Mortality and Causes of Death among Japanese Diabetics in the Tokyo Area: Prospective Follow-Up Study over Four Years

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MHIHARA, T., OHASHI, H. and HIRATA, Y. Mortality and Causes of Death among Japanese Diabetics in the Tokyo Area: Prospective Follow-Up Study over Four Years. Tohoku J. exp. Med., 1983, 141, Suppl., 661-664 — To clarify the mortality and causes of death among Japanese diabetics, we started a prospective follow-up study of 1,629 diabetics who had been registered at our Diabetes Center in 1976. After registration, all patients were checked annually for four years and we confirmed that they were still alive by sending questionnaires or obtaining copies of their resident cards. After a four-year follow-up, only 3 had dropped out, 1,486 were alive and 140 had died. The follow-up rate therefore was 99.8%. We obtained copies of the death certificates of all the deceased. It was shown that risk factors increasing the mortality ratio (the ratio of observed deaths to expected deaths) among Japanese diabetics were early onset of diabetes (0-29 years of age), treatment by insulin and the presence of diabetic retinopathy combined with proteinuria at registration. The most frequent cause of death among the 140 deceased cases was malignant neoplasm, the second ischemic heart disease and the third was cerebrovascular disease. Analysis of the underlying causes of death showed a significant increase in the death rate due to diabetes mellitus and ischemic heart disease among Japanese diabetics compared with the general population matched for sex and age.

Although there have been many reports describing the causes of death among Japanese diabetics (Hirata and Mihara 1976; Sasaki et al. 1976; Goto et al. 1976), we have found few prospective follow-up studies actually dealing with the mortality and causes of death among Japanese diabetics. To clarify the prognosis of Japanese diabetics, we started a prospective follow-up study of the patients who visited our Diabetes Center located in Tokyo in 1976. In this paper we describe the results of the four-year follow-up, especially in respect to risk factors increasing mortality, and causes of death among Japanese diabetics.

SUBJECTS AND METHODS

The study population consisted of 1,629 Japanese diabetics (898 males, 731 females) who visited our Diabetes Center and were examined for registration in this prospective follow-up study. Diagnosis of diabetes mellitus was based on the diagnostic criteria...
recommended by the Japan Diabetic Society (Kuzuya 1970). The mean age of the male subjects was 56.1 years of age and that of the female subjects was 55.5. All the patients were checked their life annually after the registration. We managed to obtain a copy of the death certificate for all the deceased cases.

RESULTS

After the four-year follow-up of the initial 1,629 diabetics, 1,486 were alive and 140 (98 males, 42 females) had died; only 3 patients had dropped out. The follow-up rate therefore was 99.8%.

The mortality ratio (ratio of observed deaths to expected deaths) among male patients was 1.10 and that among the females was 0.84. The pattern of mortality ratios in Table 1 demonstrates the marked severity of diabetes with an earlier age of onset. The subject in whom diabetes develops before the age of 30 shows a high mortality ratio of 6.36 (p<0.05). Table 2 shows the high mortality ratio among patients treated by insulin. In Table 3 is shown the high mortality ratio among patients who had both diabetic retinopathy and proteinuria at registration and the low mortality ratio among the patients who had neither retinopathy nor proteinuria. The cumulative number of deaths by main direct cause of death among the study population is illustrated in Fig. 1. Table 4 shows the observed and expected numbers of deaths among the study population by underlying causes

<table>
<thead>
<tr>
<th>Age at onset</th>
<th>Number of cases</th>
<th>Number of deaths</th>
<th>Obs./Exp.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Observed</td>
<td>Expected</td>
</tr>
<tr>
<td>0-29</td>
<td>141</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>30-39</td>
<td>267</td>
<td>10</td>
<td>6.3</td>
</tr>
<tr>
<td>40-49</td>
<td>453</td>
<td>24</td>
<td>15.8</td>
</tr>
<tr>
<td>50-59</td>
<td>477</td>
<td>49</td>
<td>38.1</td>
</tr>
<tr>
<td>60-</td>
<td>291</td>
<td>50</td>
<td>77.7</td>
</tr>
<tr>
<td>Total</td>
<td>1,629</td>
<td>140</td>
<td>139.0</td>
</tr>
</tbody>
</table>

* p<0.05.

<table>
<thead>
<tr>
<th>Methods of therapy</th>
<th>Number of cases</th>
<th>Mean age†</th>
<th>Number of deaths</th>
<th>Obs./Exp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>553</td>
<td>57.9</td>
<td>38</td>
<td>53.7</td>
</tr>
<tr>
<td>Oral‡</td>
<td>592</td>
<td>58.9</td>
<td>48</td>
<td>63.9</td>
</tr>
<tr>
<td>Insulin</td>
<td>261</td>
<td>47.3</td>
<td>35</td>
<td>9.1</td>
</tr>
</tbody>
</table>

* p<0.01. † Mean age at registration. ‡ Oral hypoglycemic agents.
Table 3. Number of deaths over four years in the four diabetic groups and the general population matched for sex and age

<table>
<thead>
<tr>
<th>At registration</th>
<th>Number of deaths</th>
<th>Obs./Exp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinopathy</td>
<td>Proteinuria</td>
<td>number of cases</td>
</tr>
<tr>
<td>Group I</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Group II</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Group III</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Group IV</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* p < 0.05, † p < 0.01.

Fig. 1. Cumulative number of deaths by main direct cause of deaths among the 1,629 diabetics.

Table 4. Number of deaths over four years by underlying causes of death among the 1,629 diabetics and the general population matched for sex and age

<table>
<thead>
<tr>
<th>Underlying cause of death</th>
<th>Number of deaths</th>
<th>Obs./Exp.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed</td>
<td>Expected</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>26</td>
<td>2.0</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>23</td>
<td>10.2</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>16</td>
<td>37.7</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>44</td>
<td>29.7</td>
</tr>
<tr>
<td>Cirrhosis of the liver</td>
<td>5</td>
<td>2.9</td>
</tr>
<tr>
<td>Other causes of death</td>
<td>26</td>
<td>56.5</td>
</tr>
<tr>
<td>All causes</td>
<td>140</td>
<td>139.0</td>
</tr>
</tbody>
</table>

* p < 0.05, † p < 0.01.
of death selected according to the International Classification of Disease.

DISCUSSION

In this study, it was shown that the risk factors increasing the mortality ratio among Japanese diabetics were early onset of diabetes, treatment by insulin and presence of diabetic retinopathy combined with proteinuria at registration. In a report by Goodkin (1975), the same trend was pointed out. In our previous report (Hirata and Mihara 1976) concerning causes of death among Japanese diabetics, the most frequent cause of death was cerebrovascular disease, the second diabetic nephropathy and the third malignant neoplasms. In this study malignant neoplasms were the leading cause of death among the 140 deceased diabetics and ischemic heart disease and cerebrovascular disease followed.

Analysis of the underlying causes of death in this study showed a significant excess mortality due to diabetes mellitus and ischemic heart disease among Japanese diabetics compared with the general population. This trend was also pointed out in the report from the Joslin Clinic by Kessler (1971).

References