Biobehavioral Approach in Occupational, Environmental and Community Health: A Report Based on Fourteen-Year Studies

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Behavioral Medicine has been defined as the interdisciplinary field concerned with the development and integration of psychosocial, behavioral and biomedical knowledge relevant to health and illness, and application of this knowledge to prevention, etiology, diagnosis, treatment and rehabilitation (International Society of Behavioral Medicine, 1990). Behavioral Medicine is a relatively new field with the scope extending from the research efforts to understand fundamental biobehavioral mechanisms to clinical diagnosis, treatment, disease prevention and health promotion. In this report, our own past studies based on biobehavioral and epidemiological approach in occupational, environmental and community health were summarized. The topics were morbidity, mortality and longevity of Japanese population (i.e., peptic ulcer in factory workers, mortality of medical practitioners and of working and nonworking population, and longevity of total Japanese population), suicide mortality (seasonal and secular trends and social life factors), traffic accident (accident-prone drivers and social risk factors), mass psychogenic systemic illness, and work stress (technostress and sociobehavioral, physical and mental effects).

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Behavioral Sciences in Medicine have been integrated as Behavioral Medicine, which is defined by the International Society of Behavioral Medicine as the interdisciplinary field concerned with the development and integration of psychosocial, behavioral and biomedical knowledge relevant to health and illness, and the application of this knowledge to prevention, etiology, diagnosis, treatment and rehabilitation. Behavioral Medicine is a relatively new field with the scope extending from the research efforts to understand fundamental biobehavioral mechanisms to clinical diagnosis, treatment, disease prevention and health promotion. In the First Congress of the International Society of Behavioral Medicine in 1990, the following 18 symposia were organized: Eating behavior, Work stress, Pain management, Biobehavioral factors in coronary heart disease, Behavioral pediatrics, AIDS, Hypertension, Exercise, Cancer, Psychoneuroimmunology, Medication in elderly, Behavioral management of coronary heart disease, Cardiovascular reactivity and disease, Social support, Relapse prevention, Pain, Work site and community intervention, and Preparation for surgery in children. In this report, our own past studies on behavioral medicine and epidemiology are summarized. The specific topics are biobehavioral and epidemiological approach in occupational, environmental and community health.

MORBIDITY, MORTALITY AND LONGEVITY OF JAPANESE POPULATION

(1) Peptic Ulcer in Factory Workers

We estimated prevalence and incidence rates of peptic ulcer at a plastics processing factory in Tokyo, and possible etiological factors for peptic ulcer were examined by means of a case control investigation. The prevalence of active and inactive peptic ulcer was 23% in 209 male workers aged 31-60. Similarly, the incidence of active and inactive peptic ulcer during one year was 5% or more. The findings from a case control...
study suggested that smoking and family history were the major etiological factors; on the other hand, neither occupational nor emotional factors were significantly associated with peptic ulcer. The incidence and prevalence of peptic ulcer in male factory workers in Japan appeared to be higher than elsewhere.

(2) Mortality of Medical Practitioners, Working and Nonworking Populations and Total Japanese Population

To assess patterns of mortality in Japanese medical practitioners, we compared the mortality of male physicians in a Japanese prefecture with those of eight major working populations, the nonworking population, and the general population of all Japan and of the prefecture. Standardized mortality ratios (SMRs) were calculated. All-causes mortality in medical practitioners aged 25-64 years was significantly higher than that of administrative and managing workers (SMR=228); it was significantly lower than that of the nonworking population (SMR=23). Physicians were found to have higher cause-specific mortality for pneumonia and bronchitis and for ischemic heart disease than the total working population. These findings suggested that the previously reported low mortality of physicians reflects principally their high socioeconomic status; within the professional class, the mortality of medical practitioners compares unfavorably with that of other persons.

The effects of a wide variety of social life factors on the mortality of eight major working and nonworking male populations aged 25-54 years in 46 Japanese prefectures were analyzed by multiple regression analysis. The analysis was conducted twice at a five-year interval, i.e., in 1970 and 1975; during the period, Japanese economy changed from a long-lasted high economic growth to a serious economic crisis with the oil crisis of 1973 as a turning point. The mortality of managers and officials and of professional and technical workers in 46 prefectures was significantly lower than that of total working population in both 1970 and 1975 (Table 1); the mortality of these workers and of total working population was positively related to proportion of rural residence in the prefectures (Figure 1). This finding suggested that the distribution of these workers in urban areas led to their low mortality. On the other hand, the mortality of persons employed in farming, fishing and forestry, in personal and domestic service and in sales was significantly high; their mortality appeared to be positively related to rural residence. Rural residence was the key factor in the mortality of the male working population. No factor was significantly related to the mortality of the nonworking population despite the fact that its mortality was six to eight times as high as that of the total working population; the mortality of the nonworking population was independent of the social life factors affecting the working population.

The effects of a wide variety of social life factors on the mortality of total Japanese population in 46 prefectures were also analyzed by stepwise regression analysis twice at a five-year interval. Age-adjusted all-causes mortality and age-adjusted cause-specific mortality from 14 major causes of death were examined. The results indicated that rural residence was the key factor affecting the mortality of total male and female populations; low income, together with old and young age groups, was another important factor for the mortality of the male population. It appeared that the effect of urbanization on mortality rates is different between Japan and Western countries.

| Populations                        | Observed deaths | Expected deaths | SMR  |
|-----------------------------------|-----------------|-----------------|------|
| Professional and technical workers| 2,524           | 4,039           | 62.5*|
| Managers and officials            | 2,143           | 4,786           | 44.8*|
| Clerical and related workers      | 6,377           | 6,418           | 99.4 |
| Sales workers                     | 6,085           | 5,440           | 111.9*|
| Farmers, lumbermen and fishermen  | 10,705          | 8,340           | 128.4*|
| Workers in transport and communica| 3,525           | 3,481           | 101.3|
| Craftsmen, Production process     | 18,157          | 18,210          | 99.7 |
| and laborers                      |                 |                 |      |
| Service workers                   | 1,696           | 1,484           | 114.3*|
| Nonworking population             | 13,508          | 2,080           | 649.6*|
| General population *              | 67,127          | 55,699          | 120.5*|

*a Calculated on the basis of the mortality of the total working population of 46 prefectures.

* The total working and nonworking populations combined. * p<0.01.
(3) Longevity of Total Japanese Population

To clarify the relative importance of social life factors in longevity by age and sex, the effects of eight social life factors on life expectancy at birth and at ages 20, 40 and 65 years for males and females were analyzed in 46 Japanese prefectures. The analysis was conducted twice at five-year intervals during the period of rapid urbanization using stepwise regression analysis after classification of twenty-two variables by factor analysis. The results indicated that urban residence was the major factor for life expectancy at birth for males and females and at ages 20 and 40 years for males (Figure 2). On the other hand, proportions of old and young persons in the population were essential factors for life expectancy at age 40 years for females and at age 65 years for males and females. In addition, in males, proportions of old and young persons in the population also positively affected life expectancy at birth and at age 20 years; employment and high income factors positively affected life expectancy at birth and at ages 20 and 40. These findings also indicated a unique position of Japan in comparison with Western countries regarding social life factors for longevity.

The effects of urbanization, low income and rejuvenation of total Japanese population on life expectancy at birth and at 20, 40 and 65 years of age were also examined for the years 1980 and 1985. For males, urbanization was the major factor determining life expectancy at birth and at age 20 years, and low income was the key determinant of decreased life expectancy except at 65 years of age. For females, high income was the factor significantly decreasing life expectancy at 65 years of age in 1980, and rejuvenation of the population inversely influenced life expectancy except at birth in 1985.

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**Figure 1.** Relationships between rural residence factor (proportion of farmers, fishermen and forest workers) and age-adjusted mortality of total working and nonworking male populations aged 25-54 years in 46 prefectures.

**Figure 2.** Relationships between social life factor and life expectancy at birth and at age 40 years for males in 46 prefectures. The proportion of farmers, fishermen and forest workers represents a rural residence factor.
SUICIDE MORTALITY

(1) Seasonal and Secular Trends

Changes in male and female suicide death rates for 33 years following the end of World War II in Japan were analyzed. The age-adjusted suicide death rates for men and women decreased during periods of economic prosperity and then increased during the years preceding economic depression (i.e., the oil crisis in the late 1973); that for men also increased after economic depression. When examined by profile analysis, the seasonal variation was slightly but significantly different in the four time periods (1950-1955, 1955-1967, 1967-1974, and 1974-1982) in both sexes except between the last two periods. It was suggested that death by suicide and its seasonal variation in Japan were affected by changes in socioeconomic conditions.

To investigate unusual secular trends in suicide rate in Japan since the Second World War, the cause-specific mortality by sex and age during the period 1950-82 was analyzed. The results indicated that: (1) suicide death rates due to two causes, i.e., poisoning by solid and liquid substances and run over by train and other means, for young persons increased remarkably in the mid 1950s; and (2) the rates due to most causes for middle-aged men continued to increase during the period of economic depression following the oil crisis in 1973.

Seasonal variations in cause- and age-specific suicide rates in males and females were analyzed in Osaka, Japan, for the years 1974-83, using profile analysis. Significant cause differences were found in males: (1) the rate for poisoning by domestic, car-exhaust or other gases was high in winter and spring and low in summer and autumn; (2) the rate for hanging, strangulation and suffocation was low in winter; (3) the rate for a variety of violent methods (chemicals, firearms, drowning, etc.) was high in summer (Figure 3). Similarly, there were sex differences in the variation for causes (2) and (3) and for ages 40-54. No significant age difference was found in either sex. Seasonal differences in the ease of suicidal methods and sex- and season-specific psychosocial factors were thought to be the major determinant of the seasonal variation.

(2) Social Life Factors

To clarify the social life factors affecting suicide mortality in Japanese men and women, the relationship between a wide variety of social and demographic indicators and age-adjusted suicide mortality was assessed in 46 prefectures in Japan by

![Figure 3](image-url)

**Figure 3.** Monthly average cause-specific suicide rates and yearly average (---) over 10 years for all males. Causes: E953 (hanging, strangulation or suffocation, •), E951 & E952 (poisoning by domestic, car-exhaust or other gases, ○), E957 (jumping from high place, ▲), E958 (run over by train or other means, △), and E950, 954, 955 (other causes, ■). Significant difference from yearly average: * p<0.05, ** p<0.01 (paired-sample t-test).
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stepwise multiple regression analysis after classification of the indicators by factor analysis. The findings indicated that rural residence was the major factor for male mortality in both 1970 and 1975; over the interval between these years, a serious economic crisis (the oil crisis) took place, and the mortality significantly increased. In addition, in 1970 (a time of high economic growth), home help for the elderly (a possible indicator of social isolation in old people), depopulation by social mobility, and urban residence were positively associated with male mortality. In women, on the other hand, both the five-year increase in suicide mortality and the effects of the social life factors were less significant. These findings also indicated a unique position of Japan in comparison with Western countries regarding social risk factors for suicide.

The effects of social life factors on age-specific mortality by suicide in men were also assessed in 46 Japanese prefectures by stepwise regression analysis twice at five-year intervals, before and after the serious economic crisis. The following factors were significantly related to the mortality in the two years: (1) the proportion of old and young men in the population for young men; (2) low income for middle-aged men; and (3) rural residence for elderly men. The mortality significantly increased after the crisis in young and middle-aged men, while no significant alteration was observed in elderly men. It was suggested that young and middle-aged men are more sensitive to socioeconomic changes in society while elderly men are mainly affected by the factor of rural residence.

TRAFFIC ACCIDENT

(1) Accident-Prone Drivers

To evaluate the role of neurobehavioral factors in the etiology of recurrent automobile accidents, we administered the Revised Wechsler Adult Intelligence Scale (WAIS-R), the Eysenck Personality Questionnaire (EPQ), and choice and simple reaction time tests to 31 accident-prone automobile drivers in Hefei city in China. These drivers who had caused three or more traffic accidents during the years 1980-1984, were selected from records of 2,723 traffic accidents registered by Hefei Traffic Police Department during the years 1980-1984. The same tests were administered to an equal number of sex- and age-matched control drivers who had no reported involvement in automobile accidents. None of the subjects had suffered from any neuropsychiatric illness or head injury. Comparisons between the two groups indicated that for accident-prone drivers scores on picture completion and block design subtests of the WAIS-R were significantly lowered; scores for neurosis extrovert behavior and psychosis (EPQ) were significantly higher; and the number of errors in the choice reaction time test was significantly higher (Table 2). It was suggested that accident-prone drivers have lower psychological performance, poorer judgement and a higher tendency than safe drivers to be neurotic, extrovert and psychotic.

(2) Social Risk Factors

To clarify major social risk factors affecting the mortality from motor vehicle accident (MVA) in Japan, the effects of a wide variety of socioeconomic and demographic indicators

| Table 2. Differences in psychological performances between 31 accident-prone automobile drivers (cases) and same number of matched controls in China. |
|----------------|-----------------|-----------------|-----------------|
|                | Mean (range)    | Matched difference (mean±SD) |
|                | Cases           | Controls         |                  |
| WAIS-R (subtest scores): |                  |                  |                  |
| Picture completion | 8.0 (5-13)      | 9.7 (6-19)       | -1.7±3.5**       |
| Block design     | 9.1 (0-15)      | 10.3 (2-15)      | -1.2±3.7*        |
| IQ:              |                  |                  |                  |
| Performance      | 92.6 (77-112)   | 99.7 (63-126)    | -7.1±16.2*       |
| EPQ (Scores):    |                  |                  |                  |
| Psychotic        | 48.6 (30-65)    | 44.4 (30-70)     | 4.2±11.2*        |
| Extrovert        | 51.9 (30-75)    | 47.4 (30-65)     | 4.5±10.4*        |
| Neurotic         | 56.3 (35-70)    | 49.8 (35-75)     | 6.5±15.5*        |
| CRT (no. of errors): |                  |                  |                  |
| Visual           | 1.0 (0-2)       | 0.5 (0-2)        | 0.5±1.0**        |
| Visual-acoustic  | 1.5 (0-3)       | 0.7 (0-3)        | 0.8±1.2***       |

* p<0.05, ** p<0.01, *** p<0.001 (paired t-test). WAIS-R = Revised Wechsler Adult Intelligence Scale; EPQ = Eysenck Personality Questionnaire; CRT = Choice Reaction Time.
(20 variables) on age-specific and age-adjusted mortality rates from MVA were analyzed in 46 prefectures of Japan. The analysis was conducted twice at a five-year interval, i.e., in 1970 and 1975, by stepwise regression analysis after classification of the indicators by factor analysis. The major social risk factors identified in the two years were as follows: (1) rural residence for persons, especially males, of major driving age (15-54 years) and young male children (0-4 years); (2) population growth by social mobility for schoolboys aged 5-14 years; and (3) high income (and employment) for schoolgirls, and proportion of old population for middle-aged females. Age-adjusted male rate of mortality from MVA within 46 prefectures was significantly higher in rural than in urban areas in the two years.

**MASS PSYCHOGENIC SYSTEMIC ILLNESS**

To clarify the pathogenic mechanism of epidemics with acute systemic neurobehavioral illness associated with photochemical air pollution in Japan (Table 3), we examined our past records in sixteen junior high school children, and compared them with major epidemics that occurred in 1970-1972, during which time Japanese society faced a new and unusual type of air pollution ("Tokyo smog"). Dysfunction of alveolar-arterial gas exchange, together with respiratory alkalosis, was found in these children, who suffered from chest discomfort, ocular irritation, emotional distress, tetany, and unconsciousness. It was concluded that anxiety reaction, precipitated by the physical effects of photochemical oxidants and athletic performance, possibly led to many outbreaks of mass psychogenic systemic illness (hyperventilation syndrome) among school children.

**WORK STRESS**

(1) **Technostress**

To examine whether computer work and bioeducational factors (age and school career) have significant effects on work stress in computer engineers in Japan, we administered a stress questionnaire to 764 male computer engineers and 211 male office workers in a computer-manufacturing factory in a western suburb of Tokyo. Four scales of perceived psychological stress at work examined were work overload, poor human relationships at work, unsuitable job, and competition-dismissal anxiety. The results of the three-way analysis of variance, in which age (20-29, 30-39, and 40-49 years), school career (high school and university graduates), and computer work (computer engineers and office workers) were three variation factors,

| Date       | Air oxidant concentration (ppm) | Circumstances (city) | No. of cases | Principal symptoms and signs                  |
|------------|---------------------------------|----------------------|--------------|-----------------------------------------------|
| Jul 18, '70a| 0.26                            | Baseball, swimming etc (Tokyo) | 43           | Unconsciousness, rigidity of extremities, dyspnea, ocular irritation |
| Aug 8, '71 | 0.10                            | Swimming (Tokyo)      | 6            | Paresthesia in extremities                    |
| Aug 27, '71| 0.18                            | Baseball (Osaka)     | 11           | Paresthesia in extremities, dyspnea, sore throat, ocular irritation |
| Aug 27, '71| 0.18                            | Baseball (Osaka)     | 12           | Consciousness disturbance, paresthesia, ocular irritation, sore throat |
| Jun 1, '72 | (0.05)b                         | Athletic performance (Tokyo) | 16           | Consciousness disturbance, tetany, dyspnea, ocular irritation, respiratory alkalosis |
| Jul-Aug, '72| 0.11-0.21                       | Physical exercise (Tokyo) | 10           | Consciousness disturbance, convulsion, accoucheur's hand, ocular irritation, sore throat |

a Approximately 6,000 citizens in Tokyo voluntarily notified of their suspected illness.
b Measured at a 1.4-km-leeward monitoring station.
indicated that: (1) there were no significant differences in all scores of work stress between computer engineers and office workers; (2) scores for unsuitable job and poor human relationships at work were significantly higher in high school graduates than in university graduates; and (3) there were significant age differences in scores for three scales of work stress (the score for unsuitable job was higher in younger workers, and scores for competition-dismissal anxiety and work overload were higher in older workers). These findings suggested that computer work has no significant effect on perceived work stress in computer engineers; on the other hand, age and school career did have effects.

To investigate personality traits and psychiatric symptoms, we administered the Structured Clinical Interview for DSM-III-R Personality Questionnaire (SCID-II Screen), the Zung Self-Rating Depression Scale (SDS), and the 30-item version of the General Health Questionnaire (GHQ-30) to 781 male computer engineers and 214 male clerical workers in the same computer-manufacturing factory 21). Subjects, aged from 20 to 49 years, were divided into university and high school graduates. Among the university graduates, scores for schizotypal and avoidant personality traits were significantly higher in computer engineers than in clerical workers (the effect of age was controlled by analysis of covariance, Table 4). No significant correlation between personality traits and symptoms with duration of employment in the university-educated computer engineers, the greater prevalence of schizotypal and avoidant personality traits might be related to their process of self-selection of job rather than to computer-manufacturing work. In summary, these data suggested that computer engineering work does not cause abnormal personality traits or psychiatric symptoms.

(2) High Medical Consultation Rate

Medical consultation rates were compared between a group of lead workers (346 males) and two groups of non-lead workers (317 and 329 males) in a newspaper company in Tokyo, Japan, where a serious industrial dispute took place over health effects of lead three years before this study 22). The comparison was also made within the group of lead workers. Maximal blood lead concentrations (BPbs) ranged from 0.1 µmol/kg (2 µg/100 g) to 3.6 µmol/kg (74 µg/100 g) with an average of 1.3 µmol/kg (27 µg/100 g) in the past three years. Ages averaged 35 years in lead workers, and 34 and 30 years in non-lead workers, the ranges being 19-55 years in all. The consultation rate of lead workers (87.0) was significantly higher than that of both the non-lead workers (72.6 and 76.9, respectively), when the number of workers who consulted physicians or dentists once or more for a year per 100 workers (general consultation rate) was compared. Disease-specific consultation rates were also higher in lead workers for seven categories of diseases and injuries such as hypertensive disease and peptic ulcers. When lead workers were divided into three groups by BPb or erythrocytes δ-aminolevulinic acid dehydratase (ALAD) levels, however, no significantly high rate was found in the higher BPb groups nor lower ALAD groups in terms of general and disease-specific consultation rates. It was concluded that the industrial dispute might have been a major cause of the high consultation rate of lead workers.

(3) Alcoholism

To examine the relationship of sociodemographic characteristics to alcohol-related problems in Japanese employees, a questionnaire survey was conducted of a total of 2,581 employees of the computer factory in the northern suburb of Tokyo 23). The questionnaires included items on gender, age, marital status, social class (i.e., education, family income and occupation), alcohol consumption, and the Kurihama Alcoholism Screening Test (KAST). Data from 1,098 male and 265 female current drinkers aged 20 years or older were analyzed; 15% and 6% of the male and female subjects, respectively, were classified as having alcohol-related problems on the basis of the KAST score (13% and 4% of the entire study population, respectively). Multiple logistic regression analysis indicated that alcohol-related problems were more prevalent in the less educated, managers and those who had a high alcohol consumption. The results suggested that
education and occupation are important factors for alcohol-related problems in Japanese employees.

To examine the effects of work stressors on alcohol use and drinking problems as well as a model of stress-induced drinking in Japanese male and female workers, a total of 2,581 employees of a computer factory were surveyed using mailed questionnaires. Five psychosocial work stressors, overtime, rotating shift, frequency of drinking, amount of alcohol consumed per drinking occasion, and drinking problems, and depressive symptoms were assessed. The hierarchical linear and logistic regression analyses were conducted in 1,043 male and 255 female current drinkers aged 20 years or older. The results suggested that overtime and lack of intrinsic work rewards are main factors for heavy and problem drinking in Japanese male workers and that ambiguity about job future is a factor for heavy drinking in Japanese female workers (Table 5). However, the model of stress-induced drinking was supported neither in males nor in females, suggesting that the effects of these work stressors on heavy and problem drinking are not mediated by depressive symptoms.

### Table 5. Hierarchical multiple linear regression analysis predicting amount of alcohol consumed per occasion from work stressors in male and female drinkers (standardized regression coefficient).

| Variables                        | Males (N=1015) | Females (N=182) |
|----------------------------------|----------------|-----------------|
| Objective work stressors         |                |                 |
| Overtime                         | 0.082*         | 0.023           |
| Rotating shift                   | -0.025         | -               |
| Psychosocial work stressors      |                |                 |
| Job overload                     | -0.042         | -0.018          |
| Lack of intrinsic rewards        | 0.106**        | 0.079           |
| Lack of control over pace        | -0.055         | -0.150          |
| Job future ambiguity             | 0.036          | 0.204*          |
| Lack of social support           | -0.019         | 0.031           |
| R²                               | 0.124          | 0.161           |

Note: Parentheses indicate total number of subjects; R², squared multiple regression coefficient. * p<0.05, ** p<0.01.

(4) Depression

To examine the relationship between psychosocial job stress and occurrence of major depression, a prospective cohort study was conducted of 3,066 male workers in two factories of an electrical company in a northern suburb of Tokyo, Japan. The study was followed up for three years; 15 workers newly developed major depression. The effects of six job stress variables, depressive symptoms, and other possible confounders were assessed by means of self-administered questionnaires once a year. Five workers without apparent psychiatric disorder were matched for each patient by gender (all male), age (within 5 years), marital status, factory, and occupation; the 15 cases and the 75 controls were compared. Proportions of perceived stress due to unsuitable jobs and human relations were significantly higher in the cases than in the controls (odds ratio was 14.0 and 3.0, respectively). Results of the conditional multiple logistic regression analysis indicated that stress due to unsuitable jobs was significantly associated with occurrence of major depression after depressive symptoms were controlled for (estimated odds ratio was 11.2 with the 95% confidence interval of 2.0-61.8). It was suggested that stress due to unsuitable jobs was a possible risk factor for occurrence of major depression in industry.

The three-year prospective study on the effects of job stress on depressive symptoms over time was conducted among male blue-collar workers aged 20 to 49 years in an electrical factory with 1,266 full-time employees in the northern suburb of Tokyo. Data were collected at yearly intervals by means of postal questionnaires. Initially ten job stress variables, five major covariates, and depressive symptoms (Zung Self-Rating Depression Scale) were measured. In the yearly examinations, depressive symptoms were measured for a total of 468 respondents. The results indicated that job unsuitability was a significant predictor of depressive symptoms in the second and third year, after control for the initial covariates and depressive symptoms. Lack of control over workspace and poor human relations at the workplace were significantly associated with depressive symptoms after one and two years, respectively. Job unsuitability and poor human relations at the workplace appeared to be risk factors for long-lasting depressive symptoms in Japanese blue-collar workers.

To investigate the factors affecting occurrence and persistence of depressive symptoms in a working population, a four-year follow-up study was conducted on a total of 6,378 employees, aged 18 to 69 years, of the electrical company in
Table 6. Estimated risks by demographic variables for occurrence and persistence of depressive symptoms (N=4,857 and 505, respectively) in an electrical company during four-year follow-up: multiple logistic regression for the discrete failure time model (odds ratios with 95% confidence intervals in parentheses).

| Variables         | Depressive symptoms |          |
|-------------------|---------------------|----------|
|                   | Occurrence          | Persistence |
| Gender:           |                      |           |
| Male              | 1.00                |           |
| Female            | 1.44 (1.11-1.87)**   |           |
| Age (years):      |                      |           |
| 18-39             | 1.00                | 1.00      |
| 40-69             | 0.70 (0.54-0.89)**   | 0.63 (0.41-0.97)* |
| Occupation:       |                      |           |
| White-collar      | 1.00                |           |
| Blue-collar       | 1.42 (1.12-1.79)**   |           |
| Marital status:   |                      |           |
| Never married     | 1.00                |           |
| Married           | 0.68 (0.54-0.87)**   |           |
| Previously married| 0.78 (0.38-1.59)     |           |

* p<0.05, ** p<0.01.

the suburb of Tokyo. Data were collected five times at one-year intervals (T-T) using a questionnaire that included the Zung Self-rating Depression Scale (SDS). Of the non-depressed (i.e., having a SDS score of 47 or less) at baseline (N=4,857), 14% were found depressed at least once during T-T. Younger, never married, female and blue-collar workers were significantly at greater risk for becoming depressed during the follow-up period (Table 6). Of the depressed at baseline (N=505), 20% were depressed every time during T-T. Younger workers were significantly at greater risk for persistence of depressive symptoms during the follow-up period (Table 6). The results suggested that age is associated with both occurrence and persistence of depressive symptoms, while gender, marital status and occupation are associated only with the occurrence.

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