Epidemiology of Skin Cancer in Japan

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In this article, the changes in the mortality rates of malignant melanoma (C43 in the ICD-10 codes) and other skin cancers (C44) in Japan from 1999 to 2014 are discussed from the viewpoint of descriptive epidemiology, employing the vital statistics data. The crude mortality rates of C43 and C44 increased parallel to age, and that of C44 rapidly increased after 80 years of age. The crude mortality rates of C43 and C44 have been increasing for both males and females. The crude mortality rates in 2014 were from 1.6- to 2.0-fold those in 1999. The male/female ratios of both C43 and C44 were almost 1.0. The correlation coefficient between the age-adjusted mortality rate of C44 and the year was 0.523 (p < 0.05), which suggests that its mortality is increasing, independent of the aging of the Japanese population. The correlation coefficient between the age-adjusted mortality rate of C43.5-7 (malignant melanoma; trunk, upper limb, lower limb) and the year was 0.925 (p < 0.05), and that of C44.0-4 (other skin cancers, head and neck) was 0.637 (p < 0.05). The correlation coefficient between the crude mortality rate of C44.0-4 (other skin cancers, head and neck) and the latitude of the capital of each of the 47 prefectures of Japan was negative, but that of C43 was positive. In Japan the amount of ultraviolet (UV) B exposure has been increasing almost continuously, but the present results suggest that the contribution of UV to the occurrence of malignant melanoma is not large. The westernization of the lifestyle of Japanese people may have something to do with the continuous increase in C43.5-7. It is not contradictory that the increasing amounts of exposure to UV radiation have brought about an increase in squamous cell carcinoma, one of whose causes is UV radiation, and consequently an increase in the age-adjusted mortality for C44.

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Codes in ICD-10
Data on the number of deaths from neoplasms of the skin in 5-year age categories were obtained from the vital statistics of Japan from 1999 to 2014 (http://www.e-stat.go.jp/SG1/estat/OtherList.do?bid=000001041662&cycode=7). Codes C43 and C44 stand for malignant melanoma and other skin cancers, respectively. The data for subcodes C43.0 to C43.9 and C44.0 to C44.9 (Table 1), which indicate the original sites, were employed as well. (The data for subcodes in 5-year age categories began to be published in 1999.)
In a society where the percentage of aged people is increasing, an 2007, 21.5%. This is the fastest increase in the world. It is natural that Changes in the age-adjusted mortality rates of C43 and C44 1999. The male/female ratios of both C43 and C44 were almost 1.0. Table 2 shows the changes in the crude mortality rates of C43 and Changes in the crude mortality rates of C43 and C44 increased parallel with age, and that of C44 rapidly increased after 80 years of age. Changes in the crude mortality rates of C43 and C44 Table 2 shows the changes in the crude mortality rates of C43 and C44. Both of them have been increasing for both males and females. The crude mortality rates in 2014 were from 1.6- to 2.0-fold those in 1999. The male/female ratios of both C43 and C44 were almost 1.0. Changes in the age-adjusted mortality rates of C43 and C44 The Japanese population is aging. In 1970, the percentage of persons aged 65 years or older was 7.1%, but in 1994 it was 14.1%, and in 2007, 21.5%. This is the fastest increase in the world. It is natural that in such a society the number of deaths from cancers would increase. In a society where the percentage of aged people is increasing, an age-adjusted mortality rate is necessary for comparisons over a long period. To calculate the age-adjusted mortality rate from 1999 to 2014, the model population in Japan in 1985 (0-4, 5-9, 10-14, etc., to 80-84 and 85 years of age or older) was employed. Figures 2 and 3 show the age-adjusted mortality rates of C43 and C44. Their correlation coefficients with the year were 0.421 (p < 0.05) and 0.523 (p < 0.05), respectively. The significantly positive and high correlation coefficient of C44 suggests that its mortality is increasing, independent of the aging of the Japanese population.

Age-adjusted mortality rate by original site Figures 4, 5, 6 and 7 show the age-adjusted mortality rates of C43-0-4 (head and neck), C43-5-7 (trunk, upper limb, lower limb), C44-0-4 and C44-5-7. The correlation coefficients with the year were 0.245 (p < 0.05), 0.925 (p < 0.05), 0.637 (p < 0.05) and -0.300 (p > 0.05), respectively.

Latitudes and crude mortality rates in the 47 prefectures of Japan Crude mortality rates were calculated for all 47 prefectures of Japan, employing the average number of deaths from 1999 to 2014 and the average of the populations reported by the censuses performed in 2000, 2005 and 2010. Table 3 shows the correlation coefficients between the crude mortality rate and the latitude of the capital of each of the 47 prefectures. The correlation coefficient of C43 was positive. Those of C44.0, C44.1, C44.3, C44.4 and C44.0-4 were negative.

Amounts of ultraviolet B radiation In Japan the data on the amounts of UVB radiation have been available since 1997 only in the city of Sapporo. Figure 8 shows the annual average amounts of UVB radiation in that city (kJ/m$^2$; Data of the Meteorological Agency, http://www.data.jma.go.jp/gmd/env/uvhp/uvb_monthave_sap.html). The correlation coefficient with the year was 0.655 (p < 0.05). That is, it has been increasing almost continuously.
Figure 1 Crude mortality rates of C43 and C44 (from 1999 through 2014) by 5-year age groups.

Figure 2 Age-adjusted mortality rates of C43 (malignant melanoma).

Figure 3 Age-adjusted mortality rates of C44 (other skin cancers).

Figure 4 Age-adjusted mortality rates of C43.0-4 (malignant melanoma; head and neck).

Figure 5 Age-adjusted mortality rates of C43.5-7 (malignant melanoma; trunk, upper limb, lower limb).

Figure 6 Age-adjusted mortality rates of C44.0-4 (other skin cancers; head and neck).

Figure 7 Age-adjusted mortality rates of C44.5-7 (other skin cancers; trunk, upper limb, lower limb).

Figure 8 Amounts of ultraviolet B in the city of Sapporo.
DISCUSSION

C43 (malignant melanoma)
Classification of the codes of the ICD-10 is dependent on the original sites. In general, therefore, one cannot know the pathological diagnosis. Malignant melanoma is one of the exceptions.

Though the etiologies of skin cancers are not completely clarified, exposure to UV radiation is considered to be one of the strongest risk factors. Though the amount of UVB has been increasing in Japan, the correlation coefficient between the age-adjusted mortality from C43 and the year was not significant. The correlation coefficient between the crude mortality rate of C43 and the latitude was positive. These results suggested that the contribution of UV to the occurrence of malignant melanoma was not large. According to one report, UV does not make a large contribution to the occurrence of melanoma in nonwhite populations[4], though it is reported that in white populations there is a positive association with intermittent sun exposure[5].

Many of the original sites of malignant melanoma of Japanese people are those that have little exposure to sunlight. Ishihara et al[6], reported that the most frequent site of malignant melanoma in Japanese people was the sole of the foot (27.0%) in a total of 2065 patients. The trunk, abdomen, buttocks and shoulders accounted for 13.8%. This distribution is different from that of Americans whose most frequent site is the trunk (34%)[7]. This difference may derive from a genetic predisposition and/or lifestyle. The correlation coefficient between the age-adjusted mortality rate of C43.5-7 and the year was more than 0.9. This shows that the distribution of the original sites in Japanese people may become similar to that of Americans in the future. The cause could not be clarified in the present study, but the westernization of the lifestyle of Japanese people may have something to do with this change.

C44 (other skin cancers)
The difference in the crude mortality rates of C43 and C44 was small in the ages under 80 years, but in the age group 80 years and older, it became large (C44 >> C43). Both the crude mortality rate of malignant melanoma and that of other skin cancers have been increasing. This is accounted for by the increase in the number of aged people since their mortality rates in the aged-population are high. However, the age-adjusted mortality from C44 has also been increasing since its correlation coefficient with the year was significantly high. That is, the occurrence of C44 is increasing independent of the aging of the Japanese population.

A case-control study in Australia reported that solar exposure was associated with squamous cell carcinoma[8]. In Japan, it is reported that solar keratosis is more frequent in low latitude regions[9]. Ishihara reported that in Japan 52.2% (554/1082) of squamous cell carcinoma was found in the scalp, face, ears, lips and neck, i.e., the sites exposed to sunlight[10].

Since the fatality rate of basal cell carcinoma is generally low, many of the deaths classified into C44 might have been from squamous cell carcinoma, whose main cause is exposure to UV radiation. If so, it is not contradictory that the increasing amounts of UV exposure have brought about an increase in squamous cell carcinoma and, consequently, the increase in the age-adjusted mortality from C44. This is supported by the findings that the correlation coefficient between C44.0-4 (sites exposed to sunlight) and the year was significantly high, and that the correlation coefficient between C44.0-4 and the latitude was negative.

Smoking
Smoking is one of the main causes of malignant diseases. However, there are virtually no reports that smoking is a significant risk factor for skin cancers. In Japan, the percentage of smokers has largely been different between males and females. In 1966, when the percentages were highest for both sexes, they were about 84% for males and 18% for females[11]. Although these percentages have been decreasing since 1966, that of males was about 30%, and that of females about 10% in 2014. However, since the sex ratio of the crude mortality rates of both C43 and C44 were almost 1.0, the contribution of smoking is not large. The age-adjusted mortality rate of lung cancer has been decreasing since 1995, i.e., since 30 years after the peak year (1966) of the percentage of smokers[12]. However, the age-adjusted mortality rates of C43 and C44 have not decreased.

Sunscreen
One article reported that sunscreen prevented the occurrence of squamous cell carcinoma[13]. Another reported that sunscreen had no effect on the occurrence of melanoma[14]. It has not been long since we began to use sunscreen widely. Now in Japan, many females use it, but many males do not. At present, there is little difference between the sexes with regard to the mortality rates of C43 and C44. In Japan, in the future, there might be differences in the mortality rates of skin cancers (especially squamous cell carcinoma) between the sexes. In addition, it is only recently that we started to use sunscreen against UVA radiation. Therefore, we must carefully observe how the mortality rate of skin cancers changes.

CONFLICT OF INTERESTS
There are no conflicts of interest with regard to the present study.

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