average pay obtained from the last 10 yr was applied.

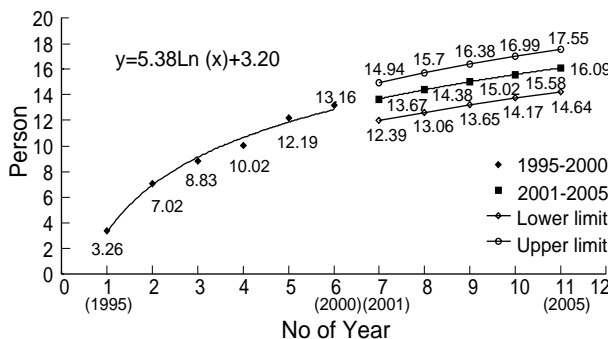


Fig. 1. Estimation of approved cases per 100,000 insured workers for work-related cerebrovascular and heart disease.

**Table 1.** Distribution of the 1995-2000 cohorts by current treatment status

Cohort	1995	1996	1997	1998	1999	2000
Open case	23	46	111	207	380	751
Closed case	106	273	284	242	203	97
Death	128	235	313	284	295	322
Total	257	554	708	733	878	1,170

Open case represents the workers, who are proven to have work-related cerebrovascular or heart disease, and are under care. Closed case represents the workers, who were proven to have work-related cerebrovascular or heart disease, were over care and received disability benefits. Death represents the workers, who were proven to have work-related cerebrovascular or heart disease, died from the disease.

**Table 3.** Mean expenditure per person for the 1995-2000 cohorts by current treatment status (Unit: million won)

Cohort	1995	1996	1997	1998	1999	2000
Mean expenditure	77	70	71	66	48	33
Open case	146	113	95	65	35	16
Closed case	68	53	51	42	33	25
Death	72	83	80	86	75	73

Mean expenditure represents benefits per person which was given by Industrial Accident Compensation Insurance i.e. medical care benefit, shutdown benefit, disability benefit, survivors benefit, funeral expenses, and injury-disease compensation annuity. Open case represents the workers, who are proven to have work-related cerebrovascular or heart disease, are under care. Closed case represents the workers, who were proven to have work-related cerebrovascular or heart disease, were over care and received disability benefits. Death represents the workers, who were proven to have work-related cerebrovascular or heart disease, died from the disease.

**Data Analysis**

A statistical package, SAS (6.12 version), was used to analyze the data. A regression equation of time (incidence year) against the number of incidence cases of work-related cerebrovascular and heart disease were obtained. The results of the analysis on insurance benefits for work-related cerebrovascular and heart disease were used to predict the insurance benefits for the future years.

**RESULTS**

**Estimation of Approved Cases of Work-Related Cerebrovascular and Heart Disease**

Based on the day of occurrence, the approved cases of work-related cerebrovascular and heart disease were increasing annually for every 100,000 insured workers, from 3.36 in 1995 to 13.16 in 2000; increasing rate of the approved cases of work-related cerebrovascular and heart disease, on the other hand, were decreasing every year for every 100,000 insured workers from 3.66 in 1996 to 0.97 in 2000 (Fig. 1).

From 1995 to 2000, the regression equation of time (inci-

**Table 2.** Forecasting cases of work-related cerebrovascular and heart disease for 2001-2005 cohorts

Cohort	Insured workers	Approved case per 100,000 workers	95% CI for approved case per 100,000 workers	95% CI for work-related cerebrovascular and heart disease
2001	9,770,120	13.7	12.4-15.0	1,211-1,460
2002	10,063,227	14.4	13.1-15.7	1,314-1,560
2003	10,365,124	15.0	13.7-16.4	1,415-1,698
2004	10,676,078	15.6	14.2-17.0	1,513-1,814
2005	10,996,360	16.1	14.6-17.6	1,610-1,931

**Table 4.** Estimated mean expenditure per person (Unit: million won)

Cohort (No.)	1995 (257)	1996 (554)	1997 (708)
Open case	3,364	5,179	10,494
+benefits will be added*	+736	+1,472	+3,552
Closed case	7,248	14,405	14,524
Death	9,164	19,408	25,110
Total expenditure	20,512	40,464	53,679
Mean expenditure per capita	80	73	76

\*: Open case represents any incomplete compensation that requires more spending such as medical care, disability benefits, and/or funeral expenses in the case of death.

dence year) against the number of incidence cases of cerebrovascular and heart disease for every 100,000 insured workers for a designated corresponding year was:

$$Y_{\text{year}} = 5.38 * \ln(X_{\text{year}}) + 3.20$$

$Y_{\text{year}}$ : Approved incidence cases of cerebrovascular and heart disease for every 100,000 insured workers in the year Y

$X_{\text{year}}$ : Coding for each year (1995=1; 2000=6; 2001=7; 2005=11)

The incidence cases of cerebrovascular and heart disease between 2001 and 2005 predicted by the regression equation are expected to increase from 13.7 in 2001 (95% CI: 12.4-15.0) to 16.1 in 2005 (95% CI: 14.6-17.6) for every 100,000 insured workers; whereas the increasing rate will be decreased as time goes (Fig. 1). And the predicted number of incidence cases of cerebrovascular and heart disease for the next 5 yr were 1,336 cases for 2001 (95% CI: 1,211-1,460 cases) and 1,769 cases for 2005 (95% CI: 1,610-1,931 cases) (Table 2).

**Estimation of Average Insurance Benefit per Person**

In 1995 cohort, the average insurance amount was 146 million won for the open cases, 68 million won for the closed cases, and 72 million won for the deaths. And in 2000 cohort, the average insurance amount was 16 million won for the open

Table 5. Expected total expenditure for the 1995-2005 cohorts

Cohort	Size of cohort	Medical care benefits			Other benefits (Except medical care)			Total Expenditure (1)+(2)*
		A	B	(1)*	C	D	(2)*	
1995	265	19		5,035	56		14,840	19,875
1996	573	19		10,887	56		32,088	42,975
1997	727	19		13,813	56		40,172	53,985
1998	760	19		14,440	56		42,560	57,000
1999	907	19		17,233	56		50,792	68,025
2000	1,248	19	1.00	23,712	56	1.00	69,888	93,600
2001	1,336	19	1.07	27,288	56	1.08	80,652	107,940
2002	1,447	19	1.15	31,772	56	1.17	94,166	125,940
2003	1,557	19	1.24	36,751	56	1.26	109,228	145,979
2004	1,663	19	1.33	42,197	56	1.36	125,764	167,961
2005	1,769	19	1.43	48,253	56	1.47	144,215	192,468

A: Medical care benefits per person (million won), B: Increased rate of cost of medical insurance, C: Other benefits per person (million won), D: Increased rate of wage. \*: million won.

Table 6. Sensitivity analysis of total expenditure for the 1998-2005 cohorts

Cohort	Size of cohort	Mean expenditure per capita*	Medical insurance cost†	Wage‡	Range of expected total expenditure‡
1995	265	75			19.9
1996	573	75			43.0
1997	727	75			54.0
1998	760	68 - 83			51.3-62.7
1999	907	68 - 83			61.2-74.8
2000	1,248	68 - 83	1.00	1.00	84.2-103.0
2001	1,211-1,460	68 - 83	1.07-1.08	1.07-1.08	87.4-130.7
2002	1,314-1,560	68 - 83	1.11-1.17	1.15-1.18	100.9-151.5
2003	1,415-1,698	68 - 83	1.23-1.27	1.23-1.28	116.8-178.9
2004	1,513-1,814	68 - 83	1.30-1.37	1.31-1.38	133.6-207.3
2005	1,610-1,931	68 - 83	1.39-1.49	1.40-1.51	152.1-239.5

\*: million won, †: increased rate, ‡: billion won.

cases, 25 million won for the closed cases, and 73 million won for the deaths (Table 3).

For the death and closed cases with disability, an average of 32 million won per person was paid for the disability benefit, funeral expense, survivors benefit, and injury-disease benefit. Therefore, if additional 32 million won was paid to workers who were under care (open case) due to death or disability, the average insurance benefit per person would be: 80 million won for the 1996 incidence cohort, 73 million won for the 1996 incidence cohort, and 76 million won for the 1997 incidence cohort (Table 4). By using 3 data of incidence cohorts, the estimated average insurance benefit per person was 75 million won; out of this benefit, 19 million won was for medical care benefit and 56 million won was for other insurance benefit except medical care benefit.

#### Estimation of Insurance Benefit for Future Years

The necessary insurance benefit for the 265 cases of the year

1995 cohort was 19.87 billion won; whereas, for 1,248 cases of the 2000 cohort, it was 93.6 billion won. Considering the increase rates in insurance payment and average wage, it was estimated that 107.9 billion won would be needed for the 2001 cohort, and 192.4 billion won for the 2005 cohort (Table 5).

After the sensitivity analysis, the predicted range of insurance benefit was 87.4-130.7 billion won for the 2001 incidence cohort and 152.1-239.5 billion won for the 2005 incidence cohort (Table 6).

## DISCUSSION

According to the human capital method and the incidence-based approach, the estimation of expenditure for this study is limited to the industrial accident compensation insurance benefits that the Korea Labor Welfare Corporation actually paid for work-related cerebrovascular and heart disease.

Human capital method excludes intangible value of human and depends solely on income. So the disadvantage of this method is to estimate expenses too low for low-income groups such as women, young teens, or old generation in labor market (3). Nevertheless, the reason that this method is widely used is because the collection of data to estimate expenses is relatively easy, and it can quantify the following factors clearly: 1) the direct expenses for the prevention of disease, diagnosis, treatment, and rehabilitation; 2) the value of lost productivity from disease; or 3) reduced future income based on the income level from the starting point.

Human capital approach can be further divided into the incidence-based approach and the prevalence-based approach. The incidence-based approach is to estimate direct and indirect expenses needed for remaining average life span of a worker since the suffering of disease. As the value of currency changes as time goes, the total expenses for the remaining life are adjusted for current value by using discount rate. This method

can convert all economic burdens into expenses, and it is usually used to evaluate the effectiveness of prevention program of occupational disease (4). The prevalence-based approach is to estimate direct and indirect expenses needed by disease during a fixed time, usually by calendar years. It estimates the following: 1) the expenses of exhausted resources by disease, 2) converted expenses of reduced productivity affected by disease, the disability or death—during the fixed time; and then it re-evaluates to current value by using discount rate (5).

Usually, the statistics on industrial accident compensation insurance are reported based on the approval date of care, and so there is time difference between the real occurrence date of work-related industrial accident/disease and the approval date of care. Especially, in the case of cerebrovascular and heart disease, the time difference between the onset of disease and the approval date of care is 1 to 2 yr or more in many cases. The reason for the difference is that the statistics of work-related cerebrovascular and heart disease published by the Ministry of Labor reflect the data at around the approval date of work-related disease, rather than the data of the occurrence of disease.

Therefore, if research was conducted with data based on the approval date of care, the results of research would not reflect the yearly work-related cerebrovascular and heart disease; if this is the case, it is impossible to predict the magnitude of occurrences and the expenditure of benefits. To remove this confounding factor, this study calculated the number of cerebrovascular and heart cases from the date of occurrence, not from the approval date of care.

The predicted cases of work-related cerebrovascular and heart disease were estimated to be 1,336 cases in 2001 (95% CI: 1,211-1,460 cases) and 1,769 cases in 2005 (95% CI: 1,610-1,931 cases). The predicted cases for future years in this research are the results of the analysis of the trends of work-related cerebrovascular and heart disease, which is based on a group of insured workers for the last 6 yr.

When the number of work-related disease cannot be obtained accurately, the method of proportionate attributable risk is usually used to estimate the number of work-related disease cases. This method is based on the hypothesis that the occurrences of disease are partly attributable to work. For example, about the work-related cerebrovascular and heart disease and death, Leigh et al. (6) attributed to work only 1-10% and Markowitz et al. (7) and Kraut (8) 1-3%. Karasek and Theorell (9) estimated work-related cerebrovascular and heart disease by applying 9-13% for men and 3-7% for women. In the case of Korea, from the comparison of the estimated occurrences of cerebrovascular disease from the trial observation system by the Ministry of Health and Welfare (10) and the results of this study on the work-related cerebrovascular and heart disease, it can be concluded that 3.3% of cerebrovascular and heart disease can be attributable to work.

According to data obtained from 1995, 1996, and 1997 incidence cohorts, average insurance benefit per person was estimated to be 75 million won; medical care benefit was 19 mil-

lion and other benefits except medical care benefit was 56 million. At the completion of treatment, if there is a determination of disability, the disability benefit was close to the sum of medical care benefits and shutdown benefit. In the case of death, most of the benefits were for surviving family benefits and funeral expenses.

Finally, the estimated insurance benefit for work-related cerebrovascular and heart disease was 43 billion won for 1996 incidence cohort and 93.6 billion for the 2000 incidence cohort; the results show that, besides the currently paid insurance benefits, the additional 4 billion won and 55.4 billion won is needed for the respective cohorts. Also, for the 2001 incidence cohort and the 2005 incidence cohort, 107.9 billion won (95% CI: 87.4-130.7 billion) and 192.5 billion won (95% CI: 152.1-239.5 billion) will be needed for insurance benefits, respectively. The results show that, as time goes, insurance benefits for the cerebrovascular and heart disease will be increased.

Estimates of the economic cost of occupational disease have at least two purposes. First, economic estimates can play a role in informing the political and administrative decision-making processes which shape occupational health policy. Second, economic estimates can illuminate value judgments. Public and private responsibility for workers health is diffused, when the assumptions that underlie industrial health policies remain implicit. Economic analyses can make those assumptions explicit through contrasting the benefits and costs of alternative occupational health policies. For these two reasons, economic analysis can be used as a tool to encourage rational health and labor policies (5).

Since the 1990s, the proportion of the insurance benefits spent on work-related cerebrovascular and heart disease to the total fund of industrial accident compensation insurance is expected to increase annually in consideration of rapidly increasing number of suffering patients and death due to work-related cerebrovascular and heart disease. This research presents concrete evidence for the burden of expenses. The average accumulated insurance benefits per workers with work-related cerebrovascular and heart disease were estimated to be 75 million won. The results of this study show that the increase in medical expenses, average pay, and the number of disasters will lead to the increase of insurance benefits for work-related cerebrovascular and heart disease. The necessary insurance benefits for the 2000 incidence cohort were 93.6 billion won, which has increased 4.7 times more compared to 19.9 billion won for the 1995 incidence cohort.

Countries of similar standards with Korea, regarding work-related cerebrovascular and heart disease, are Japan and Taiwan (11). In the cases of Europe or America, there is some difference in the standards of industrial accident compensation insurance in each country or state; therefore, not every work-related cerebrovascular and heart disease receives benefits (12). Also there are not many studies done on expenditure of cerebrovascular and heart disease by country or state unit. Fahs et al. (5) calculated the expenses spent on death due to work-related asymp-

tomatic coronary heart disease and cerebrovascular disease in New York City in 1985. The total expenses for asymptomatic coronary heart disease were U\$47,281-U\$11,219 for direct expenses and U\$36,062 for indirect expenses; the total expenses for cerebrovascular disease were U\$58,518-U\$24,413 for direct and U\$34,105 for indirect expenses.

The limitations of this research are as follows: 1) In the estimation of expenses, the actual number of cohorts and predicted cases are tricky. In this research, a regression equation reflecting the changes in incidence cases for the last 6 yr and the number of predicted cases were estimated under the assumption that the number of eligible workers for the benefits would increase consistently at the rate of 3% and the decreasing rate of work related cerebrovascular and heart disease would maintain its trend. At present, this approach is considered to be the best in estimating the number of cases for work-related cerebrovascular and heart disease, and the limitation will be overcome through continuous collection of data. 2) As to the factors affecting the expenses of work-related cerebrovascular and heart disease, the increases in medical insurance payment, average pay, and approved cases were considered in this research. The intensity of medical service, the amount of medical service use, the benefit range, the approval standard for work-related industrial disease, and the financial situation of industrial accident compensation insurance can also affect benefits. However, since there are no data available for the intensity of medical service, the amount of medical service use, or the benefit range in the area of industrial accident compensation insurance, it is not easy to obtain those data. So this study used insurance benefit data only. 3) Finally, insurance benefits on work-related cerebrovascular and heart disease by incidence cohorts in this study are accumulated expenses from the occurrence date to the completion of care including the expenses for disability or death. Whereas the total industrial accident insurance benefits, which are reported by the Korea Labor Welfare Corporation as annual report show only the total yearly expenses for each calendar year. As a result, no direct comparisons can be made between these two sets of data. When the Korea Labor Welfare Corporation reports the usage of industrial accident compensation insurance fund yearly, insurance benefit data should be presented by types of industrial accidents, which includes occu-

pational diseases, to forecast more accurate insurance benefits.

## ACKNOWLEDGEMENT

This work was supported by the Faculty Research Fund of Konkuk University in 2002.

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