Relationship of Dietary and Smoking Habits with Stomach Cancer: A Case-control Study of Stomach Cancer in Saitama, Japan

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Dietary and smoking habits were examined in 66,707 participants in a mass screening test for stomach cancer in Saitama, Japan. Eighty-eight participants with stomach cancer, diagnosed by barium X-ray examination and histologically verified after endoscopic examination, were compared with the remaining 66,619 participants, in a case-control study. In a food consumption frequency questionnaire, dietary habits were investigated on the basis of intake of six individual food items: rice, miso soup, boiled fish, pickled vegetables, nuts, and seaweed; and seven food groups: potatoes, soybean products (except miso soup), fruits, green-yellow vegetables, white vegetables, raw vegetables, and fish/shellfish (all types); together with current cigarette smoking status and individual preference for salty foods. There was no substantial association between the risk of stomach cancer and the consumption of any dietary item, except for the consumption of rice (four or more bowls per day, RR=0.2; CI: 0.1 to 0.6). Neither was an increase in risk from cigarette smoking found. The risk score assessment revealed no correlation between risk and risk scores. In spite of the limitations of the present study, our findings seem to support the view that the lifestyles of stomach cancer patients found in the mass study were different from those of stomach cancer patients found in hospitals. J Epidemiol, 1994; 4: 59-63.

case-control, diet, smoking, stomach cancer

The mortality rate for stomach cancer has fallen gradually in Japan, possibly following the westernization of food intake in this country[1]. Western-type foods, i.e. milk products, animal meats, fatty foods, raw vegetables, and fruits have been more frequently consumed than ever while the main Japanese traditional foods, i.e. rice and salty foods have been consumed less so. Diet has been a main focus in the epidemiology of stomach cancer, and it has been suggested that diets high in salt and low in raw vegetables and fruits increase the risk of this cancer. Evidence for this is inconclusive, however, because of inconsistent findings[2,3].

In recently published studies on stomach cancer, the relative risks of etiological factors are usually around 2. Trichopoulos et al.[4] and La Vecchia et al.[5] have found that a clearer picture of risk is obtained if food items associated with stomach cancer are considered jointly. Even the simple addition of a few items led to a marked increase; for example, individuals with a low frequency of vegetable and fruit consumption and high intake of starchy foods had almost 7 times the risk of stomach cancer than those reporting high vegetable/fruit and low starch intake (RR=6.9; 95% CI=3.7-13.1)[6].

Our previous studies[6,7] showed that current cigarette smoking, preference for salty foods, and the consumption of rice, miso soup, boiled fish, and pickled vegetables were positively related, and the consumption of nuts, seaweed, potatoes, soybean products, fruits, green-yellow vegetables, white vegetables, raw vegetables, and fish/shellfish were inversely related to the risk of stomach cancer, and the same clear picture of risk was observed in a combined risk score (RR=5.3; 95% CI=3.2-8.6; trend P<0.01).

The aim of the present study was to examine whether our previous observation could be reproduced in a different set of population.

MATERIALS AND METHODS

Saitama Prefecture had a total population of 6,400,000 in 1990 in 92 cities, towns, and villages. Of the residents...
Table 1. Agreement of consumption frequencies assessed by the repeated survey.

| Item                                | Identical answer (%) |
|-------------------------------------|----------------------|
| Preference for salty foods          | 87.6                 |
| Current cigarette smoking           | 96.1                 |
| **Six individual food items**       |                      |
| Rice                                | 88.8                 |
| Miso soup                           | 93.3                 |
| Boiled fish                         | 73.7                 |
| Pickled vegetables                  | 76.0                 |
| Nuts                                | 69.8                 |
| Seaweed                             | 83.8                 |
| **Seven food groups**               |                      |
| Potatoes                            | 69.5                 |
| Soybean products (except miso soup) | 82.7                 |
| Fruits                              | 89.4                 |
| vegetables                          | 83.1                 |
| White vegetables                    | 89.4                 |
| Raw vegetables                      | 83.6                 |
| Fish/shellfish                      | 74.1                 |

* 179 pair data

Table 2. Distribution of cases and controls by sex and age.

| Age group | Cases | Controls |
|-----------|-------|----------|
|           | Male  | Female   | Male  | Female |
| -44       | 5     | 6        | 3610  | 13420  |
| 45-54     | 5     | 12       | 4014  | 17500  |
| 55-64     | 13    | 9        | 4741  | 13228  |
| 65-74     | 16    | 8        | 3681  | 5203   |
| 75+       | 12    | 2        | 696   | 526    |
| Total     | 51    | 37       | 16742 | 49877  |

The findings for both sexes were comparable and therefore are presented combined.

RESULTS

There was no measurable association between the risk of stomach cancer and the consumption of any dietary food and current cigarette smoking status, except with that for the consumption of rice (Table 3). The risk score assessment revealed no correlation between risk and risk scores (Table 4-(A)), showing a clear contrast to the results derived from our previous paper (Table 4-(B)).

DISCUSSION

We failed to find a positive association between diet and stomach cancer risk. Possible problems of the present study are now discussed.

It is well known that dietary assessment is not easy. Here, the reproducibility study shows rather low concordance between the two sets of answers given about dietary intake, ranging form 69.5% to 89.4% for the 13 food items and groups. Diet questions consisted of food consumption frequencies only; no quantitative assessments were made and responses were classified into only two categories, yes or no. Such assessment of dietary intake may make attaining the objective of the study difficult.
The second possible problem of the present study lies in the selection bias. As the subjects of the present study cooperated in a mass screening test for stomach cancer, they may be more health conscious. For instance, in the present study, there were significant differences ($P<0.01$ in both males and females: tested by the root square method) in the percentage of current smokers between the general population in Japan (about 56% in males and 13% in females, in 1990) and the 66,707 participants (about 43% and 9%, respectively). Yet, we find that the distribution of dietary risk scores of controls in the present study (Table 4A) is identical to that of the 294 general population controls from the previous study (Table 4B) (d.f.$=3$, $P=0.51$), making one wonder whether they were really so different from the general population in lifestyle after all.

The third possible problem is a length bias. It is said that stomach cancer patients found in mass screenings have better prognoses than those found in hospitals, which may be associated with diet. It seems likely, therefore, that diet plays some roles, although minor, in the overall risk of stomach cancer found in the mass screening. A case-control sample size is another possible problem in the present study. We had considered the level of relative risk that was regarded as important to detect and the exposure rate (proportion exposed) among controls in an unmatched study, and estimated the smallest detectable relative risk at 1.6 before we started the present survey. However, the exposure rate among controls exceeded or fell short of the original estimate for some categories of dietary food intake. This was partly responsible for the negative results.

Finally, a specific problem in the present study should be mentioned. Our finding on rice consumption was not consistent with the previous studies; rice consumption was inversely related to the risk of stomach cancer in the present study. In our previous studies, interviews of inpatients were conducted prior to diagnostic procedures by requesting information on lifestyle during the period before onset of symptoms that led to the current hospital admission. In contrast, all questions in this study were self-administered. It is possible that stomach cancer patients altered their diet because of their gastric discomfort, consuming less rice. In Japan, rice consumption per

### Table 3. Relative risks of stomach cancer by dietary item in food frequency questionnaire among participants in a mass screening test for stomach cancer.

| Item                                | No. of cases/controls | Relative risk | 95% Confidence interval | Risk score |
|-------------------------------------|-----------------------|---------------|--------------------------|------------|
| Preference for salty foods           |                       |               |                          |            |
| No                                  | 59/45005              | 1.0           |                          | 0          |
| Yes                                 | 29/21201              | 0.9           | 0.6-1.5                  | 1          |
| Current cigarette smoking           |                       |               |                          |            |
| No                                  | 62/54019              | 1.0           |                          | 0          |
| Yes                                 | 23/11601              | 1.1           | 0.6-1.8                  | 1          |
| Six individual food items           |                       |               |                          |            |
| Rice                                |                       |               |                          |            |
| $<=$ 3 bowls/day                    | 85/59115              | 1.0           |                          | 0          |
| $>=$ 4 bowls/day                    | 3/7323                | 0.2           | 0.1-0.6                  | 1          |
| Miso soup                           |                       |               |                          |            |
| $<=$ 2 cups/day                     | 77/62771              | 1.0           |                          | 0          |
| $>=$ 3 cups/day                     | 11/3656               | 1.6           | 0.8-3.1                  | 1          |
| Boiled fish                         |                       |               |                          |            |
| $<=$ 1/week                         | 38/35291              | 1.0           |                          | 0          |
| $>=$ 2/week                         | 50/31042              | 1.1           | 0.7-1.7                  | 1          |
| Pickled vegetables                  |                       |               |                          |            |
| $<=$ 1/day                          | 43/30821              | 1.0           |                          | 0          |
| $>=$ 2/day                          | 45/35658              | 0.8           | 0.5-1.1                  | 1          |
| Nuts                                |                       |               |                          |            |
| $<=$ 1/month                        | 51/35261              | 1.0           |                          | 1          |
| $>=$ 1/month                        | 35/30797              | 0.8           | 0.5-1.2                  | 0          |
| Seaweed                             |                       |               |                          |            |
| $<=$ 1/week                         | 6/6937                | 1.0           |                          | 1          |
| $>=$ 2/week                         | 80/59288              | 1.6           | 0.7-3.8                  | 0          |

(Continued)
Table 3. (Continued)

| Item                        | No. of cases/ controls | Relative riska | 95% Confidence interval | Risk scoreb |
|-----------------------------|------------------------|---------------|--------------------------|-------------|
| **Seven food groups**       |                        |               |                          |             |
| Potatoes                    |                        |               |                          |             |
| < = 4/week                  | 52/43435               | 1.0           |                          | 1           |
| > = 5/week                  | 33/22612               | 1.0           | 0.6-1.6                  | 0           |
| Soybean products (except miso soup) |                        |               |                          |             |
| < = 1/week                  | 17/9286                | 1.0           |                          | 1           |
| > = 2/week                  | 68/57001               | 0.6           | 0.3-1.0                  | 0           |
| Fruits                      |                        |               |                          |             |
| < = 1/week                  | 8/6592                 | 1.0           |                          | 1           |
| > = 2/week                  | 76/59645               | 1.2           | 0.5-2.5                  | 0           |
| Green-yellow vegetables     |                        |               |                          |             |
| < = 4/week                  | 17/12345               | 1.0           |                          | 1           |
| > = 5/week                  | 68/53915               | 0.9           | 0.5-1.6                  | 0           |
| White vegetables            |                        |               |                          |             |
| < = 4/week                  | 7/6238                 | 1.0           |                          | 1           |
| > = 5/week                  | 79/60014               | 1.4           | 0.6-3.1                  | 0           |
| Raw vegetables              |                        |               |                          |             |
| < = 1/week                  | 11/9364                | 1.0           |                          | 1           |
| > = 2/week                  | 75/56837               | 1.1           | 0.6-2.1                  | 0           |
| Fish/shellfish (all types)  |                        |               |                          |             |
| < = 4/day                   | 29/22348               | 1.0           |                          | 1           |
| > = 5/day                   | 56/43701               | 0.9           | 0.6-1.5                  | 0           |

a Based upon unconditional logistic regression; adjusted for sex and age (three categories).
b The risk score (1, 0) was assigned to all items because of that preference for salty foods, current cigarette smoking, rice, miso soup, boiled fish, and pickled vegetables were thought to be risk enhancing factors, and the others were thought to be risk reducing ones.6,7)

Table 4. Relative risks of stomach cancer by dietary risk scorea.

| Item                        | No. of cases/ controls | Relative riska | 95% Confidence interval |
|-----------------------------|------------------------|---------------|-------------------------|
| **(A) On participants in mass screening test for stomach cancer** |                        |               |                         |
| Risk score (Trend P < 0.87) |                        |               |                         |
| < = 3                       | 33/29017               | 1.0           |                         |
| = 4                         | 14/12298               | 0.8           | 0.4-1.6                 |
| = 5                         | 13/9083                | 1.0           | 0.5-1.9                 |
| > = 6                       | 21/12961               | 1.0           | 0.5-1.8                 |
| **(B) On 294 pairs derived from our previous paper** |                        |               |                         |
| Risk score (Trend P < 0.01)  |                        |               |                         |
| < = 3                       | 53/127                | 1.0           |                         |
| = 4                         | 55/66                 | 1.9           | 1.1-3.2                 |
| = 5                         | 58/45                 | 3.5           | 2.0-6.1                 |
| > = 6                       | 128/56                | 5.3           | 3.2-8.6                 |

a See text.
b There was no difference in data processing between (A) and (B), but unconditional and conditional logistic regression analyses were used for (A) and (B), respectively; adjusted for sex and age.

capita is decreasing year by year; a Japanese Government Report in 199213) showed a decrease from 216.1 g/day in 1985 to 197.9 g/day in 1990, suggesting that persons having more than four bowls of rice per day have become fewer. So, the assessment of rice consumption should be done with care, by researchers, for instance, a dose-response relationship.

In spite of the possible problems of the present study, our findings seem to support the view that the lifestyles of stomach cancer patients found in the mass study were different from those of stomach cancer patients found in hospitals. Their lifestyles should be further investigated by refinements of questionnaire and dietary assessment procedures, and comparison of histological types of stomach cancer should be undertaken.

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