Short Communication

Years of Potential Life Lost as the Indicator of Premature Mortality in Occupational Medicine

Katsumi YOSHIDA*, Hiroki SUGIMORI*, Yoshihiro YAMADA*, Takashi IZUNO*,
Michiko MIYAKAWA**, Chieko TANAKA** and Eiko TAKAHASHI**

* Department of Public Health, St. Marianna University School of Medicine, Kawasaki
** Depart. of Hygiene & Preventive Medicine, Showa University School of Medicine, Tokyo
*** Medical and Health Care Center, Mitsukoshi Co. Ltd., Tokyo
** Department of Hygiene, Toho University School of Medicine, Tokyo

Abstract

Measurement of premature mortality is necessary to plan medical programs and to conduct effective medical activities. The purpose of this study was to compare the years of potential life lost (YPLL) with other mortality indices and to understand the usefulness and limitations of quantitative measurement for premature mortality. Data concerning death during employment were surveyed from 1979 to 1984. One thousand seven hundred twenty-five deaths were observed in 1,504,462 person-years in the study population. Proportionate mortality ratios indicated medical problems concerning malignant neoplasms and heart disease, but they could not identify the problems of suicide and traffic accidents occurring in the relatively younger group. YPLL by a constant end point at 60 years of age could rank these causes next below the major leading causes of death. Thus, YPLL might be a useful indicator of the problems concerning premature mortality in occupational medicine.

Key words: Years of Potential Life Lost (YPLL), Premature mortality, Occupational medicine, Healthy worker effect, Age-adjusted mortality rate

Introduction

A reduction in premature mortality is a central goal of occupational health practice [1]. Therefore, it is necessary to quantify premature mortality in the occupational field to establish medical policy and evaluate medical actions taken in occupational medicine.

Some statistics such as age-adjusted mortality rates have been widely used as health indicators [2]. However, these indicators may fail to adequately reflect premature mortality in younger groups, because these are dominated by the underlying disease process of the elderly [3].

Years of potential life lost (YPLL) [4] or working years lost [5] are both recognized as approaches to quantitatively measuring premature mortality.

The purpose of this study is to compare YPLL with other ordinary mortality indices and to evaluate the usefulness and the limitations of YPLL as an occupational medical indicator.

Subjects and Method

This survey was conducted in a securities-related company from 1979 to 1984. The death cases were collected for persons under employment and data regarding age and the cause of death were gathered on the basis of death certificates. The number of male death cases was 1,725 during the observation period. The cause of death was re-coded in accordance with the International Classification of Disease modified 9th version. Sixty-nine cases were excluded from the following analysis because cause of death could not be confirmed.

The number of person-years and the death cases by age are shown in Table 1. The distribution of age ranged from 18 to 60 years among the observed subjects.

The causes of death were classified into the following 9 groups: malignant neoplasms (ICD 9; 140-208), heart disease (ICD 9; 393-398, 401-405, 410-429), cerebrovascular disease
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Table 1  Number of subjects and death cases by age during the observation period.

<table>
<thead>
<tr>
<th>Age</th>
<th>Person-years</th>
<th>Death cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-19</td>
<td>36,997</td>
<td>8 (1)</td>
</tr>
<tr>
<td>20-24</td>
<td>190,880</td>
<td>57 (3)</td>
</tr>
<tr>
<td>25-29</td>
<td>293,348</td>
<td>103 (7)</td>
</tr>
<tr>
<td>30-34</td>
<td>310,562</td>
<td>143 (11)</td>
</tr>
<tr>
<td>35-39</td>
<td>218,579</td>
<td>152 (6)</td>
</tr>
<tr>
<td>40-44</td>
<td>128,350</td>
<td>125 (7)</td>
</tr>
<tr>
<td>45-49</td>
<td>97,532</td>
<td>197 (8)</td>
</tr>
<tr>
<td>50-54</td>
<td>148,696</td>
<td>513 (17)</td>
</tr>
<tr>
<td>55-59</td>
<td>79,518</td>
<td>427 (9)</td>
</tr>
<tr>
<td>Total</td>
<td>1,504,462</td>
<td>1,725 (69)</td>
</tr>
</tbody>
</table>

Parentheses indicate the cases whose cause of death was not certified.

(YPLL 91 in...330, 1981 estimated by the Statistics Bureau, Management and Coordination Agency. The rate was expressed per 100,000 subjects. The standardized mortality ratio (SMR) and 95% confidence interval were calculated based on direct standardization. The reference population was based on the Japanese population in 1981 estimated by the Statistics Bureau, Management and Coordination Agency. The rate was expressed per 100,000 subjects. The standardized mortality ratio (SMR) and 95% confidence interval were calculated based on direct standardization of age. The reference age-specific mortality ratio was based on the Vital Statistics in 1981 from the Statistics and Information Department, Ministry of Health and Welfare, Japan. The confidence interval of the SMR was based on Ederer’s method. The proportionate mortality ratio (PMR) was a ratio of cause-specific SMR to the all causes SMR. SMR is considered to provide information on a study group’s overall dying, but PMR is considered to be a tool for estimating cause-specific risks.

Two common weighting systems for YPLL are the remaining life expectancy (RLE) and the constant end point (CEP) methods. In the YPLL based on the CEP method, YPLL was tabulated by subtracting the age of death from the defined end point life. In this study, two endpoints, 60 and 65 years of age, were used. The life expectancy at a specified age was based on Vital Statistics in 1981 from the Statistics and Information Department, Ministry of Health and Welfare, Japan. The YPLL was expressed as the summation of years of each cause.

Results

The differently weighted YPLLs and age-adjusted mortality rates are shown in Table 2. This table consists of the following statistics: observed death cases, SMR and 95% confidence interval, PMR, direct age-adjusted rate, YPLL weighted by RLE, and YPLL weighted by CEP at 60 y.o. and 65 y.o.

According to the age-specific mortality rates, the leading cause of death was malignant neoplasms. Heart disease, cerebrovascular disease, and digestive tract and liver disease followed malignant neoplasms.

All SMRs were less than 1.0 and significantly lower than for the reference population. PMRs for malignant neoplasms and heart disease were over 1.0, but PMRs for other causes were under 1.0. The YPLL weighted by CEP at 60 y.o. and 65 y.o. and YPLL by weighted RLE were 22,528 and 30,808 and 50,280.53, respectively.

Table 3 shows the mean age at death and three YPLLs. Mean ages at death for suicide, unintentional injuries, and traffic accidents were significantly younger than those of other causes of death. Mean YPLLs for suicide, unintentional injuries, and traffic accidents were significantly higher than those of other causes of death as determined by the analysis of variance.

Figure 1 indicates the proportion distribution of the causes of death. This figure presents mortality rates. Using the age-adjusted mortality rates, malignant neoplasms represented 43.7% of the total mortality rate, followed by heart disease (16.9%), cerebrovascular disease (12.6%), digestive tract and liver disease (8.0%), suicide (6.9%) and traffic accidents (5.4%). Using the YPLL by CEP at 60 y.o., the first and second leading causes were similar to those in the age-adjusted mortality rates. In contrast, they were followed by suicide (12.4%), traffic accidents (11.8%), and cerebrovascular disease (10.3%).

Figure 2 indicates the proportion distribution of the caus-
Table 3 Mean age at death and YPLL by cause of death.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Age at death</th>
<th>RLE(^2)</th>
<th>YPLL(^1)</th>
<th>CEP(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>60 y.o.</td>
<td>65 y.o.</td>
<td></td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>48.8 ± 8.4</td>
<td>28.1 ± 7.6</td>
<td>11.2 ± 8.4</td>
<td>16.2 ± 8.4</td>
</tr>
<tr>
<td>Heart disease</td>
<td>47.1 ± 10.3</td>
<td>29.8 ± 9.4</td>
<td>12.9 ± 10.3</td>
<td>17.9 ± 10.3</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>48.7 ± 8.0</td>
<td>28.2 ± 7.1</td>
<td>11.3 ± 8.0</td>
<td>16.3 ± 8.0</td>
</tr>
<tr>
<td>Pneumonia and bronchitis</td>
<td>50.4 ± 8.3</td>
<td>26.8 ± 7.4</td>
<td>9.6 ± 8.3</td>
<td>14.6 ± 8.3</td>
</tr>
<tr>
<td>Digestive tract and liver disease</td>
<td>49.7 ± 7.8</td>
<td>27.4 ± 7.0</td>
<td>10.4 ± 7.8</td>
<td>15.4 ± 7.8</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>49.4 ± 9.0</td>
<td>27.7 ± 8.2</td>
<td>10.7 ± 9.0</td>
<td>15.7 ± 9.0</td>
</tr>
<tr>
<td>Suicide</td>
<td>38.0 ± 10.5(^a)</td>
<td>38.0 ± 9.7(^a)</td>
<td>22.0 ± 10.5(^a)</td>
<td>27.0 ± 10.5(^a)</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>37.4 ± 10.9(^a)</td>
<td>38.6 ± 10.1(^a)</td>
<td>22.6 ± 10.9(^a)</td>
<td>27.6 ± 10.9(^a)</td>
</tr>
<tr>
<td>Traffic accidents</td>
<td>34.5 ± 11.2(^a)</td>
<td>41.3 ± 10.4(^a)</td>
<td>25.5 ± 11.2(^a)</td>
<td>30.5 ± 11.2(^a)</td>
</tr>
<tr>
<td>Total</td>
<td>46.5 ± 10.3</td>
<td>30.4 ± 9.3</td>
<td>13.6 ± 10.3</td>
<td>18.6 ± 10.3</td>
</tr>
</tbody>
</table>

Figures indicate mean ±S.D. (years).
1: years of potential life lost
2: remaining life expectancy method
3: constant end point method
\(^a\): Mean ages at death for suicide, unintentional injuries, and traffic accidents were significantly younger than those for other causes of death based on analysis of variance.
\(^a^5\): Mean YPLLs for suicide, unintentional injuries, and traffic accidents were significantly higher than those for other causes of death based on analysis of variance.

Figure 1 Proportions of causes of death by direct age-adjusted rate and YPLL at 60.

Discussion

Reduction of premature mortality during employment has been one of the central goals of occupational medicine\(^5\). For effective medical activities, the status of premature mortality should be evaluated quantitatively. Direct and indirect age-adjusted mortality rates have been used as mortality indices to elucidate the medical problems in occupational medicine\(^5\).

However, Gaffey\(^1\) pointed out that SMR did not explicitly take into account the age at which the observed death occurred, only how many deaths there were. Yerushalmy\(^10\) pointed out that age-adjusted mortality rates put relatively heavy emphasis and penalties on minor proportionate changes at older ages.

The limitations associated with age-adjusted mortality data have led to the development of alternative methods to summarize mortality experience of younger persons\(^9\). YPLL has been available as an indicator of premature mortality. Romeder et al.\(^13\) reported that the concept of potential years of life lost originated with the primary object of comparing the relative importance of...
YPLL is designed to give a broad view of the relative importance of major causes of premature mortality. This index is useful for health planners who intend to define properties and programs for prevention of premature mortality. However, there are few statistical methods to compare the YPLLs of different populations with different distributions. The age-adjusted rate of YPLL based on direct standardization is one of the methods used to compare two or more different populations. Wise et al. reported that little was gained from the standardization of YPLL for monitoring year-to-year trends in a relatively stable population.

For health planning concerning early preventive medical activity from premature mortality, other dimensions such as morbidity and disability should be taken into account. Some diseases such as diabetes mellitus, which plays an important role in the incidence of chronic diseases, may fail to be recognized as a cause of death.

In summary, YPLL is a simple statistical method that can be used to identify the relative importance of premature mortality in occupational medicine.

Acknowledgments

We wish to thank former Professor Haruo Kondo of Keio University for his suggestions and encouragement during this study.

This paper was presented in part at the 62nd Annual Meeting of Japan Association of Industrial Health, Aomori, Japan in 1989.

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(Received Jun. 4, 1996/Accepted Dec. 25, 1996)