Morbidity and health survey of wintering members in Japanese Antarctic research expedition

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ABSTRACT

Study design. The Japanese Antarctic Research Expedition (JARE) started in 1956. Syowa Station is the mother station of JARE at 69°00’S and 39°35’E in East Antarctica. An epidemiological survey of the wintering team of JARE was carried out based on the annual reports of JARE over the period 1956-2001. Methods. The total number of personnel was 1,236 including 3 females. The age of personnel was from 21 to 56 (average 33.1). We examined the proportion of personnel who had contracted disease with healthy personnel, as reported by the medical department at Syowa as well as a health survey of the latest party by biochemical analyses. Results. The total number of diseases was 4,760. The ratios of surgical-orthopedic, internal medical, and dental cases were 45%, 23%, and 13%, respectively. Only one death from a blizzard was recorded. In the latest party, serum levels for triglyceride, calcium, and gamma-glutamyl transpeptidase increased during the wintering period. Conclusion. The very low mortality of JARE may be due to the effective personnel selection and that there have been no severe accidents. There has been no deterioration in nutritional parameters in JARE recently.

Key words: Antarctica, disease distribution, health survey, frostbite, stress-related diseases, ultraviolet ray-related diseases

INTRODUCTION

The Japanese Antarctic Research Expedition (JARE) started in 1956. In JARE, a wintering team is assembled every year, and leaves Japan by icebreaker in November. People and materials are transported to Antarctica by this icebreaker once a year, and air transportation is not used. The members of the wintering team stay in Antarctica for 14 months. There is no supply from the outside world for 10 months, and wintering members cannot leave Antarctica during this period.

At Syowa Station, the Japanese Antarctic base, about 40 wintering members maintain year-round operation every year. Clarifying the trend of diseases and the condition of one’s health during the Antarctic winter provides useful information in working out countermeasures in Antarctica, and also in controlling the health of each member of the wintering team (1,2).

SUBJECTS AND METHODS

At Syowa Station (69°00’S, 39°35’E), the mean temperature is about -10°C. The sun does not set for about 60 days during the summer period from November to January, and does not rise for about 45 days during the winter period from May to July.

An epidemiological survey of the wintering team of JARE: The total number of wintering members of the 1st to 41st JARE (The 2nd and 6th JARE were excluded because there were no wintering teams those years), for the period from 1956 to 2001, is 1,236, including 3 females. The mean age is 33.1 years old (range 21-57). An epidemiological survey of the wintering teams of
JARE was carried out based on the annual reports of each JARE excepting the 1st and 24th JARE. The 1st and 24th JARE did not make medical reports. We examined the total number of cases of diseases and the trend of disease distribution.

A health survey of the most recent wintering team: A health survey of members of the 40th Japanese Antarctic Research Expedition was conducted; the subjects were 39 males and 1 female who underwent serial examinations for physical, hematological and sero-biochemical analyses, periodically, during the winter period between February 1999 and January 2000. Enough food was prepared and brought to Antarctica for the year and stored frozen. Subjects had 3 regular balanced meals a day. Intergroup differences were examined by analysis of variance. Differences were considered statistically significant at P < 0.05.

RESULTS

An epidemiological survey of the wintering team of JARE: the total number of cases of disease at Syowa Station was 4,744, and only one death from a blizzard was recorded. Table I shows the percentage of disease by the medical department. The highest percentage was found in the surgical/orthopedic domain at 45%, followed by internal medicine at 23% and dentistry at 13%. Other diseases in dermatology, ophthalmology, and so on, extended over almost all domains. Although differences in the action program and criteria for description by physicians of each team preclude simple comparison, the number of diseases per person in each team was 2 to 9 and did not decrease.

The total number of cases of frostbite was 326, and it had two peaks, one in May and one in September (Figure 1). The total number of cases of upper respiratory tract infection was 256, and it had a peak in December (Figure 2). The total number of stress-related diseases was 343, and it had a peak in June (Figure 3). Moreover, 4 cases of alcohol-related disease were recorded in June. The total number of ultraviolet (UV) ray-related diseases (photo dermatitis, cheilitis, and

| Table I. The percentage of diseases by the medical department at Syowa Station from 1956 to 2001. |
|----------------------------------|---|
| Surgery, orthopedics            | 45 |
| Internal medicine               | 23 |
| Dentistry                       | 13 |
| Dermatology                     | 7  |
| Ophthalmology                   | 6  |
| Otolaryngology                  | 4  |
| Psychiatry                      | 2  |
| Urology                         | 0.1 |

Figure 1. Seasonal change of total cases of frostbite at Syowa Station from 1956 to 2000.

Figure 2. Seasonal change of total cases of upper respiratory tract infection at Syowa Station from 1956 to 2000.
UV ophthalmia) was 127, and the number of these diseases has increased since around 1980 (Figure 4).

A health survey of the most recent wintering team: there was no significant change in body weight among the subjects. However, the percentage of body fat mass increased significantly compared to initial levels during the wintering period. Decreases in the number of white blood cells and platelets were observed during this period. There was no great change in serum levels of total cholesterol. In particular, serum levels of calcium and albumin in June 1999, in the polar night period, were significantly higher than initial levels. Compared to initial levels, serum levels of triglyceride and gamma-glutamyl transpeptidase increased significantly during the wintering period (Table II).

**Table II.** Seasonal variation in clinical parameters in the 40th Japanese Antarctic Research Expedition (mean±SD).

| Parameter                          | I (Feb ’99) | II (Jun ’99) | III (Oct ’99) | IV (Jan ’00) |
|-----------------------------------|-------------|--------------|---------------|--------------|
| Body weight (kg)                  | 69.8±9.4    | 70.4±8.9     | 70.1±8.2      | 69.7±8.8     |
| % body fat mass (%)               | 19.7±4.1    | 21.2±3.7a    | 21.0±3.3b     | 20.9±3.9a    |
| White cell count (x10^3/mm³)     | 60.6±13.9   | 59.5±13.6    | 55.0±13.2c    | 57.7±13.1    |
| Red cell count (x10^6/mm³)       | 493±38      | 500±40       | 504±39        | 505±39       |
| Hemoglobin (g/dl)                 | 15.3±1.1    | 15.6±1.2     | 15.7±1.2      | 16.0±1.2     |
| Platelet count (x10^4/mm³)       | 24.9±5.0    | 22.8±4.0a    | 22.0±4.2a     | 22.6±4.3a    |
| Serum albumin (g/l)               | 45.5±2.7    | 46.7±2.8a    | 45.7±2.4      | 47.7±3.5d    |
| Serum calcium (mmol/l)            | 2.02±0.10   | 2.11±0.09a   | 2.09±0.06b    | 2.07±0.08b   |
| Serum total cholesterol (mmol/l)  | 5.19±0.98   | 5.33±0.93    | 5.32±0.98     | 5.16±0.93    |
| Serum triglyceride (mmol/l)       | 1.20±0.48   | 1.45±0.71    | 1.42±0.73     | 1.64±0.76a   |
| Serum gamma-glutamyl transpeptidase (nkat/l) | 481±236       | 622±425a       | 626±394a       | 632±396a       |

* P<0.01 relative to I; * P<0.05 relative to I;

* P<0.05 relative to I and III; * P<0.01 relative to I and III.

Figure 3. Seasonal change of total cases of stress-related diseases at Syowa Station from 1956 to 2000.

Figure 4. Time series of total number of ultraviolet ray-related diseases per person at Syowa Station.
DISCUSSION

Some diseases have characteristic tendencies, and these observations may be useful for the prevention of severe illnesses. Only one death from a blizzard was recorded. The very low mortality rate of JARE may be due to effective personnel selection as well as the lack of chances for severe accidents.

The incidence of frostbite showed two peaks. The temperature in April and May is around -20°C, which is not so cold in Antarctica. However, members of JARE had not experienced this kind of coldness in Japan, and it is a season in which the temperature falls rapidly. Frostbite is caused partly by carelessness. Wintering members take care of to protect themselves after an episode of frostbite, so the incidence of frostbite decreases. However, the temperature falls further in August and September, and outdoor activities of members increase in that season. Therefore, the members cannot easily prevent frostbite.

It is said that infectious diseases do not break out much in Antarctica. However, we can find a prevalence of upper respiratory tract infection. When the icebreaker "SHIRASE" comes to pick up the wintering team every December, the common cold seems to spread at Syowa Station. It is called "SHIRASE cold". It is assumed that the icebreaker brings pathogenic microbes.

It is considered that isolation from the outside world produces various sources of stress (3). Especially, in the midwinter/polar night period, the sun does not rise, and several members of each team become depressed. Moreover, several cases of alcohol-related disease were recorded during this period. However, none of the subjects suffered from sever stress-related disease and there was no suicide. Many subjects might acclimate to "Antarctic life" at Syowa Station.

The destruction of the earth’s ozone layer affects the environment. The ozone hole was first detected during the Antarctic spring. Through meteorological data, the ozone hole was detected in spring of 1980 and has been enlarging ever since. UV related-diseases have increased since around the spring of 1980. Enlargement of the ozone hole may have influenced this trend.

At Syowa Station, goods and materials are brought in once a year. Fresh vegetables go bad one after another. So, intake of nutrients in the second half of wintering period is restricted, and that may be connected with the occurrence of disease. However, no deterioration in the nutritional parameters during this period was observed in the latest wintering team. Various foods keep well frozen, and two licensed cooks prepare every meal at the Syowa Station of today. Moreover, some members eat and drink too much between meals during the wintering period, and it is difficult to estimate exactly the individual intake in Showa Station. It has been reported that serum calcium did not decrease in spite of the absence of sunshine during the polar night period (4). We consider that an excess of nutrition during the wintering period is connected with changes in serum levels of triglyceride, gamma-glutamyl transpeptidase, and calcium. If anything, wintering nutrition may be excessive.

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