Epidemiology Note

A Comparison of Trends in the Incidence Rate of Lung Cancer by Histological Type in the Osaka Cancer Registry, Japan and in the Surveillance, Epidemiology and End Results Program, USA

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Trends in the incidence rate of lung cancer by histological type were examined, based on data from the Osaka Cancer Registry (OCR), Japan and the Surveillance, Epidemiology and End Results Program (SEER), USA. Among males, an increasing trend was observed for adenocarcinoma in both registries. In the OCR, the incidence rate of adenocarcinoma has recently overtaken that of squamous cell carcinoma, whereas in the SEER, adenocarcinoma had already taken the lead since 1990–93. For squamous cell carcinoma, the decreasing trends in the OCR were consistent with a previous study, whereas in the SEER, the decline was earlier and steeper. For small cell carcinoma, the incidence rate was leveling off in the OCR, whereas it was already in decline in the SEER. For large cell carcinoma, the decreasing trend began earlier in the SEER. Among females in both registries, the incidence rate of adenocarcinoma has clearly been on the increase, whereas in other histological types the incidence rates were decreasing or at least leveling off. As for the age-specific incidence rate, different patterns were observed between the two registries: in the OCR, the incidence rate was on the increase in older age groups such as 70–74 years and also in younger age groups such as 45–49 years, whereas it decreased in intermediate age groups such as 55–59. In contrast, stable decreasing trends were observed in the SEER, except for adenocarcinoma. The increase in incidence rate observed among younger age groups in the OCR should be carefully monitored.

Key words: lung neoplasms – neoplasms by histological type – registry – incidence – Japan – United States

BACKGROUND

In Japan, the incidence of lung cancer overtook stomach cancer in 1998 with a mortality count of 53,724, which was one sixth of all deaths from cancer (1). In particular, the increase in adenocarcinoma (ADC) has been widely reported. Here we updated the previous study (2) using the data from the Osaka Cancer Registry (OCR), adding new data for 1994–97 to those of 1974–93 and comparing them with cancer registry data in the USA.

MATERIALS AND METHODS

The Osaka Cancer Registry (OCR) has been operating since 1962, covering ~9,000,000 residents in Osaka Prefecture, Japan. After obtaining permission from the OCR to use their data, case-listing tables for registered cases from 1962 to 1998 without personal identification became available in the form of an electronic file.

The Surveillance, Epidemiology, Endpoints and Results Program (SEER) of the National Cancer Institute started in 1973 and now covers ~14% of the total US population. Data from the SEER database was available on the Internet (3) once we registered and gave our consent to the 1973–98 Public-Use Data Agreement. Their PC software for data handling, SEER*Stat (ver. 4.1.3), was also available on the Internet.

Incidence data up to 1973 were excluded because the proportion of cases accompanied by a diagnosis of histological type

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Table 1. Trends of age-specific lung cancer incidence rates (per 100 000) in Osaka Cancer Registry, Japan

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–44</td>
<td>7.3</td>
<td>6.7</td>
</tr>
<tr>
<td>45–49</td>
<td>20.8</td>
<td>16.0</td>
</tr>
<tr>
<td>50–54</td>
<td>35.1</td>
<td>39.2</td>
</tr>
<tr>
<td>55–59</td>
<td>67.8</td>
<td>72.8</td>
</tr>
<tr>
<td>60–64</td>
<td>133.5</td>
<td>141.0</td>
</tr>
<tr>
<td>65–69</td>
<td>217.6</td>
<td>266.5</td>
</tr>
<tr>
<td>70–74</td>
<td>297.3</td>
<td>349.2</td>
</tr>
<tr>
<td>75–79</td>
<td>352.4</td>
<td>456.7</td>
</tr>
<tr>
<td>80–84</td>
<td>298.5</td>
<td>412.8</td>
</tr>
<tr>
<td>85+</td>
<td>224.4</td>
<td>300.2</td>
</tr>
</tbody>
</table>

Total No. of cases: 3958, 5224, 6777, 8337, 9652, 11554, 14599, 19686, 26124, 33229, 39022, 47247.

Proportion of cases with specific diagnosis of histological type (%)

<table>
<thead>
<tr>
<th>Risk indices with age standardization*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR74</td>
</tr>
<tr>
<td>CR79</td>
</tr>
<tr>
<td>ASR(1)</td>
</tr>
<tr>
<td>ASR(2)</td>
</tr>
<tr>
<td>ASR(3)</td>
</tr>
</tbody>
</table>

*CR: cumulative risk for 0 to 74/79 years of age. ASR: age standardized rate (per 100 000), with standard population of (1) world, (2) USA (2000), (3) Japan (1985).

was <30% in Osaka and comparable data from the SEER were also limited. From 1974 through 1997, the registered cases of lung cancer numbered 45 502 males and 17 987 females for the OCR and 200 799 males and 112 326 females for the SEER. Among the data from both registries, categories were created both for cases and for populations, according to gender, period and age group, i.e. male or female, 50 4-year study period from 1974–77 through 1994–97 and every 5-year age group from 0–4 through 85+.

For age standardization, three standard populations (1) world (4), (2) USA (2000) (5) and (3) Japan (1985) (6), were used.

Both registries classified lung cancer cases into six groups by histological type, according to the criteria of the International Agency for Research on Cancer (IARC) (7): squamous cell carcinoma (SQCC) (M: 8050–8076), adenocarcinoma (ADC) (M: 8140, 8211, 8230–8231, 8250–8260, 8323, 8480–8490, 8550–8560, 8570–8572), small cell carcinoma (SCC) (M: 8040–8045) and large cell carcinoma (LCC) (M: 8012–8031, 8310), unspecified cancer (M: 8000–8004, 8010–8011, 8032–8034) and other specified histological types (beside those mentioned above). The first four groups are the four major histological types.

The data from the OCR showed that the proportion of cases with a diagnosis of specified histological type throughout the study period varied between 34.6 and 70.1% for males and 28.6 and 63.5% for females, generally increasing from the first study period to the last. In contrast, the data from the SEER showed a higher proportion of cases with a diagnosis of a specific histological type: 76.7–85.2% for males and 78.1–84.4% for females. Therefore, under the assumption that the distributions of different histological types in the same gender and age groups were the same between those cases with and those without a specific histological type, we compensated for the proportion of cases without a specific histological type, as was done in the previous study (2): the procedures in detail are shown below. Based on these estimated incidence rates, the cumulative risks of 0–74 years of age were calculated.

All incident cases were divided into categories according to gender, period and 5-year age group and incidence rates were calculated within each category.

The proportion of the incident cases in each of the four major histological types against all the incident cases with specified histological diagnosis was calculated by gender, period and 10-year age group.

The incidence rate for each category (1) multiplied by the proportion of each of the four major histological types among all specific histological types (2) are the estimated incidence rate of the four major histological types for each category.
When compared in detail with the previous study, there are some differences in the numbers in the tables. These discrepancies originated from the ongoing updates of the data and also from the different determinations of age at diagnosis. In this study, for the data of the OCR, the age at diagnosis was calculated from the number of days from the birthday to the day of diagnosis, divided by 365.25. In the data from the SEER, the age at diagnosis was calculated from the number of days from the birthday to the day of diagnosis, divided by 365.25. In the data from the SEER, the actual age at diagnosis itself was available.

As for the classification criteria for the data of the OCR, the influence of using different classification systems (i.e. the 1978 Japan Lung Cancer Society classification and the 1981 WHO classification) was so limited that it did not seem to be a major reason for the changing trends of incidence by histological type (8).

**RESULTS**

Gender- and age-specific lung cancer incidence rates of both the OCR and the SEER for six 4-year periods from 1974 through 1997 are shown in Tables 1 and 2, respectively. For the data on males in the OCR, the incidence rate increased in younger age groups, i.e. 40–44 through 50–54 and also in those 65–69 years or older. The observed increase in younger age groups was more evident than in the previous study (2). In the 55–59 and 60–64 groups, as in the previous study, the incidence rate decreased. For females, the incidence rate increased in 45–49 and 50–54 and in 70–74 or older, except the 80–84 group. For both genders, the cumulative risk (CR) from 0 to 74 years of age increased again, although both of them seemed to have leveled off in the previous study.

Although the incidence rate in the SEER remained higher than those in the OCR, they have been decreasing in all age groups for males, whereas for females aged 60–65 years or older they were still increasing sharply. As for CR, a steadily decreasing trend was observed in males, whereas it increased slightly in females.

In Figs 1 and 2, the CR from 0 to 74 years of age by histological type for both genders in the OCR and the SEER are shown. For SQCC the CR was leveling off in both genders in the OCR. In the SEER, it was markedly decreasing in males and leveling off in females. Also, the difference between the OCR and the SEER became small for males. For ADC an apparent increase was observed in both genders of the OCR. In males, the CR for ADC had overtaken that of SQCC. In the SEER, ADC had already overtaken SQCC, but it seemed to level off in males and to be still slightly increasing in females. For SCC, in both genders of the OCR and in the SEER females, the CR increased until 1990–93 but not in 1994–97. In the SEER males, the CR had already been on the decrease.
both registries, no increasing trend was observed for either gender.

Trends in the incidence rate by gender, histological type and age group in both registries are shown in Figs 3–6. These are drawn from estimated incidence rate, as noted above. For SQCC (Fig. 3), the incidence rate in the OCR males became almost constant among older age groups, but in the 55–59, 60–64 and 65–69 groups, the incidence rate decreased slightly and among those aged 45–49 and 50–54 they increased. In the OCR females, a similar pattern was observed. In the 60–64 and 65–69 groups, the incidence slightly decreased, but in the 40–44 and 45–49 groups it increased. In the SEER males of all age groups the incidence rates have been declining, whereas in females they were increasing slightly among older age groups but decreasing among younger age groups.

For ADC (Fig. 4), the incidence rate in the OCR was on the increase in all age groups for males and females except the 40–45, 55–59 and 65–69 groups. In SEER, the incidence rates
Lung cancer trends by histological type were increasing slightly among older age groups but decreasing or at least leveling off among younger age groups.

For SCC (Fig. 5), a pattern similar to SQCC was observed. In the OCR for both genders, incidence rates were on the increase among younger age groups such as 45–49 and 50–54 and in the oldest age group, but among the rest they decreased or at least leveled off.

For LCC (Fig. 6), the rarest among the four major types, the incidence rates in both registries were also on the decrease or leveling off among most age groups, except for the 40–44 and
45–49 groups in both genders of OCR. This might be due to fluctuations in the small number of cases in each category.

In the SEER program, there seemed to be a pattern in which the decrease was observed in SQCC first, then in LCC, followed by SCC and finally ADC. Moreover, there seemed to be a gradually changing pattern from increase to decrease, from younger age groups to older age groups and from one period to the next. In contrast, different trends of incidence among age groups were observed in the OCR. Among the older and younger groups, the incidence rate tended to increase, whereas...
it showed a trend of decreasing or leveling off among intermediate age groups such as 60–64, except for ADC, in which the incidences were on the increase among most of the age groups.

DISCUSSION

In the present study, an increase in the incidence rate of ADC especially among young groups was suspected in the OCR, consistent with another study of autopsy cases in Japan, where an increase in ADC cases were reported (9). On the other hand, those of SQCC and SCC seemed to decrease or at least to level off. This is possibly due to the decrease in the prevalence of smoking after the 1970s. However, even among SQCC and SCC, the incidence rate rose among young age groups. Such an increasing trend in young age groups might be significant rather than a mere fluctuation. In Japan, the prevalence of smoking increased among young females and ceased to decrease among young males (10–12). Such a high prevalence of smoking among the young or a decline in the age of smoking initiation could be possible explanations. Also, some changes in lifestyle, such as an increase in the proportion of dietary fat in energy intake (11), could be another explanation and require further studies of association with lung cancer incidence in Japan.

The decreasing trend observed in the SEER, especially for SQCC, was stable, so the difference in incidence rate between the OCR and the SEER became small. In developed countries such as the USA, where tobacco controls have been actively conducted, the trend in lung cancer has changed for the better owing to this tobacco control (13). The proportions of current smokers in the USA in 1998 had fallen to 26.4 and 22.0% for males and females, respectively (14). In addition, the prevalence of those who had ever smoked was on the decrease in a more recent birth cohort (15). However, according to a recent report (16), the incidence rate ceased to decrease among younger group who were born after 1950, possibly owing to their earlier initiation into cigarette or marijuana smoking. Since our results showed the incidence increasing among some younger groups, careful monitoring of such groups will be needed in Japan.

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