

Death due to Overwork (*Karoshi*)

Causation, health service, and life expectancy of Japanese males

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Abstract: As a member in the Expert Study Committee of the Ministry of Health, Labour and Welfare of Japan (MHLW), which conducted a large-scale review of literatures as well as medical evaluations, the author (Araki), together with his co-author, summarized the rulings of the Supreme Court on *karoshi* (death due to overwork), the statutory revision of the standard recognizing labour accidents, the effects of overwork on the onset of brain and heart diseases, and a comprehensive industrial health service that prevents *karoshi*. We suggested that the mortality rate and life expectancy of Japanese males can be improved by such preventive measures as well as by promoting pathophysiological, clinical and socio-medical studies.

Key words: *Karoshi*; Overwork; Brain and heart diseases; Life expectancy; Industrial health service; Ministry of Health, Labour and Welfare; Japan

Introduction: Life Expectancy of Japanese Males and Females

The average life expectancy of the Japanese, especially for females has been higher than any other nation for many years. In 2003, the life expectancy for Japanese females reached a record high of 85.3 years.¹⁾ The life expectancy for males, however, was only 78.4 years for the

same year. While Japan still ranked as one of the countries with a high average life expectancy for males along with Iceland and Sweden, it was certainly not high enough to claim that Japanese males have a significantly longer life expectancy than other nations.¹⁾

This relatively short life expectancy of Japanese males compared to Japanese females, when viewed on an international scale, may be

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attributed to a difference in the effects of occupational and social life factors on males and females. In particular, it is possible that the gender difference in the impact of risk factors is greater in Japan than in Western countries. This is compatible with the results from the studies conducted by the author for the entire Japanese population, and they have been summarized as follows.

- (1) Social life factors such as living in rural areas (a few causes of death are attributed to urban living), a low income (and unemployment), and elderly or younger age distribution of the population are major risk factors affecting life expectancy,^{2,3)} all-causes mortality (age-adjusted death rate),⁴⁾ infant mortality rate,⁵⁾ and death rate from lifestyle-related diseases such as cerebrovascular disease,^{4,6)} ischemic heart disease^{4,6)} and cancer.^{4,7)} These factors are also major risk factors for marriage⁸⁾ and birth.⁸⁾
- (2) The influence of these risk factors on the average life expectancy^{2,3)} and all-causes mortality⁴⁾ for males was greater than females.
- (3) The effects of such factors were also evident for occupation-specific mortality rates among males.⁹⁾

The "Expert Study Committee on Standard Recognizing Brain and Heart Diseases" (hereafter referred to as "Expert Committee")¹⁰⁾ of the Ministry of Health, Labour and Welfare (MHLW) was organized in November 2000 to revise the standard recognizing labour accidents that cause death by brain and heart diseases stemming from overwork (commonly referred to as *karoshi*). In this paper, the author, as the committee member representing the epidemiological and public health disciplines, introduces the conclusions that were reached by the Expert Committee concerning the effect of overwork on the onset of brain and heart diseases, the prevention of *karoshi*, and the comprehensive industrial health service. The effectiveness of the preventive measures that are expected to improve the mor-

tality rate and life expectancy of the Japanese is also discussed. It is notable that almost all deaths induced by brain and heart diseases, which have been recognized as labour accidents in recent years, have occurred in males.¹⁰⁾

Supreme Court's Ruling and Statutory Revision

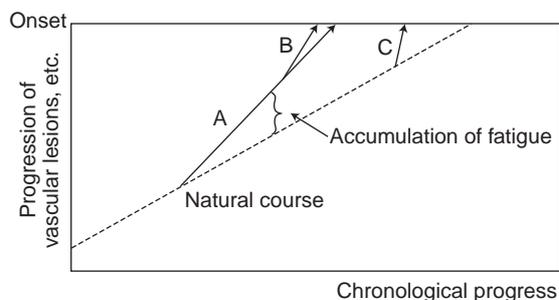
In July 2000, the Supreme Court ruled on two male cases demanding compensation for labour accidents.¹⁰⁾ The cases were related to a 54-year-old driver assigned to a branch manager, who developed a subarachnoid hemorrhage, and a 51-year-old driver of a large tour bus who developed hypertensive brain hemorrhage. The verdict passed in the former case was that a cerebral aneurysm was exacerbated by chronic fatigue stemming from long operating hours and continuous excessive stress. For the latter case, the verdict reached was that repeated increases in blood pressure due to driving and exposure to cold had weakened the driver's blood vessels. It was concluded that these conditions led to the development of the said diseases.

Four months after these two legal rulings were delivered by the Supreme Court, MHLW established the Expert Committee mentioned above, which conducted a large-scale review of publications and medical evaluations concerning the relationship between accumulated fatigue due to overwork and the development of brain and heart diseases; and it later compiled a report on its findings in November 2001.¹⁰⁾ Based on this report, the standard recognizing brain and heart diseases stemming from labour accidents was revised on the following day.¹¹⁾ Furthermore, the "Comprehensive Program for the Prevention of Health Impairment Due to Overwork" was established in February 2002, and the Director-General of the MHLW Labour Standards Bureau notified the Labour Bureaus in each prefecture about the Comprehensive Program.¹²⁾

Table 1 Causal Relationship between Overwork and the Onset of Brain and Heart Diseases: Conclusions of the Expert Study Committee on Standard Recognizing Brain and Heart Diseases, Ministry of Health, Labour and Welfare, Japan

1. The work, which is obviously an excessive amount, conducted in the period close to the onset of brain or heart disease, has been proven to be a possible direct cause to the onset of the said disease according to current medical knowledge. Therefore, the present accreditation standard introduced based on this idea shall be judged to be valid.
2. Accumulated chronic fatigue may impact the onset of brain and heart disease. Hence an accumulation of chronic fatigue, not limited to periods close to the onset of brain and heart diseases but also periods prior to that should be considered as an obvious work overload.
3. Assessing the extent of work overload shall be specifically and objectively based on an examination of work conditions six months prior to the onset of the disease, and the extent shall be assessed from the perspective of whether the accumulation of fatigue at the time of the onset was at a level that significantly deteriorates vascular lesions and such beyond its natural course, leading to an onset of brain and heart diseases.
4. Specifically, it is appropriate to comprehensively assess the effects of various factors including working hours, irregularities of labour, work restrictions, shift work system and work environment, as well as the factors of mental strain originating from work.
5. Focusing on working hours, i.e., the most important factor in accumulation of fatigue, if a worker had (1) consecutively engaged in long working hours which is recognized to be of an especially significant length (basically more than 100 hours of overtime) during one month prior to the onset of the disease, or (2) consecutively engaged in long working hours (basically more than 80 hours of overtime per month) which is recognized to be of a significant length during two or six months prior to the onset of the disease, then the work shall be judged to be strongly related to the onset.
6. When basically more than 45 hours of overtime per month is not evident during one or six months prior to the onset, the relationship between work and the onset is judged to be weak. The relationship between work and the onset is judged to be stronger with the greater number of overtime working hours basically exceeding 45 hours per month.
7. Hypertension, alcohol consumption, and smoking are some risk factors that could trigger the onset of brain and heart diseases. An individual with multiple risk factors is more prone to develop said diseases. Therefore, the state of worker's health, the extent of pre-existing diseases, and the overload of work must be fully studied when determining comprehensively the relationship between these factors and the brain or heart disease developed in the worker.

(From the MHLW Expert Study Committee Report on Standard for Recognition of Brain and Heart Diseases¹⁰⁾)



- A. Significant deterioration of vascular lesions, etc. due to accumulated fatigue related to work
- B. Induction of the onset of disease due to acute workload
- C. Onset of disease due to acute work overload

Fig 1 Progression of vascular lesions etc. due to overwork and onset of brain and heart diseases

(From the MHLW Expert Study Committee Report on Standard for Recognition of Brain and Heart Diseases,¹⁰⁾ partly revised)

Effect of Overwork on the Onset of Brain and Heart Diseases

Table 1 shows the conclusions of the MHLW's

Expert Committee on the causal relationship between overwork and the onset of brain and heart diseases.¹⁰⁾ According to the former Standards on Recognition of Labour Accidents (Labour Standards Bureau Notifications No. 38 issued in February 1995 and No.30 issued in January 1996), only excessive work during very short periods before the onset of cerebrovascular disease, ischemic heart disease and arrhythmias, i.e., between the previous day and the time immediately before the disease onset, or within a week before the onset, was accepted as a direct cause. Overwork prior to that period was not legally accepted as a direct cause, but it was only taken into account in making general judgments.¹⁰⁾

In contrast, based on the results of the epidemiological research conducted later, the Expert Committee reached the conclusion this time that overwork carried out over a long period of time from one to six months prior to

Table 2 Summary of Epidemiological Research Papers on the Causal Relationship between Long Working Hours and Onset of Brain and Heart Diseases

| Average working hours or average overtime hours | Observation period | Study design and results | | | | | Authors |
|---|-------------------------------------|--------------------------------|---|--|---|--------------------------|---|
| | | Diseases | Causes studied | Study method | Results | Statistical significance | |
| Work for 10 hours or more per day including lunch break | 3 years | Hypertension | Working hours, lifestyle | Follow-up study | Decreased hazard ratio (0.54) compared to work for less than 10 hours per day ¹⁾ | Yes | N. Nakanishi <i>et al.</i> (1999), in Japanese |
| Work for 10.9 hours per day or for 277 hours per month | 10 years prior to onset of disease | Myocardial infarction | Lifestyle | Case-control study | Unhealthy life style compared to control group of 9 working hours per day or 221 working hours per month | Yes | K. Shido (1995), in Japanese |
| Work above 11 hours per day | One month prior to onset of disease | Acute myocardial infarction | Working hours, risk factors, height, weight, etc. | Case-control study | Increased odds ratio (2.44) compared to work for 7–9 hours per day | Yes | S. Sokejima <i>et al.</i> (1998) |
| Portal to portal hours of 11 hours or more per day | 2.8 years | Brain and heart diseases | Working situation, lifestyle | Follow-up study | Hazard ratio (i.e., relative risk for brain and heart diseases corrected for other factors) is 2.7 | Yes | S. Uchiyama <i>et al.</i> (1992), in Japanese |
| Office and one-way commuting hours of 61.3 hours or more per week | | | Working hours, subjective symptoms | Comparison between workers with long and short working hours | Increased systolic blood pressure in workers aged 50–59 years compared to those with short working hours (56.5 hours) | Yes | K. Iwasaki <i>et al.</i> (1998) |
| Work for 60 hours or more per week | | Juvenile myocardial infarction | Prolonged emotional stress | Patient study | 46% of patients worked 60 hours or more for a long period before onset of symptoms | | H. Russek <i>et al.</i> (1958) |
| Work for 60 hours or more per week | 1.5 years | Hypertension | Occupational stress | Nested case-control study | Increased odds ratio (2.2) for patients with new onset of hypertension Increased odds ratio (2.0) for patients with new administration of antihypertensives | Yes Yes | T. Uehata <i>et al.</i> (1994), in Japanese |
| Overtime work of 50 hours or more per month | 1.5 years | Hypertension | Occupational stress | Nested case-control study | Increased odds ratio (1.5) for patients with new onset of hypertension Increased odds ratio (3.2) for patients with new administration of anti-hypertensives | No Yes | |
| Overtime work of 60 hours or more per month | | | 24-hour average blood pressure | Case-control study | Increased blood pressure compared to the group with overtime work for 30 hours or less per month | Yes | T. Hayashi <i>et al.</i> (1996) |
| Overtime work for 96 hours per month | | | 24-hour average blood pressure | Case study | Increased blood pressure and shortened sleeping hours compared to the months of overtime work for 43 hours | Yes | |
| Overtime work for 100 hours per month | | | Subjective symptoms of fatigue | Questionnaire study | Complaint of lack of sleep in 50% or more | | Occupational Fatigue Handbook (1995), in Japanese |
| | 6 months | Acute myocardial infarction | Working situation, lifestyle | Case-control study | No difference in working hours, overtime working hours, and holidays from healthy controls | No | H. Yoshida <i>et al.</i> (1993), in Japanese |

¹⁾Reduction in the occurrence of hypertension due to long working hours is explained as a result of decreased obesity caused by increased energy consumption. (From the MHLW Expert Study Committee Report on Standard for Recognition of Brain and Heart Diseases,¹⁰⁾ partly revised)

Table 3 Onset of Brain and Heart Diseases and Preventive Measures To Be Taken by Employers for Overtime Work

| Category | Hours of overtime work ^{*1} | Relation of hours of overtime work to onset of brain and heart diseases | Preventive measures to be taken by employers |
|----------|--|---|---|
| I | Basically 45 hours or less per month for the past one or six months | Weak | None |
| II | Basically 45 to 100 hours for the past one month or 45 to 80 hours per month for the past 2 or 6 months, prior to onset of disease | Becomes gradually stronger as overtime working hours increase | Employers shall provide industrial physicians or physicians qualified to be selected as industrial physicians such as physicians registered with local industrial health centers in the case of workplaces without any obligation to select industrial physicians (hereinafter, "Industrial physicians etc.") with information about the work environment, working hours, number and hours of night work, past medical examination results, etc. concerning workers who are involved in the work. Employers shall be advised and instructed by industrial physicians etc. concerning health management at the workplaces (Measure A). |
| III | Basically more than 100 hours for one month or more than 80 hours for the past 2 or 6 months prior to onset of diseases | Strong | In addition to Measure A mentioned above, employers shall provide workers involved in the concerned labour with health guidance through meetings with the industrial physicians etc. When the industrial physicians etc. recognize such as necessary, the workers shall have medical examinations which the industrial physicians etc. judge to be necessary. The opinion of the industrial physicians etc. shall be sought concerning the results of medical examinations and the necessary measures to be taken by employers (Measure B). |

^{*1}Overtime work is defined as more than 40 hours of work per week. (Compiled by Iwasaki and Araki based on the Notification from the Director-General of MHLW's Labour Standards Bureau in February 2002¹²⁾)

the onset of the diseases would be deemed as the principal cause of disease onset.¹⁰⁾ Furthermore, according to the new Standard, long working hours (overtime work hours per month) were introduced as an indication of overwork and accumulated fatigue, enabling clear and prompt judgment of the extent of overwork when certifying labour accidents. Figure 1 shows the progression of vascular lesions etc. and the onset of brain and heart diseases due to overwork; it was illustrated by the Expert Committee.¹⁰⁾

Table 2 summarizes the content of the epidemiological research papers concerning the relationship between long working hours and the onset of brain and heart diseases, on which the conclusions in the Expert Committee were based (see Table 1).¹⁰⁾ In addition, the original

English papers written by the present authors concerning the effects of work stress on ischemic heart disease,^{13,14)} hypertension,¹⁵⁾ and the immune system¹⁶⁾ are included in the references at the end of this paper.

Prevention of *Karoshi* and Its Effect on Life Expectancy

1. Comprehensive industrial health service

A comprehensive industrial health program to prevent *karoshi* was issued in the form of a notification from the Director-General of the Labour Standards Bureau, MHLW.¹²⁾ Based on this notification, Table 3 shows the relationship between overtime work hours and the onset of brain and heart diseases as well as preventive measures which should be taken by employers.

Table 4 Comprehensive Industrial Health Service to Prevent *Karoshi*

| | |
|----------------------------------|---|
| Government | <ol style="list-style-type: none"> 1) Shorten working hours <ol style="list-style-type: none"> 1. Promote taking annual paid holidays 2. Promote a long holiday system 3. Reduce nonprescribed work 2) Publicize the national subsidy system for secondary health examinations and other occupational health services 3) Encourage night shift workers to undergo voluntary health examination 4) Strengthen preventive medical care and other health administration measures |
| Both labour unions and employers | <ol style="list-style-type: none"> 1) Shorten working hours 2) Comply with overtime work limitation standards 3) Conclude appropriate overtime work agreement 4) Comply with requirements about introducing an irregular working system, discretionary labour system, and flexible working hour system 5) Improve participation rate for medical examinations 6) Fully implement measures after medical examinations 7) Enhance medical care to maintain and promote worker's health 8) Create a comfortable work environment |
| Individual employees | <ol style="list-style-type: none"> 1) Recognize excessive fatigue and the need to take rests 2) Practise primary, secondary and tertiary prevention of lifestyle-related diseases |

(Compiled by Araki and Iwasaki based on the MHLW Expert Study Committee Report on Standard for Recognition of Brain and Heart Diseases¹⁰⁾)

In addition, Table 4 presents comprehensive industrial health measures to prevent *karoshi* that should be taken by respective government offices, employers, labour unions, and individual workers. These measures were compiled based on the Expert Committee report.¹⁰⁾

The source of the data, which served as the basis for developing the new standard on recognizing labour accidents, was limited primarily to past cases of labour accidents and epidemiological research papers. There were very few papers which clarified the mechanism or pathological changes that overwork (mental stress, irregular work, long working hours, etc.) exacerbated the blood vessel lesions in the brain and heart causing death. Consequently, as an industrial health measure conducted by the government, it is necessary to promote pathophysiological, clinical and socio-medical studies on the relationship between overwork and *karoshi*. These studies will define the effect of overwork on brain and heart diseases more clearly from qualitative and quantitative viewpoints; thus, a more accurate recognition stan-

dard can be established.

2. Effects of industrial health service on mortality rate and life expectancy

The benefits derived from measures to prevent *karoshi* are not simply limited to a reduced number of worker deaths caused by brain and heart diseases. Improving overwork conditions over an extended period of time will reduce risk factors for lifestyle-related diseases such as hypertension, obesity, alcohol consumption and smoking. As a result, the onset and progression of brain and heart diseases in the labour force, that comprises the majority of the whole population, will also be prevented. Furthermore, this would also contribute to an improvement in the mortality rate and life expectancy of Japanese as a whole. If the government, employers, and individual employees respectively strive to prevent *karoshi*, the onset of brain and heart diseases of employees would be prevented and *karoshi* would decrease. Moreover, the life expectancy of working Japanese males, who account for a greater portion

of the working population than females, is expected to be prolonged.

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