OVERVIEW

Overview of the Japan Collaborative Cohort Study for Evaluation of Cancer (JACC)

Akiko Tamakoshi

Abstract

Starting in the late 1980s, a major collaborative effort has been carried out in Japan to increase knowledge about factors contributing to mortality from cancer and circulatory disease. This Japan Collaborative Cohort Study (JACC Study) is sponsored by the Ministry of Education, Science, Sports and Culture of Japan (Monbukagakusho) and has contributions from 45 areas of the country. With Drs Kunio Aoki and Yoshiyuki Ohno as leading figures in this endeavour, the cohort now covers more than 100,000 participants enrolled at various centers located from Hokkaido in the North to Kyushu in the South. To collect epidemiological information at baseline, a self-administered questionnaire was used. Follow-up was to 2003 in the majority of cases and a total of 17,404 deaths were registered, the five commonest sites of cancer development being the lung, stomach, liver, pancreas and colon in men, and the stomach, lung, liver, colon and pancreas in women.

Keywords: Japan Collaborative Cohort Study - cancer - circulatory disease - questionnaire

Introduction

To enlarge our knowledge about life-style factors and mortality from total causes and major cancers systematically, with additional attention to coronary heart disease and stroke in Japan, we have completed this supplement publication based on the Japan Collaborative Cohort Study (JACC Study) for Evaluation of Cancer Risk sponsored by the Ministry of Education, Science, Sports and Culture of Japan (Monbusho).

The JACC Study is a large-scale population-based study started in the late 1980s (Aoki, 1996, Ohno et al, 2001, Tamakoshi et al, 2005) to reveal risk factors and to provide cancer prevention strategies. It includes 45 areas in Japan: 3 towns in Hokkaido district, 5 towns in Tohoku, 5 towns in Kanto, 1 city, 3 towns and 2 villages in the Chubu, 8 towns and 2 villages in Kinki, 1 city and 1 town in Chugoku, and 4 cities, and 9 towns and 1 village in Kyushu (none in the Shikoku district, see Figure 1). Follow-up has already been carried out until 2003 except in 3 areas.

Because the JACC Study is based on more than 100,000 subjects recruited from almost the whole of Japan with a reasonably long follow-up period, the matrix data we provide in the present special supplement should greatly help us to clarify our knowledge about life-style factors and death from cancer and circulatory diseases, like coronary heart disease and stroke in Japan.

Subjects and Methods

Study Participants

From 1988 through 1990, we established the JACC study in 45 areas in Japan. This was a multicenter-collaborative study, in which 24 institutions voluntarily participated. The recruitment of the study subjects was dependant on each investigator, who had the responsibility to collect epidemiological information at baseline, to design the study and to collect the data over a long period.

Because the JACC Study is based on more than 100,000 subjects recruited from almost the whole of Japan with a reasonably long follow-up period, the matrix data we provide in the present special supplement should greatly help us to clarify our knowledge about life-style factors and death from cancer and circulatory diseases, like coronary heart disease and stroke in Japan.
to construct a cohort in each area. In 22 out of 45 areas, all residents living in the target area (not always equal to the whole area, but usually somewhat smaller and readily describable included districts) were regarded as study subjects, and questionnaires were supplied. In 20 areas, those who had undertaken a basic health examination that was conducted under the Health and Medical Service Law for the Aged were invited to participate in the study. In 2 areas, the study subjects were those examinees of health examination plus volunteers. In 1 area, subjects were defined based on the health checkup for atomic bomb survivors. To participate in the study, individual informed consent was obtained in 36 out of 45 areas (written consent in 35 areas and oral consent in 1 area), and in the remaining 9 areas, group consent from the head of the area was obtained.

**Questionnaire**

To collect epidemiological information at baseline, a self-administered questionnaire was used to collect demographic information: past medical history; family medical history; health condition one year prior to entry; exercise/sports activities engaged in; frequency of food intake and preference for salty and fatty foods; smoking and alcohol drinking status; health check-up history; occupation; residential area; education; behavioral attitude/stress; and reproductive history for women. All information was entered into a computer using the same format, under the responsibility of each investigator, and then sent to the central secretariat of the JACC study restricting face-sheet information so that anyone outside the study area was also annually verified by the investigator in each area by reviewing population-register sheets of the cohort members. We executed follow-up until the end of 2003, except in 3 areas, in which follow-up was stopped at the end of 1999.

**Data Analysis**

There were 110,792 subjects (46,465 men and 64,327 women), aged 40 to 79 years at the baseline. From those, we excluded 1,014 participants with previous history of cancer at any site at the baseline, thus 109,778 were a basic target of the analysis. We also excluded subjects who did not answer the target question item from each analysis. Therefore, the numbers of subjects, observed person-years and total and cause-specific deaths in each table were different.

For each participant, the person years of follow-up were calculated from the date of filling out the baseline questionnaire to death, moving out of the community, or the end of 2003 (1999 in 3 areas), whichever came first. The sex-specific relative risks and 95% confidence intervals of total mortality, total cancer mortality (C00-C97 by ICD-10), cause-specific cancer mortality, death from ischemic heart disease (I20-I25) and cerebrovascular disease (I60-I69) were calculated by using the Cox proportional hazard model adjusted for age group and areas. We picked up cancer sites with more than 100 events, thus we dealt with cancers of esophagus (C15), stomach (C16), colon (C18), rectum(C19-C20), liver (C22), gall bladder/duct (C23), pancreas (C25), lung (C33-C34), breast (C50), cervix uteri (C53), prostate (C61), kidney (C64), urothelial tract (C65-C67), non-Hodgkin lymphoma (C82-C85), multiple myeloma (C90) and myeloid leukemia (C92) for the purpose of this article.

**Follow-up**

The date and cause of death were annually or biannually confirmed, with the permission of the director-general of the Prime Minister’s Office (Ministry of Public Management, Home Affairs, Post and Telecommunications). The date of move-outs from the study area was also annually verified by the investigator in each area by reviewing population-register sheets of the cohort members. We executed follow-up until the end of 2003, except in 3 areas, in which follow-up was stopped at the end of 1999.

**Ethical Review**

Our entire study design, which comprised singular and collective use of epidemiologic data and biological materials (serum only), was approved in 2000 by the Ethical Board at Nagoya University School of Medicine.

**Table 1. Characteristics of the Study Population**

<table>
<thead>
<tr>
<th></th>
<th>40-44</th>
<th>45-49</th>
<th>50-54</th>
<th>55-59</th>
<th>60-64</th>
<th>65-69</th>
<th>70-74</th>
<th>75-79</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number at baseline</td>
<td>5,995</td>
<td>5,797</td>
<td>6,310</td>
<td>7,655</td>
<td>8,362</td>
<td>5,468</td>
<td>3,965</td>
<td>2,626</td>
<td>46,178</td>
</tr>
<tr>
<td>Number of deaths</td>
<td>233</td>
<td>350</td>
<td>665</td>
<td>1,201</td>
<td>1,977</td>
<td>1,935</td>
<td>2,079</td>
<td>1,790</td>
<td>10,230</td>
</tr>
<tr>
<td>Number of move-outs</td>
<td>407</td>
<td>300</td>
<td>230</td>
<td>219</td>
<td>204</td>
<td>181</td>
<td>145</td>
<td>90</td>
<td>1,776</td>
</tr>
<tr>
<td>Person-years</td>
<td>81,805</td>
<td>78,976</td>
<td>84,932</td>
<td>99,543</td>
<td>103,068</td>
<td>63,840</td>
<td>40,415</td>
<td>22,898</td>
<td>575,477</td>
</tr>
<tr>
<td>Mortality rate*</td>
<td>2.8</td>
<td>4.4</td>
<td>7.8</td>
<td>12.1</td>
<td>19.2</td>
<td>30.3</td>
<td>51.4</td>
<td>78.2</td>
<td>17.8</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number at baseline</td>
<td>7,530</td>
<td>7,870</td>
<td>9,039</td>
<td>10,700</td>
<td>10,948</td>
<td>8,461</td>
<td>5,459</td>
<td>3,593</td>
<td>63,600</td>
</tr>
<tr>
<td>Number of deaths</td>
<td>137</td>
<td>219</td>
<td>344</td>
<td>644</td>
<td>1,085</td>
<td>1,402</td>
<td>1,595</td>
<td>1,748</td>
<td>7147</td>
</tr>
<tr>
<td>Number of move-outs</td>
<td>477</td>
<td>365</td>
<td>367</td>
<td>373</td>
<td>397</td>
<td>410</td>
<td>353</td>
<td>237</td>
<td>2979</td>
</tr>
<tr>
<td>Person-years</td>
<td>102,613</td>
<td>106,831</td>
<td>122,636</td>
<td>142,301</td>
<td>140,083</td>
<td>103,791</td>
<td>62,590</td>
<td>36,824</td>
<td>817,669</td>
</tr>
<tr>
<td>Mortality rate</td>
<td>1.3</td>
<td>2.0</td>
<td>2.8</td>
<td>4.5</td>
<td>7.7</td>
<td>13.5</td>
<td>25.5</td>
<td>47.5</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number at baseline</td>
<td>13,525</td>
<td>13,667</td>
<td>15,349</td>
<td>18,355</td>
<td>19,310</td>
<td>13,929</td>
<td>9,424</td>
<td>6,219</td>
<td>109,778</td>
</tr>
<tr>
<td>Number of deaths</td>
<td>370</td>
<td>569</td>
<td>1,009</td>
<td>1,845</td>
<td>3,062</td>
<td>3,337</td>
<td>3,674</td>
<td>3,538</td>
<td>17,404</td>
</tr>
<tr>
<td>Number of move-outs</td>
<td>884</td>
<td>665</td>
<td>597</td>
<td>592</td>
<td>601</td>
<td>591</td>
<td>498</td>
<td>327</td>
<td>4,755</td>
</tr>
<tr>
<td>Person-years</td>
<td>184,418</td>
<td>185,807</td>
<td>207,568</td>
<td>241,845</td>
<td>243,151</td>
<td>167,632</td>
<td>103,005</td>
<td>59,721</td>
<td>1,393,146</td>
</tr>
<tr>
<td>Mortality rate</td>
<td>2.0</td>
<td>3.1</td>
<td>4.9</td>
<td>7.6</td>
<td>12.6</td>
<td>19.9</td>
<td>35.7</td>
<td>59.2</td>
<td>12.5</td>
</tr>
</tbody>
</table>

* Per 1,000 person years.
Results

The mean follow-up periods were 12.5 years for men and 12.9 years for women. There were 17,404 deaths (10,230 men and 7,174 women) occurred during follow-up period. As shown in Table 1, mortality rates of men were higher than those of women in any age group. Among men’s cancer mortality, the five commonest sites were lung, stomach, liver, pancreas and colon, and among women, those were stomach, lung, liver, colon and pancreas (Table 2).

Discussion

With more than 12 years of follow-up, almost 15% of subjects in our cohort died, and one-third of mortality was caused by cancer. The follow-up condition of mortality with cancer site shown here was almost the same as that of the end of 1999 (Watanabe et al., 2005a). It must be useful for understanding risk factors of cancer with the matrix shown in this supplement and for constructing a comprehensive cancer prevention strategy.

Table 2. Mortality Overall

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>ICD Code</th>
<th>40-44</th>
<th>45-49</th>
<th>50-54</th>
<th>55-59</th>
<th>60-64</th>
<th>65-69</th>
<th>70-74</th>
<th>75-79</th>
<th>Total</th>
<th>%</th>
<th>%*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men All causes</td>
<td>233 350 665 1,201 1,977 1,935 2,079 1,790 10,230 100.0</td>
<td>100.0</td>
<td>38.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All cancers</td>
<td>C00-97</td>
<td>85 152 309 561 958 731 622 476 3,894 100.0</td>
<td>32.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td>C15</td>
<td>5 7 21 30 40 26 15 9 153 3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomach</td>
<td>C16</td>
<td>19 34 54 118 184 141 129 98 777 20.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colon</td>
<td>C18</td>
<td>11 6 24 28 49 34 34 33 219 5.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectum</td>
<td>C19-20</td>
<td>6 14 14 38 25 26 23 18 164 4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>C22</td>
<td>11 25 58 80 132 63 58 36 463 11.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gall bladder</td>
<td>C23</td>
<td>0 1 5 7 12 26 10 11 72 1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>C25</td>
<td>6 10 12 32 46 44 38 36 224 5.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung</td>
<td>C33-34</td>
<td>13 19 59 114 249 200 149 101 904 23.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prostate</td>
<td>C61</td>
<td>1 1 7 9 34 30 43 43 169 4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>C64</td>
<td>0 3 2 9 11 6 11 4 46 1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urothelial tract</td>
<td>C65-67</td>
<td>0 3 3 6 22 21 25 14 94 2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hodgkin’s lymphoma</td>
<td>C82-85</td>
<td>0 4 10 13 26 16 12 12 93 2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td>C90</td>
<td>1 3 3 6 13 10 8 5 49 1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myeloid leukemia</td>
<td>C92</td>
<td>3 6 4 8 10 4 7 2 44 1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>I20-25</td>
<td>18 27 39 77 107 126 143 129 666 16.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>I60-69</td>
<td>17 29 73 129 220 267 327 260 1,322 12.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Women All causes | 137 219 344 644 1,085 1,402 1,595 1,748 7,174 100.0 | 100.0 |
| All cancers | C00-97 | 70 109 182 318 451 440 423 332 2,325 100.0 | 32.4 |
| Esophagus | C15 | 0 1 3 2 3 6 6 6 27 1.2 |
| Stomach | C16 | 10 15 18 59 63 78 77 66 386 16.6 |
| Colon | C18 | 0 10 19 29 37 46 36 43 220 9.5 |
| Rectum | C19-20 | 5 4 8 12 23 11 17 9 89 3.8 |
| Liver | C22 | 3 7 15 38 53 55 25 31 227 9.8 |
| Gall bladder | C23 | 2 7 8 12 12 16 26 12 95 4.1 |
| Pancreas | C25 | 2 8 12 27 53 43 45 27 217 9.3 |
| Lung | C33-34 | 8 8 22 32 65 49 51 33 268 11.5 |
| Breast | C50 | 14 15 18 17 14 12 7 6 103 4.4 |
| Cervix uteri | C53 | 5 2 8 2 5 4 5 5 36 1.5 |
| Kidney | C64 | 0 0 3 0 4 2 9 3 19 0.8 |
| Urothelial tract | C65-67 | 1 0 3 3 7 8 9 10 41 1.8 |
| Non-Hodgkin’s lymphoma | C82-85 | 1 3 4 14 18 10 10 5 65 2.8 |
| Multiple myeloma | C90 | 2 2 3 6 11 8 9 8 49 2.1 |
| Myeloid leukemia | C92 | 1 3 2 4 8 6 6 3 33 1.4 |
| Ischemic heart disease | I20-25 | 7 3 18 18 48 97 115 152 458 6.4 |
| Cerebrovascular disease | I60-69 | 17 24 35 69 129 232 313 332 1,151 16.0 |

*Percentage of deaths per all causes
Grants

The JACC Study has been supported by Grants-in-Aid for Scientific Research from the Ministry of Education, Science, Sports and Culture of Japan (Monbusho), and Grant-in-Aid for Scientific Research on Priority Areas of Cancer, and Grant-in-Aid for Scientific Research on Priority Areas of Cancer Epidemiology from the Japanese Ministry of Education, Science, Culture, Sports and Technology (Monbusho-Kagaku-sho) (No. 61010076, 62010074, 63010074, 1010068, 2151065, 3151064, 4151063, 5151069, 6279102, 11181101, 17015022 and 18014011).

Acknowledgements

The authors sincerely express their appreciation to Dr. Kunio Aoki, Professor Emeritus, Nagoya University School of Medicine and the former chairman of the JACC Study, and Dr. Haruo Sugano, the former Director, Cancer Institute, Tokyo, who greatly contributed to the initiation of the JACC Study, as well as Dr. Yoshiyuki Ohno, Professor Emeritus, Nagoya University School of Medicine, who was the past chairman of the study. The authors also wish to thank Dr. Tomoyuki Kitagawa, Cancer Institute of the Japanese Foundation for Cancer Research and the former chairman of Grant-in-Aid for Scientific Research on Priority Area ‘Cancer’ and Dr. Kazao Tajima, Aichi Cancer Center Research Institute and the former chairman of Grant-in-Aid for Scientific Research on Priority Area of Cancer Epidemiology for their full support of this study.

The past investigators of the study group, with the co-authorship of this paper, are as follows (in alphabetical order; affiliations are those where they participated in the study): Dr. Sadamu Anzai, Showa University School of Medicine; Dr. Kunio Aoki, Aichi Cancer Center; Dr. Isaburo Fujimoto, Center for Adult Diseases, Osaka; Dr. Katsuhito Fukuda, Kurume University School of Medicine; Dr. Noriyuki Hachiya, Akita University School of Medicine; Dr. Tsutomu Hashimoto, Wakayama Medical University; Dr. Norihiko Hayakawa, Research Institute for Radiation Biology and Medicine, Hiroshima University; Dr. Tomio Hirohata, Kyushu University School of Medicine; Dr. Shigeru Hisamichi, Tohoku University Graduate School of Medicine; Dr. Teruo Ishibashi, Asama General Hospital; Dr. Yoshinori Ito, Fujita Health University School of Health Sciences; Dr. Sigetoshi Kamiyama, Akita University School of Medicine; Dr. Shuugo Kanamori, Shiga Medical Center for Adults; Dr. Takeshi Kawaguchi, Showa University School of Medicine; Dr. Keiichi Kawai, Kyoto Prefectural University of Medicine; Dr. Akio Koizumi, Graduate School of Medicine and Faculty of Medicine, Kyoto University; Dr. Yoshiho Komachi, University of Tsukuba, Institute of Community Medicine; Dr. Minoru Kurihara, Research Institute for Radiation Biology and Medicine, Hiroshima University; Dr. Motofumi Masaki, Showa University School of Medicine; Dr. Minoru Matsuzaki, Chigasaki Public Health and Welfare Center; Dr. Hirotsugu Miyake, Sapporo Medical University School of Medicine; Dr. Masachika Morimoto, Shiga Medical Center for Adults; Dr. Shinetsu Morio, Kanagawa Cancer Center; Dr. Motoi Murata, Chiba Cancer Center; Dr. Shuichi Nakagawa, Kyoto Prefectural University of Medicine; Dr. Kenichi Nakamura, Showa University School of Medicine; Dr. Masahiro Nakao, Kyoto Prefectural University of Medicine; Dr. Yoshiyuki Ohno, Nagoya University Graduate School of Medicine; Dr. Ruichiro Sasaki, Aichi Medical University; Dr. Takashi Shimamoto, Institute of Community Medicine, University of Tsukuba; Dr. Hirooyuki Shimizu, Gifu University School of Medicine; Dr. Iwao Sugimura, Asahikawa Kosei Hospital; Dr. Minoru Sugita, Toho University School of Medicine; Dr. Takaichiro Suzuki, Research Institute, Osaka Medical Center for Cancer and Cardiovascular Diseases; Dr. Yukio Takizawa, Akita University School of Medicine; Dr. Heizo Tanaka, Medical Research Institute, Tokyo Medical and Dental University; Dr. Toshihiko Tanaka, Chigasaki Public Health Center; Dr. Suketami Tominaga, Aichi Cancer Center Research Institute; Dr. Hideaki Toyoshima, Nagoya University Graduate School of Medicine; Dr. Hiroki Watanabe, Kyoto Prefectural University of Medicine; Dr. Shaw Watanabe, Tokyo University of Agriculture; Dr. Hiroshi Yanagawa, Jichi Medical School; and Dr. Seishi Yoshimura, Shiga Medical Center for Adults.

References


by smoking status: findings from the Japan Collaborative Cohort Study. *Int J Cancer, 105*, 249-54.


Overview of the JACC Study
Akiko Tamakoshi


