Cost and determinants of morbidity from work related disabling injuries in Taiwan.

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Cost and determinants of morbidity from work related disabling injuries in Taiwan

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Abstract

***Objectives*—To estimate the cost and determinants of morbidity from work related disabilities.**

***Methods*—114 people who lived in metropolitan Taipei and who had received disability compensation from the Labor Insurance Bureau from March to June, 1991 were randomly selected. There were 77 workers interviewed through a questionnaire that inquired about possible loss of productivity including the duration of morbidity, the ability to return to work, and any change in monthly income upon returning to work.**

***Results*—The mean (SD) duration of a stay in hospital was 29 (39) days, median: 15 days. The average duration between discharge from the hospital and returning to work was 111 (146) days, median: 45 days. The main determinants of the duration of the stay in hospital were the number of stays in hospital and the severity of the injury. A multivariate linear analysis showed that old age and the severity of injury determine the durations of morbidity. An ordinal logistic regression analysis showed that the severity of injury, size of the factory, and age determined the magnitude of future productivity loss. Based on these models, it was estimated that the total duration of morbidity (in hospital and at home) due to occupational disability was 660 000 person-days each year. When the percentage of the decrease in income because of permanent disability was converted into a loss of work days, the annual morbidity costs were about 19 000–26 000 person-years between 1985–1990.**

***Conclusion*—The morbidity cost was about five times as high as the lump sum payment that a worker usually received for disability compensation. We conclude that morbidity cost should be evaluated carefully in the future for the establishment of accurate and fair disability compensation payments.**

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Keywords: occupational disability; morbidity cost; compensation

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An average of one to two/thousand male workers in Taiwan sustain work related disabling injuries annually[1–3]; also, the annual mortality rate of male workers due to occupational injuries is about 0·5/thousand.[2 3] The risk of major occupational injuries among female workers is about one sixth that of male workers and has not shown any tendency to decline in the past six years.[1–3] The total mortality due to occupational injuries in Taiwan is five to 10 times higher than that of more industrialised countries such as Japan or the United States.[2]

Besides the above figures, there are other reasons to call for continuous efforts and more allocation of resources for research and the prevention of occupational injuries. Most occupational injuries can be avoided if safety mechanisms are clearly understood and proper precautions followed.[4–7] Furthermore, the social costs of occupational injuries are much greater than those of other health problems because the age group of injured workers is relatively young and they are economically productive.[3]

There are two key elements of social cost. One is the direct cost such as expenditures for goods and services. The other is the indirect cost that includes the loss of potential earning or loss of productivity.[9] The indirect cost is usually several times higher than the direct cost.[10] In occupational accidents, the indirect cost can be further divided into the mortality cost of occupational fatalities and the morbidity cost of occupational injuries.[9]

In this paper we try to estimate the cost and determinants of morbidity due to work related permanent physical impairment—that is, occupational disabilities, in Taiwan.

Subjects and methods

To draw a representative sample of workers with work related disabling injuries, we visited the Labor Insurance Bureau weekly during the months of March to June, 1991. Every worker who lived in the metropolitan Taipei area and had received his or her compensation in the previous week was registered and given a number. Through the procedure of random sampling, 114 people were selected. Additional information such as their address, the telephone numbers of their home and workplace, and the details of their injuries, etc were obtained from the Labor Insurance Bureau. To receive disability compensation resulting from occupational injuries, these workers had to have finished their initial medical treatment, and the disability should be relatively stable. All workers with an occupationally-related permanent disability will cer-

Table 1 Comparison of the pattern of injuries and the degree of disabilities

	Interviewed n = 77	*Not interviewed n = 37*	*P value*
Age (y):			
Mean (SD)	37·3 (11·1)	33·6 (11·3)	0·096
Range	8–62	16–57	
Sex M:F	58:19	34:3	0·036†
Injury:			
Blindness due to eyeball injury	1	0	0·39†
Cervical and thoracic trauma	2	2	
Lumbosacral trauma	4	0	
Lower extremity	3	1	
Bilateral upper extremities	5	0	
Unilateral upper extremities	60	34	
Finger(s)	2	0	
Degree of disability:			
1–3‡	3 (2)	1	0·68†
4–6‡	2 (1)	1	
7–9‡	16 (3)	4	
10–12‡	27 (1)	21	
13–15‡	29 (5)	10	
Disability compensation (NT$):			
Mean (SD)	113 725 (114 950)	117 938 (155 851)	0·82*
Range	15 300–470 000	19 200–915 000	
Median	71 400	81 600	
Duration of stay in hospital:			
Mean (SD)	23 (36)	46 (129)	0·69*
Range	0–252	0–738	
Median	13	11	

*Wilcoxon rank-sum test. †χ^2 test. ‡( ) No of workers not returned to work.

tainly obtain their compensation payment because of workmen's compensation legislation in Taiwan. In the years 1985 to 1990, there were 34 416 workers who obtained compensation.[3]

After performing a pilot test, we designed a questionnaire[11–13] that inquired about possible loss of productivity including the duration of morbidity (in hospital and at home), any compensation payments or reimbursements received, whether the subjects could return to work, and if there were any changes in their incomes. We employed two groups of interviewers with three members in each group: one medical professional (a medical doctor or physical therapist) and two social workers. Each interviewer received a six hour interview training course and every item of inquiry was standardised. From July to November 1991, interviewers visited the selected workers.

Data were then coded into a computer and analysed by a statistical package SAS/STAT PC 6·04.[14] We applied multiple linear regression analysis for the estimation of the duration of total morbidity including the duration of a stay in hospital and rest at home after acute injuries. Then, an ordinal logistic regression analysis[15] was also performed to obtain the adjusted odds ratio (OR) of all the determinants of future loss of productivity. We have classified the decrease in monthly income (in NT$) into four ordinal categories: <5000, 5000–9999, 10 000–24 999, and >25 000. The independent variables we put in to fit the model included age, sex, severity of injury, educational level, size of the factory, relationship to the employer, etc.

To estimate the total morbidity cost of work related disability in Taiwan, we can only use the severity of injury and age as the independent variables because no information on the other determinants is available at the national registration data. We have constructed a model to predict the magnitude of the person's future decrease in working capability. In this model, the proportion of change in monthly income was assumed to be a percentage of loss of working capability. The resulting models from the multiple regression were used to estimate the productivity lost due to morbidity for the years 1985 to 1990. Each worker's future loss of productivity was calculated as the percentage of loss multiplied by his or her potential working years. To estimate the potential working years, we assumed that each worker would have worked until 65 years of age had he or she not been injured. Thus, we obtained the person's potential working years by subtracting the person's age from 65. Both parts of the morbidity cost—that is, the duration of the stay in hospital plus convalescence at home and the future loss of productivity—shared the same time unit: person-days or person-years.

Results

Among the 114 workers randomly selected, there were 92 men and 22 women. Their mean (SD) age was 36·1 (11·3) with a range from 16–62. According to the regulations of the Labor Insurance Bureau, the degree of disability was classified, from severe to mild, on a scale of 1–15 (1 being the most severe).[16] Most of the disabilities were mild—that is, 76·3% of the workers fell between 10–15 on the severity scale. The age and sex distribution of these 114 workers, as well as the cause, agent, and severity of the injury, were similar to those of all disabled workers in Taiwan in 1990.[3]

We successfully interviewed 77 workers; the interview rate was 67·5%. The mean (SD) duration from the onset of injury to the date of the interview was 10·1 (6·7) months. Sixty five of them (84%) had returned to work by the time of our study. There were 12 workers who could not be interviewed because of difficulties in making an appointment. Other common reasons for a lack of an interview were either a change in place of employment and moving out of metropolitan Taipei, or a loss of contact with their families (21/37). Three people refused to be interviewed and one person died. Other than the distribution of sex, there was no significant difference in the characteristics of those interviewed and those who were not (table 1).

The mean (SD) duration of a stay in hospital for the 77 people interviewed was 29 (39) days, median: 15 days. The number of stays in hospital ranged from 0 to 6. The degree of disability was further categorised into severe (degree 1–3), moderate (degree 4–9), and mild (degree 10–15). The duration of convalescence at home (after discharge from the hospital and before returning to work) was about five times longer than that of the stay in hospital, and the variability of the convalescence was also greater (table 2). The total duration of morbidity was the sum of the stays in hospital and at home.

Both the number of times a patient was admitted to hospital and the severity of the disability (but not age) were important determinants in the multiple linear regression

Table 2 Duration of morbidity (in hospital or at home) among disabled workers (stratified by the severity of the disability)

Degree of disability	Workers n		Duration of Morbidity	Duration of stay in hospital	Duration of rest at home
1–2*	2	Mean (SD)	9680	190 (88)	9490
		Range	7428–11932	128–252	7300–11 680
3–6	3	Mean (SD)	250 (142)	52 (18)	198 (156)
		Range	90–360	35–71	19–309
		Median	300	53	265
7–9	16	Mean (SD)	209 (174)	35 (29)	174 (157)
		Range	18–565	6–112	5–565
		Median	165	25	133
10–12	27	Mean (SD)	58 (75)	11 (10)	47 (78)
		Range	0–360	0–31	0–360
		Median	30	10	19
13–15	29	Mean (SD)	93 (152)	12 (16)	81 (141)
		Range	7–767	0–82	0–685
		Median	40	7	26

*Two workers who had been bedridden for two years after their injury were assumed to be unable to work until the retirement age of 65.

analysis of the duration of the stay in hospital. Except for the two most severely injured workers (degree of disability 1–2 on table 2, namely, confined to bed) the 75 workers we visited had an average duration of convalescence at home of 111 (146) days, median: 45 days. Results of the multiple regression analysis of convalescence at home and durations of morbidity of these 75 workers showed that these two dependent variables shared the same determinants—that is, the age of the worker and the severity of the injury (table 3).

In exploring each person's future loss of productivity, we calculated the decrease in income after the documentation of permanent disability. The decrease in monthly income was stratified and analysed by the Mantel-Haenszel χ^2 test for trends. Table 4 shows that there is a trend in the decrease of monthly income associated with a more severe injury ($P < 0.0001$), an injury that involved parts other than the hands ($P = 0.003$), or a lower educational level ($P = 0.04$). Also, an ordinal logistic registic regression analysis was performed to explore the determinants of the decrease in monthly income. The result showed that after adjustment for various factors, an increase in the severity of injury, a decrease in size of the factory, or an older age are independently associated with an increased OR of greater loss in monthly income (table 5).

With the proportion of decrease in monthly income as the dependent variable, a multiple linear regression model was constructed to explore the importance of the age of the worker and the severity of the injury. The proportion of decrease in monthly income for those over 45 years of age showed a dramatic increase (14·6%). Moreover, the severity of the injury sustained by the worker also significantly determined the magnitude of decrease in the person's monthly income (table 6). The total duration of morbidity due to occupational disability, inferred from the model, was about 660 000 person-days, or 1808 person-years, annually for the past six years. The average morbidity cost for each disabled

*Table 3 Models constructed from multiple linear regression to predict the duration of stay in hospital, rest at home, and total morbidity**

Dependent variable	Independent variables	Parameter estimate	P value	R^2
Duration of stay in hospital	Intercept	66·7	0·0001	0·66
	Degree of severity (1–15)	−5·8	0·0001	
	Number of stays in hospital	19·0	0·0001	
Duration of rest at home	Intercept	272·5	0·0050	0·35
	Degree of severity (1–15)	−28·6	0·0001	
	Age	4·4	0·0085	
Duration of morbidity	Intercept	392·6	0·0002	0·38
	Degree of severity (1–15)	−37·3	0·0001	
	Age	4·1	0·0160	

*Other independent variables, such as educational level ($P = 0.63$), the size of the factory judged by number of workers ($P = 0.92$), relation with the employer ($P = 0.67$) were not included in the model because they were not significant. The two workers with permanent disability were excluded from the model of the duration of rest at home and morbidity to downgrade their influence on the models.

Table 4 Decrease in monthly income stratified by demographic and other characteristics of the disabled workers

	Decrease in monthly income				
	<4999NT$	5000–9999NT$	10 000–24 999NT$	>25 000NT$	P value*
Sex M:F	45:14	4:4	5:1	4:0	0·664
Age:					
16–44	46	5	2	3	0·072
⩾45	13	3	4	1	
Education level:					
<High school	39	7	6	4	0·040
⩾High school	20	1	0	0	
Married	15	2	2	1	0·833
Unmarried	44	6	4	3	
Size of factory judged by number of workers:					
<29	41	4	6	2	0·894
⩾30	18	4	0	2	
Relative of the employer:					
No	35	6	6	3	0·070
Yes	24	2	0	1	
Injured part:					
Hands	54	5	4	2	0·003
Others	5	3	2	2	
Severity of the disability:					
Mild	48	4	3	1	<0·001
Moderate	11	3	3	1	
Severe	0	1	0	2	

*Mantel-Haenszel χ^2 test for trends.

Table 5 Adjusted ORs of different independent variables for loss of productivity calculated from an ordinal logistic regression analysis (the dependent variables are the four different levels of decrease in monthly income—1st row of table 4)

Independent variables	Adjusted OR (95% CI)	P value
Severity of injury:		
Mild	1·0	
Moderate	0·19 (0·70 to 0·054)	0·01
Severe	0·004 (0·10 to 0·0002)	<0·001
Size of factory (by number of workers):		
<29	0·16 (0·80 to 0·029)	0·03
⩾30	1·0	
Age:		
16–44	1·0	
⩾45	0·29 (0·94 to 0·086)	0·05
Relatives of the employer:		
No	0·27 (1·19 to 0·058)	0·08
Yes	1·0	
Education level:		
<High school	0·26 (2·38 to 0·028)	0·23
⩾High school	1·0	

Table 6 Proportion of decrease in monthly income predicted by the multiple regression model stratified by age and severity of the injury

Age (y)	Severity	Decrease in monthly income (%)
<44	Mild (10–15)	7·34
	Moderate (4–9)	24·73
	Severe (1–3)	87·37
⩾45	Mild (10–15)	21·93
	Moderate (4–9)	39·32
	Severe (1–3)	100·0

Table 7 Morbidity costs (in person-years) of occupational disabilities in Taiwan 1985-90, estimated by our models from tables 3 and 6

Calendar year	*Severity of injury*	*Victims (n)*	*Duration of morbidity (y)*	*Productivity loss (× 100 y)*	*Total morbidity cost (× 100 y)*	*Morbidity costs/ person (y)*
1985	Total	5358	186	206	224	4·2
	Severe (1–3)	156	220	24	26	16·5
	Moderate (4–9)	1042	790	70	78	7·4
	Mild (10–15)	4160	840	112	121	2·9
1986	Total	6002	1870	223	242	4·0
	Severe (1–3)	114	160	18	20	17·6
	Moderate (4–9)	955	670	70	77	8·1
	Mild (10–15)	4932	1030	135	145	2·9
1987	Total	6496	2140	244	265	4·1
	Severe (1–3)	167	240	24	26	15·7
	Moderate (4–9)	1078	770	77	85	7·8
	Mild (10–15)	5243	1120	143	154	2·9
1988	Total	6163	1980	227	247	4·0
	Severe (1–3)	123	180	20	21	17·4
	Moderate (4–9)	1003	710	73	81	8·0
	Mild (10–15)	5022	1100	134	145	2·9
1989	Total	5617	1760	206	223	4·0
	Severe (1–3)	118	170	19	21	17·9
	Moderate (4–9)	853	600	63	69	8·1
	Mild (10–15)	4634	990	123	133	2·9
1990	Total	4780	1520	177	192	4·0
	Severe (1–3)	101	140	19	20	20·2
	Moderate (4–9)	757	530	55	61	8·0
	Mild (10–15)	3910	850	102	110	2·8

worker was equal to a loss of 4·1 person-years. After stratifying the morbidity cost with the severity of the disability, we found that the average losses of working years for the mildly, moderately, and severely disabled workers were 2·9, 7·9, and 17·6 person-years, respectively. During the past six years the annual morbidity cost for all disabled workers ranged from 19 000 to 26 000 person-years (table 7).

Discussion

In the estimation of the morbidity cost of occupational disability, difficulties and limitations do exist and need to be assessed. We could only focus on the metropolitan Taipei area and the number of workers selected was also limited to 114 due to the amount of time and effort we were able to offer for home visits. Nevertheless, the metropolitan Taipei area includes a wide variety of industries that are also widespread throughout the country, and the random selection we used provided us with a representative sample as was shown by the lack of obvious difference between the demographic data of the workers in our group and workers in the rest of the nation.[3] Although about 30% of the workers were not interviewed, there was a significant difference in only the distribution of sex between those interviewed and those not interviewed. As sex was not found to be a main determinant in morbidity costs, we think that our results are acceptable.

The design of this study was retrospective, which was different from the four year follow up recommended by Baker *et al.*[9] In our country it usually takes a long time (an average of 10·1 months) to receive disability compensation and there was about a six to 12 month time lag between the compensation payment and our interviews. Moreover, workers generally settle their compensation only if their disabilities have stabilised to avoid any future medical costs. Thus, it is reasonable to assume that the severity of the disability will not change appreciably after our interviews.

There might be some doubt about the legitimacy of the use of the proportion of decrease in monthly income as an index to estimate the degree of loss of productivity. We think that this is a reasonable method of estimation in Taiwan or in other developing countries without a comprehensive system of workmen's compensation. A large proportion of employers in Taiwan do not take full responsibility for workers with occupational disabilities, and those who do not pay much attention to occupational safety and health are more likely to have victims of injury. Instead of being transferred to another job with a similar income, workers who are injured might receive a lower salary when their jobs change, or are even laid off because of the change in their working capability. The disability compensation provided by the Labor Insurance Bureau is often the only payment they receive. Therefore our index is a reasonable estimate because the loss of productivity of the disabled workers is usually reflected in their monthly income.

Our ordinal logistic regression analysis showed that the three most significant factors for the decrease in monthly income were: the severity of the injury, the size of the factory, and age (table 5). The severity of the injury and age were probably the most important factors, because both of them are also the main predictors of the duration of morbidity (table 3). Fortunately, the models we used to predict national loss also contained these two factors (tables 3 and 6), which probably made our estimation of national morbidity cost due to occupational disability relatively accurate.

Table 8 Comparison of costs (in person-years) due to occupational mortality and disability in Taiwan, 1985-90

Calendar year	*Mortality cost*	*Morbidity cost of disability*
1985	32 500	22 400
1986	32 500	24 200
1987	36 700	26 500
1988	43 100	24 700
1989	44 300	22 300
1990	43 800	19 200

Although we have tried to obtain more information from the Labor Insurance Bureau, it does not regularly collect data on the size of the factory. Failure to control for the determinants other than the severity of the injury and age, as well as the small number of subjects interviewed, might limit the generality of our conclusions. We think that our results of morbidity cost are unbiased but have a wide confidence interval (CI), and thus recommend a larger sample for future studies.

We have computed the working years of potential life lost (WYPLL) as an alternative way to estimate the indirect costs of occupational mortalities in our previous article.[1] We found that the WYPLL of occupational mortalities (in Taiwan) was about 38 800 person-years annually. In this study, we have estimated the WYPLL of occupational disability in Taiwan and obtained a figure of about 23 200 person-years annually. Thus the ratio of WYPLL between occupational mortality and disability was about 2:1 (table 8). The annual mortality cost showed a tendency to increase, a result that may be due to the large proportion of occupational fatalities[1] from traffic accidents and an increase in the frequency of major occupational accidents at construction sites. On the contrary, the annual morbidity cost of occupational disability decreased yearly. The decrease in the proportion of workers in manufacturing industries as well as the migration of hazardous industries to neighbouring developing countries might contribute to the result.

The morbidity costs that we have calculated should not be considered to be the only loss to the victims of occupational injuries simply because effects such as pain, grief, and family or social disruption cannot be measured in these terms.[9] Workers in developing countries like Taiwan still have extremely high risks in the working environment. Injured workers should be properly treated and receive enough compensation not only for their future but also the future of their family members. At the same time, a greater effort toward the prevention of occupational injuries must be implemented. The amount of disability compensation payment given to those who sustained injury was so limited that it only covered about one fifth the morbidity cost that we computed.[16] We recommend that our people, government, and employers make a joint effort to establish a more reasonable compensation payment.

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