

Causes of death and life expectancies among dentists

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Summary

The standardised mortality ratios (SMR) were obtained for dentists in Tokyo according to the causes of their deaths, in order to compare them with those for general Tokyo citizens. Furthermore, an abridged life table was prepared and those dentists' life expectancies were estimated. The materials used were 560 death certificates for male dentists issued in the 10-year period 1985–1994. The documents were kept at the Health Insurance Co-operative Society for Tokyo Dentists, run by the Tokyo Dental Association (TDA). With the general Tokyo residents as a reference population, the SMRs for dentists were significantly higher for oesophageal and colon cancers and significantly lower for heart diseases and pneumonia/bronchitis. The life expectancy for a 25-year-old dentist in Tokyo was 51.26 years. That at birth was stochastically estimated at 75.37 years, which was some one year shorter than that for an ordinary inhabitant (76.67 years), though the difference was insignificant.

Japan has achieved the greatest longevity in the world through its compulsory health insurance system and the improved environmental hygiene realised by its economic success. Yet much still remains unknown about the health condition of dentists who are in charge of people's oral health, the very basis for a healthy life. It is not yet clear whether they live longer or shorter than the other inhabitants in the same social environment, or what kinds of diseases bring about their death. Many reports on deaths of dentists in Japan that appeared in the 1960s and 1970s¹⁻³ focused on the percentages of their causes of death and were not concerned with comparisons with the local populations by means of standardisation. Few attempted to estimate dentists' life expectancies either, perhaps because the method for developing a life table for professional groups had not yet been established.

In the present investigation, the authors analysed the causes of death among male dentists in Tokyo and compared the incidence of the causes between the professional and the general Tokyo population. We also developed an abridged life table and estimated the life expectancy at birth (life span) for the dentists of Tokyo.

Our ultimate goal is to elucidate the health condition of dentists working in a modern megalopolis and develop a health promoting and maintaining programme that enables them to stay healthy throughout life.

Materials and methods

The data analysed consisted of 560 death certificates and corner's reports for male dentists that were issued in the 10-year period from 1985 to 1994 and maintained at the Health Insurance Co-operative Society for Tokyo Dentists run by the Tokyo Dental Association (TDA). Though the total number of deaths among the dentists registered with the Society amounted to 601 during this period, the number of female dentists was excluded from the data, as males accounted for 93.17 per cent.

Some 80 per cent of members of the TDA are registered with the Health Insurance Co-operative Society, paying fees according to their incomes; the Society reimburses 70–90 per cent of the medical expenditures that the members and their families paid. As the Society offers a special grant at the time of its member's death,

the death certificates must be submitted to the Society, which made an accurate analysis of the members' causes of death possible. The population figure or denominator ($n=4,704$) was obtained as the average of the registered memberships on three occasions: the day previous to the start of survey (December 31, 1984); the middle year in the survey period (1990); the last day of survey (December 31, 1994). The subjects were classified into age brackets of 5-year intervals.

Comparison of causes of death between dentists and ordinary residents in Tokyo with regard to standardised mortality ratios (SMR)

SMRs were calculated for dentists classified according to age brackets and the main causes of death and compared with those for the overall metropolitan residents obtained from the Vital Statistics for 1990. SMRs were statistically examined by means of Normal distribution ($n < 30$) and Poisson distribution ($n < 29$). An SMR larger than 1.0 means that the group in question had a higher risk of dying of that disease than the reference group, and an SMR smaller than 1.0 means that the group had a lower risk. Causes of death were classified according to ICD-9 (117 Rubrics List of Mortality for Japan; Ninth Revision International Classification of Diseases).

Association between the underlying and associated causes of death stated in the death certificate

Death certificates mentioning circulatory diseases as the underlying causes of death were examined for the entry of associated causes of death. The data were subjected to the multiple causes of death analysis⁴ to yield the odds ratio and 95 per cent confidence interval.

Development of the life table for dentists

In estimating life expectancies for age groups under 25, general population data on death were used in place of those pertinent to dentists, as there was no information for the latter. The proportion of persons alive at the beginning of the age interval dying during the interval (${}_nq_x$) was calculated according to Chiang's method⁵.

Results

Age distribution of the subject population

The age distribution of male dentists (Members of the Health Insurance Co-operative Society for Tokyo Dentists) for 1990, the middle year in the survey, was plotted on a histogram. It may be visualised as a curve

with two peaks, at 30–44 years and 60–65 years respectively (Figure 1).

Ratio of the leading causes to all causes of death

The deaths from the leading causes were compared with those from all causes in the survey period. Malignant neoplasms accounted for 40.18 per cent, cerebrovascular diseases for 16.25 per cent, heart diseases for 15.54 per cent and pneumonia and bronchitis for 7.68 per cent. Figure 2 represents the comparison of these figures with the data of the Vital Statistics for 1990. As can be seen, the ratios of malignant neoplasms and cerebrovascular diseases were higher than those for the overall Japanese population, indicating that dentists died more specifically of these diseases.

Comparison of causes of death between dentists and ordinary Tokyo citizens with regard to SMR

SMRs were calculated for dentists, with the deaths in the overall Tokyo population as reference. The SMR for total deaths of dentists was estimated at 1.00, which meant that there was no difference at all in the overall mortality rate between the two populations. Among the leading causes of death, the SMR for overall malignant neoplasms was significantly higher in dentists ($P < 0.01$); it was particularly higher for cancers in the oesophagus and colon ($P < 0.01$). For most other cancers, SMRs were also greater than 1.0, though the differences were insignificant. Of cerebrovascular diseases, SMRs were higher than 1.0 for intracerebral haemorrhage and cerebral infarction, though the differences were not significant. SMRs for heart diseases and pneumonia and bronchitis were significantly lower than those in the general population ($P < 0.05$, Table 1).

The association between the underlying and associated causes of death in circulatory diseases

Among death certificates with diseases of the circulatory system as the underlying causes of death, hypertensive diseases were frequently associated with ischaemic heart disease, cerebrovascular diseases, and cerebral infarction; the association was significantly frequent ($P < 0.05$). Cerebral infarction was also complicated by diabetes mellitus at a significant frequency ($P < 0.05$, Table 2)

Abridged life table for male dentists of Tokyo

A life table for male dentists practising in Tokyo in the 1985–1994 period was developed (Table 3). Their life expectancy at age 25 was 51.26 years, which was nearly one year shorter than 52.22 years for the general Tokyo

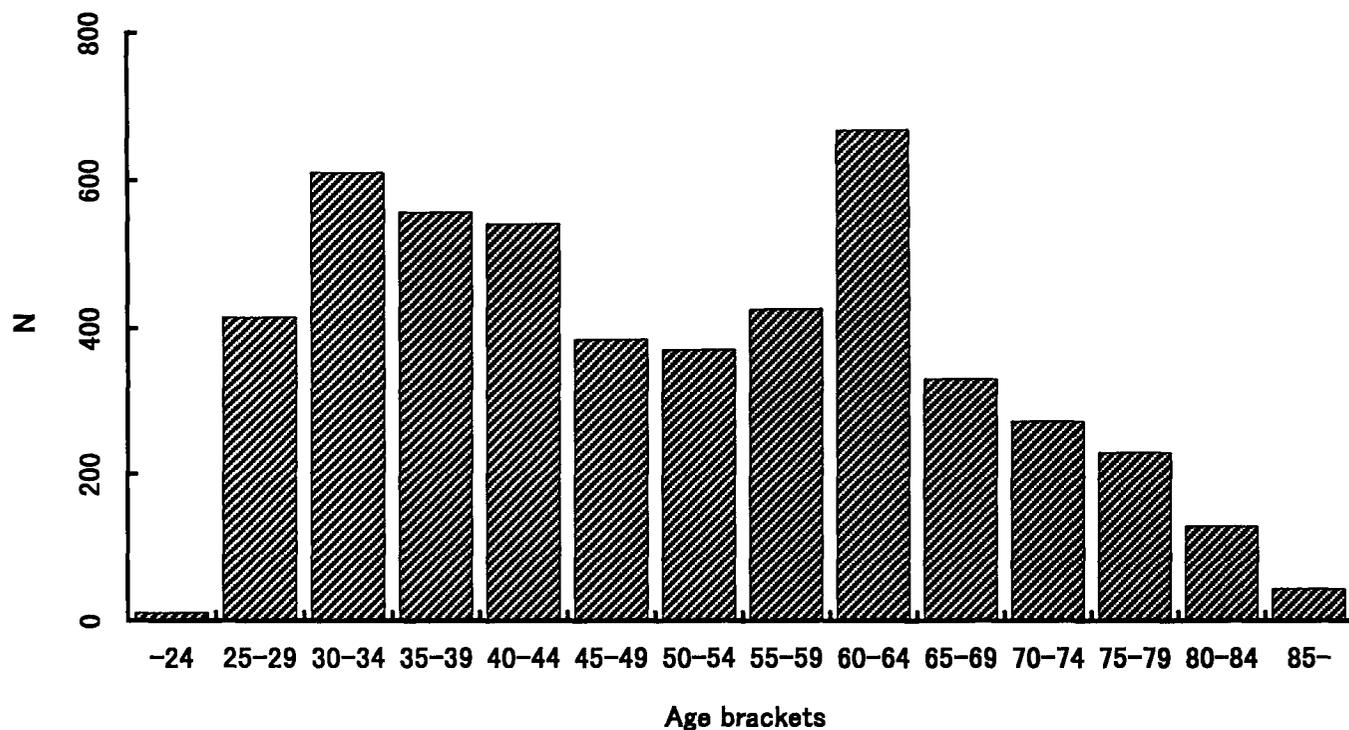


Figure 1

- Number of Tokyo dentists registered with the Health Insurance Cooperative Society as classified by age (1990).
- Nombre de chirurgiens-dentistes de Tokyo inscrits auprès de la Société coopérative d'assurances de santé par âge (1990).
- Zahl (nach Alter) der bei der Krankenversicherung für Zahnärzte gemeldeten Zahnärzte Tokios (Angaben von 1990).
- Número de dentistas de Tokio inscritos en la Sociedad Cooperativa de Seguro Sanitario, clasificados por edad (1990).

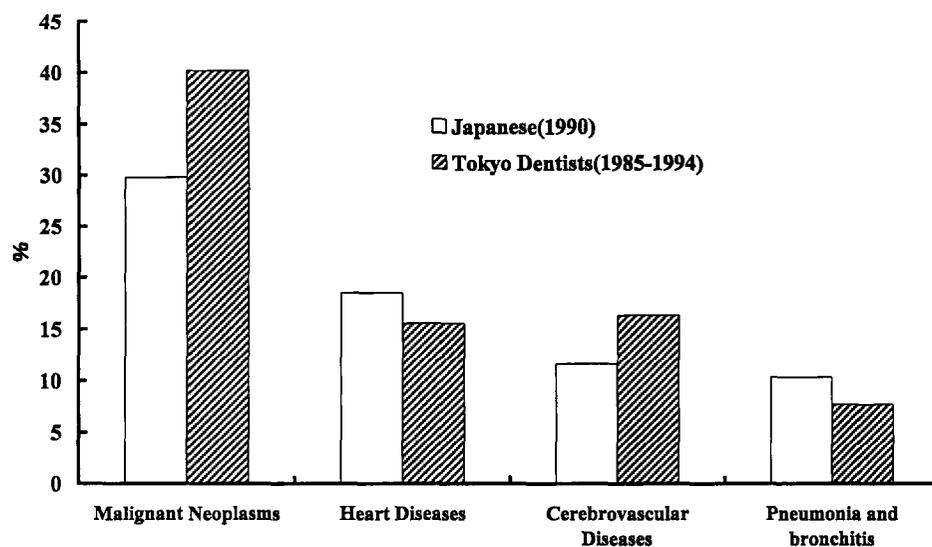


Figure 2

- Comparison of mortalities for leading causes between Japanese population and Tokyo dentists.
- Comparaison des mortalités pour des causes majeures entre la population japonaise et les chirurgiens-dentistes de Tokyo.
- Vergleich der Sterberate infolge der am häufigsten auftretenden Erkrankungen zwischen der allgemeinen Bevölkerung Japans und den Zahnärzten Tokios.
- Comparación de mortalidades entre la población japonesa y dentistas de Tokio por causas.

citizens, but the difference was insignificant. The estimated life expectancy at birth for male dentists of Tokyo was 75.37 years, which did not differ much from 76.67 years for the metropolitan population.

Discussion

Analysis of causes of death

There have been many studies, including one by Gulanic⁶,

Table 1 Deaths from leading causes as classified by age and standardised mortality ratio (SMR). Male dentists (1985–1994).

Causes of death (ICD-9)	Ages									Total	SMR#
	20–	30–	40–	50–	60–	70–	80–	90–	100–		
Tuberculosis (5)	–	–	–	–	1	2	2	–	–	5	0.84
Malignant Neoplasms (28–37)	1	9	9	20	55	70	49	12	–	225	1.35**
Oesophagus (28)	–	–	3	–	1	3	3	–	–	10	6.81**
Stomach (29)	–	1	2	4	13	9	9	2	–	40	1.01
Rectum, Anus (30) + Colon	1	–	2	2	10	8	5	3	–	31	1.53**
Liver (31)	–	1	–	5	3	9	6	–	–	24	1.13
Pancreas (32)	–	–	–	1	2	6	4	1	–	14	1.56
Lung, Trachea, Bronchus (33)	–	4	1	3	10	15	12	2	–	47	1.30
Leukaemia (36)	–	–	–	1	1	–	1	–	–	3	1.08
Others (37)	–	3	1	4	15	20	9	4	–	56	
Benign neoplasms and unspecified nature (38)	–	–	–	–	2	2	–	–	–	4	
Diabetes (39)	–	–	–	–	–	1	2	–	–	3	0.46
Hypertensive diseases (48)	–	1	–	–	–	–	1	–	–	2	
Heart diseases (51–56)	–	3	–	6	24	26	25	3	–	87	0.80*
Ischaemic heart disease (51,52)	–	2	–	5	13	12	11	2	–	45	0.82
Heart failure (55)	–	1	–	1	7	9	13	1	–	32	0.75
Others (54,56)	–	–	–	–	4	5	1	–	–	10	
Cerebrovascular diseases (58–60)	–	1	3	8	18	36	19	5	1	91	1.20
Intracerebral hemorrhage (58)	–	1	–	3	4	12	6	1	–	27	1.20
Cerebral infarction (59)	–	–	3	3	10	18	9	3	1	47	1.17
Others (60)	–	–	–	–	–	–	–	–	–	0	
Pneumonia and Bronchitis (63,66)	1	–	–	3	11	18	8	2	–	43	0.67*
Liver cirrhosis (73,74)	–	1	–	2	–	4	1	1	–	9	0.59
Nephritis, Nephrosis (76,77)	–	–	1	2	5	7	1	–	–	16	
Accidents (E104–114)	–	–	1	1	2	1	2	1	–	8	0.64
Suicides (E115)	–	–	1	–	3	3	5	–	–	12	1.19
Others (89)	–	2	3	–	13	13	16	3	1	51	
Total	2	17	18	42	134	187	131	27	2	560	1.00

Statistical test by normal and Poisson distribution * $P < 0.05$ ** $P < 0.01$ **Table 2** 95% Confidence intervals and odds ratios in the association between underlying causes and associated causes of death connected with diseases of the circulatory system.

Underlying causes of death	×	Associated causes of death	Odds ratio	95% Confidence intervals	
Ischaemic heart disease (51–52)#	×	Hypertensive disease	12.042	(5.210–27.829)	$P < 0.05$
	×	Heart failure	2.497	(0.922–6.760)	
Cerebrovascular diseases (58–60)	×	Hypertensive disease	0.719	(0.406–1.273)	$P < 0.05$
	×	Heart failure	3.717	(1.704–8.107)	
	×	Pneumonia and Bronchitis	0.852	(0.427–1.702)	
	×	Diabetes	1.722	(0.621–4.775)	
Intracerebral hemorrhage (58)	×	Hypertensive disease	0.502	(0.153–1.648)	
	×	Heart failure	2.723	(0.788–9.408)	
	×	Pneumonia and Bronchitis	0.923	(0.278–3.063)	
Cerebral infarction (59)	×	Hypertensive disease	0.809	(0.394–1.662)	$P < 0.05$
	×	Heart failure	4.595	(1.957–10.789)	
	×	Pneumonia and Bronchitis	0.946	(0.397–2.253)	
	×	Diabetes	3.466	(1.236–9.717)	
	×	Arrhythmia	1.722	(0.382–7.772)	

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of the standardised mortality ratio (SMR) for causes of death as related to occupations of the deceased. Yet they are always encumbered with the problem of which population to choose as a reference. In our present investigation, we chose Tokyo metropolitan citizens as the reference population, who shared the social environment with the dentist subjects and, by comparing SMRs between the two groups, examined the profes-

sional factors that led to the specific causes of deaths among dentists.

Yatsu *et al.*⁷ studied the percentages of various causes of death compared to the total deaths among dentists using the records for 1971–1975 maintained by the Japan Dental Association. They have reported that heart disease was always the most frequent cause of death among dentists, with a much higher incidence than that

Table 3 Abridged life table for male dentists in Tokyo (1985–1994).

Age interval	Ratio of persons alive or dead by the end of the age beginning and during (nq x)	Of 100,000 born alive		Stationary population		
		Number living at beginning of age interval (1x)	Number dying during age interval (ndx)	In the age interval (nLx)	Average remaining lifetime for Tokyo dentists (ex)	Average remaining lifetime for Tokyo population
0–4	0.004187	100000.00	418.657	99656.6	75.37	76.67
25–29	0.002746	98657.20	270.936	492611.7	51.26	52.22
30–34	0.003957	98386.26	389.357	490992.5	46.39	47.36
35–39	0.004624	97996.91	453.136	488933.5	41.57	42.54
40–44	0.009359	97543.77	912.950	485611.5	36.75	37.77
45–49	0.015799	96630.82	1526.663	384526.1	32.07	33.10
50–54	0.024963	95104.16	2374.046	470108.1	28.54	28.58
55–59	0.042413	92730.11	3932.995	454523.8	24.20	24.26
60–64	0.063820	88797.12	5667.036	430560.4	20.15	20.22
65–69	0.094004	83130.08	7814.578	397263.9	16.35	16.42
70–74	0.156045	75315.50	11752.640	349095.1	12.77	12.88
75–79	0.247135	63562.87	15708.630	280441.1	9.64	9.74
80–84	0.395258	47854.24	18914.780	192073.1	6.94	7.10
85+				140249.9	4.85	

for the general population at the time, and concluded that dentists were more prone to die of heart diseases than other people. Another report by Yatsu *et al.*⁷ has pointed to the higher incidence of cardiographic abnormalities noted in the screening tests of 3,873 practising dentists, in comparison to ordinary citizens.

The authors' study of SMR, however, showed that the risk for dentists in Tokyo dying of heart diseases was significantly lower than for the general Tokyo population. This difference might be explained by two factors, besides the difference in the statistical techniques employed: changes in the composition of fatal diseases among the Japanese as a whole, and the relative inaccuracy of the data. Yatsu *et al.* used (no death certificates attached); the small size and specificity of our subject population (limited to dentists practising in Tokyo). As seen in *Figure 2* nevertheless, the ratio of deaths from heart diseases was lower for dentists than even that for the general population (18.5 per cent). This suggests that changes with time in fatal diseases afflicting the Japanese must have been the most probable reason for the difference.

Interestingly enough, the authors found that SMR for overall malignant neoplasms was significantly higher in dentists. The particularly high SMRs for oesophageal cancer and colon cancer including those of rectum and anus might indicate the importance of daily habits in the analysis. Among many epidemiological studies of the causes for oesophageal and colon cancer, Kamon *et al.*⁸ carried out a Ridit analysis of the characteristics of patients in the area with a high oesophageal cancer incidence. They reported that cigarette smoking and frequent intake of hot food, tea and gruel, in particular, were high risk factors for the disease. From his cohort study of the Japanese, Hirayama⁹ has demonstrated a highly positive correlation between the mortality rate from rectosigmoidal cancer and alcohol consumption. In their report Tajima and Tominaga¹⁰ have pointed out

as risk factors for colon cancer such eating habits as a preference for Western style breakfast and eating quickly without chewing well. In light of these reports, our findings might reflect the daily life of many dentists, in which they are pressed by dental practice, having meals in haste in their meagre spare time, indulging themselves in cigarette smoking and alcohol drinking to relieve mental stress and physical fatigue. The high incidence of colon cancer appears to be explained in part by the finding by Vena *et al.*¹¹ that the disease is more frequent among those engaged in sedentary work over a long period of time, as dentists also work in a sitting position.

Though the differences were not significant, SMRs were higher in dentists (1.30) for cancers of lung, trachea and bronchus. As Pokowitz *et al.*¹² and Uesaka *et al.*¹³ have maintained, this might be due not only to cigarette smoking but also to the dust inhalation from tooth scraping as well as dental laboratory work and plaster handling involved in dental practice.

It is a matter worthy of special mention with regard to work conditions that Japanese dentists work extremely long hours. According to the formal document of the Japanese Ministry of Health and Welfare¹⁴, after the introduction of the compulsory health insurance system in 1958, the number of patients treated in a dental clinic continued to increase until the early 1970s. In 1970, when the number of patients per dentist was the greatest, the average number treated per dentist stood at 31.8 patients a day. This figure, however, should have been even greater for privately practising dentists, as the total number of dentists, the denominator, included those who were not working at all and those working for shorter hours in hospitals. Magoshi *et al.*¹⁵ reported in 1971 that, in four large cities in Japan, the average working hours for a dentist, including those for preparation and dental laboratory work, amounted to 11 hours 33 minutes, which confirmed that dentists were leading a life of

physical and mental overwork.

As shown in *Table 2*, death from diseases of the circulatory system in the present series were frequently accompanied by hypertensive diseases as associated causes of death. Since Auerbach's report¹⁶ it has been generally accepted that cigarette smoking and drinking can induce arteriosclerosis and hypertension. The same can probably be said of dentists. The high incidence of cerebral infarction accompanied by diabetes mellitus in our survey supports Steiner's view¹⁷ that diabetes impairs the blood vessel wall and induces atherosclerosis, and that of Salonen *et al.*¹⁸ that the development of cerebral infarction and cerebral haemorrhage are significantly related to cigarette smoking and a past history of diabetes.

The SMRs for liver cancer (1.13) and liver cirrhosis (0.59) did not differ significantly from those for the general Tokyo population. The association of hepatitis B (HBV) with liver cancer and liver cirrhosis has long been noted^{19,20}. The survey by Mosley *et al.*²¹ of the hepatitis B incidence among American practising dentists has shown the high risk of contracting this disease among those in the profession. In Japan, too, Mochizuki²² has reported on the basis of a questionnaire survey that dentists experience hepatitis more frequently (16.8 per cent) than ordinary citizens (1.32 per cent). He furthermore examined 209 dentists practising in Tokyo for serum HB antigen and antibody and carried out a case control study, with ordinary citizens as the control. He has demonstrated a significantly higher HB-antibody positivity ratio in dentists than that in the general public. Yet our results showed that HBV infection did not directly cause death among dentists. More detailed studies are in order to elucidate the relationship of HBV infection to the development and mortality of hepatitis.

Suicides, another factor of interest, accounted for 2.14 per cent of the total deaths among the dentists of Tokyo, though its SMR was only a little over 1.0. The convergence of suicide cases in the age bands of 60s, 70s, and 80s, appeared to reflect the social responsibilities and despair in the face of incurable diseases those older dentists had to face, the true reason for which could not be known from death certificates. The American Dental Association²³ has reported that the suicide ratio to total deaths among dentists was 2.03 per cent for the 1968–1972 period. Mansky²⁴ has stated on the basis of the data collected by Metropolitan Life Insurance Inc. in the same period that the suicide rate for American dentists was twice the rate for ordinary Americans.

As the authors reported in 1996²⁵, no suicide case was found among the deaths of Tokyo Dental Association (TDA) members in the 1988–1994 period. This difference may be attributable to the difference in the data: while in our present investigation the suicide rate was calculated from death certificate entries, our earlier study was based on documents compulsorily filed and submitted to the TDA by the families of the deceased, which tended to be modified for the sake of the social status of the dead and the wishes of the families. The future studies of death in occupational groups should thus be based on the underlying causes of death recorded in death certificates, in order to avoid misleading conclusions.

Average life expectancies for dentists

From the *Report on Survey of Medical Care Institutions in Japan 1975*, Kakinuma *et al.*³ obtained life expectancies in 1975 for all Japanese male dentists. They found that the life expectancy for a 45-year-old dentist was 32.2 years, a figure comparable to our result, 32.06 years. The life expectancy at birth estimated for male dentists of Tokyo stood at 75.37 years, which was similar to the overall average (only male) of 75.92 years in 1990. In developing a life table for any occupational group, the basic question is how to set the death rates for the age between birth and the start of working. In Japan's educational system, the minimal age for acquiring a dentist's license is 24; before practising independently, a young dentist usually spends a few more years working at a larger institution under a senior dentist's guidance. This makes it impossible to include deaths at under 25 years in the calculation. In our attempt to obtain the life expectancies for dentists under 25, we substituted overall Tokyo death rates for the missing data. In estimating life expectancies for occupational groups, this is at present the only technique for supplying pre-practise information.

The authors hope to carry out more detailed studies of deaths among dentists so that a health-promotion programme specifically aimed at dentists can be developed. When this goal has been attained, it will improve dentists' daily habits, preclude occupational risks, and help them contribute to dental care in good health and happiness. It is also hoped that dental associations in every country will redouble their efforts to promote and maintain dentists' health from the viewpoint of occupational health science.



Causes de décès et espérance de vie des chirurgiens-dentistes

Résumé

On a obtenu les taux normalisés de mortalité pour des chirurgiens-dentistes de Tokyo, selon les causes de leur décès, afin de les comparer avec ceux des habitants de Tokyo en général. Par ailleurs, on a préparé un tableau abrégé de vie et on a estimé l'espérance de vie de ces chirurgiens-dentistes. Comme documentation, on a utilisé 560 actes de décès pour des chirurgiens-dentistes hommes sur une

période de 10 ans (1985-1994). Les documents étaient conservés à la Société coopérative d'assurances de santé des chirurgiens-dentistes de Tokyo, gérée par l'Association dentaire de Tokyo. En prenant comme référence de population les résidents de Tokyo, les taux normalisés de mortalité des chirurgiens-dentistes étaient considérablement plus élevés en matière de cancer du colon et de l'œsophage et étaient bien moins élevés pour les maladies cardiaques et les bronchites/pneumonie. L'espérance de vie pour un chirurgien-dentiste de 25 ans à Tokyo était de 51,26 ans. Celle-ci était estimée de manière aléatoire à la naissance à 57,37 ans, soit environ une année de moins que celle d'un habitant ordinaire (76,67 ans), bien que la différence soit insignifiante.



Todesursachen und Lebenserwartung bei Zahnärzten

Zusammenfassung

Die standardisierte Sterblichkeitsrate (*standardised mortality ratios*) nach Todesursache für Zahnärzte in Tokio wurde mit der für die allgemeine Tokioter Bevölkerung verglichen. Desweiteren wurde eine gekürzte Lebenserwartungstabelle erstellt und Schätzungen bezüglich der allgemeinen Lebenserwartung der darin aufgeführten Zahnärzte vorgenommen. Analysiert wurden 560 Sterbeurkunden männlicher Zahnärzte, die in den Jahren 1985-1994 verstarben. Die Dokumente stammten von der dem Tokioter Zahnärzterverband unterstehenden Krankenversicherung für Zahnärzte. Verglichen mit den Angaben für die übrige Tokioter Bevölkerung waren die Sterbeziffern bei Zahnärzten infolge Ösophagus- und Kolonkarzinom signifikant höher und infolge Herzerkrankungen und Pneumonie/Bronchitis signifikant niedriger. Die mittlere Lebenserwartung eines 25jährigen Zahnarztes in Tokio betrug 51,26 Jahre. Die Lebenserwartung bei Geburt wurde stochastisch auf 75,37 Jahre geschätzt. Dieser Wert lag um ca. ein Jahr unter dem für die übrigen Bewohner (75,67) angenommenen, wobei es sich um einen nicht signifikanten Unterschied handelte.



Causas de fallecimiento y expectativa de vida de los odontólogos

Resumen

De dentistas de Tokio y de acuerdo con las causas de sus muertes, se obtuvieron porcentajes de mortalidad normalizada (PMN), con el fin de compararlos con las de ciudadanos comunes de la misma ciudad. Se preparó, además, un tabla de vida abreviada y se calcularon las expectativas de vida de estos dentistas. Los materiales utilizados fueron 560 partidas de defunción de odontólogos varones emitidos durante un período de diez años (1985 a 1994). Estos documentos habían sido archivados en la Sociedad Cooperativa de Seguro Sanitario para los dentistas de Tokio, que es administrada por la Asociación Dental de Tokio. Con los residentes de Tokio como población de referencia, los PMNs correspondientes a los dentistas eran considerablemente más elevados por cánceres del esófago y de colon y considerablemente más bajos por enfermedades del corazón y neumonia/bronquitis. La expectativa de vida de un dentista de Tokio, de 25 años de edad, era 51.26 años, que al nacer se había estimado estocásticamente en 75.37 años, un año menos que la calculada para un habitante común (76.67 años), aunque la diferencia era insignificante.

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