A Comparative Epidemiological Study on the Effects of Physical Fitness on Health Level

Jun Hiraoka, Yosikazu Nakamura, and Hiroshi Yanagawa

Clinical tests, a questionnaire on life style and mental health, and physical fitness tests were conducted on 3,132 individuals (1,796 men and 1,336 women) to find the relationships between physical fitness level and life style, mental health, or cardiovascular risk factors among Japanese.

Individuals with an advanced physical fitness level also exhibited optimum mental health: the odds ratio (OR) and 95% confidence interval (CI) for their sensation of fatigue (fast recovery) was 1.16 (95% CI = 1.00 to 1.35) and that for mood recovery (fast) was 1.29 (95% CI = 1.12 to 1.49).

Among those with an advanced physical fitness level, the following were rare (OR): daily smoking [0.78]; obesity (over 120%) [0.73 (95% CI = 0.62 to 0.87)]; thick subcutaneous fat (over 20 mm on the back) [0.77 (95% CI = 0.66 to 0.90)]; high blood sugar level [0.64 (95% CI = 0.50 to 0.82)]; and hypertension [0.67 (95% CI = 0.49 to 0.91)]. These are risks for circulatory diseases. These data show that risk factors associated with cardiovascular disease are more common in those with a low physical fitness level. J Epidemiol, 1996 ; 6 : 120-127.

During the past 50 years, the life style of the Japanese has undergone dramatic changes due to westernization. Their diets have changed to include large quantities of proteins and lipids and a smaller quantity of fibers, while the total caloric intake has increased. On the other hand, opportunities for physical activity have been decreased due to the development of transportation, industrial machinery, and automated household appliances. In association with these changes in life style, the prevalence of obesity and hyperlipidemia has increased. But among Japanese, the mortality rate from ischemic heart disease (for 100,000 people) was 9.9 in 1950, increased until 1970, but was still 41.4 in 1992. This is much smaller than 196.7 in the United States and 287.5 in the U.K. Furthermore the prevalence of ischemic heart disease among Japanese is not on the rise.

Extensive previous investigations in the United States and Europe showed many risk factors for ischemic heart disease. Physical fitness is one. It is associated with a cardiopulmonary function, lipid and glucose metabolism, inhibition of aging of the musculoskeletal system, and recovery from mental strain. But it is not clear whether these facts apply to the Japanese.

This study is concerned with physical fitness and its relationship with risk factors in the Japanese. Specifically, the study intends to show the relationship between physical fitness and life style, mental health, or other cardiovascular risk factors.

METHODS

The subjects of the study were 3,132 individuals (1,796 men and 1,336 women) who had been examined at one of the seven centers for health promotion (Hyogo Prefectural Center, Tottori Prefectural East Center, Tottori Prefectural West Center, Ehime Prefectural Center, Okinawa Prefectural General Center, Chiba City Center, and Takarazuka City Center). These centers for health promotion have been estab-

Received March 12, 1996 ; accepted June 3, 1996.

1Tako Central Hospital, Chiba, Japan.
2Department of Public Health, Jichi Medical School, Tochigi, Japan.
Address for correspondence : Jun Hiraoka, Tako Central Hospital, 388-1 Tako-machi Chiba, 289-22 Japan.
listed throughout Japan by local governments to promote and examine the health status of the general population. Examinees were given physical fitness and clinical tests and questioned about their life style and mental health status according to the standard guidelines. The physical fitness tests included the following 6 items: grip strength (average of right and left hands), side step, vertical jump, standing trunk flexion, sit-up, and Harvard step test. Through these tests, muscular strength, agility, power, flexibility, and endurance were measured. Each physical fitness test was performed according to a standard protocol and rated using the physical fitness test scoring chart. From this score, our physical fitness tests, a comprehensive index was prepared, which was then adjusted for sex and age, because we had prepared the scores using the deviation by sex and age classes from the standard physical fitness levels. Each item was rated on the 5-level physical fitness scale shown below:

Description of physical fitness scale:

| Score | Definition |
|-------|------------|
| 1 | Lower (less than m - 1.5 sd) |
| 2 | Slightly lower (between m - 1.5 sd and m - 0.5 sd) |
| 3 | Normal (between m - 0.5 sd and m + 0.5 sd) |
| 4 | Slightly higher (between m + 0.5 sd and m + 1.5 sd) |
| 5 | Higher (over m + 1.5 sd) |

The scores for the 6 items were added to obtain a comprehensive score. In the present study, this score was used as an index for the comprehensive physical fitness level. When one or two of the 6 test items was missing, a normal value (score 3) was given. To evaluate the score for physical fitness, 19 or less was classified as “low”, while 20 or higher was classified as “high”. This classification generally divided the subject population into two halves.

The clinical tests included subcutaneous fat on the back, blood sugar, serum total cholesterol, systolic blood pressure, diastolic blood pressure, height, and weight. A degree of obesity was computed by using the following formula:

Degree of obesity(%) = (weight / standard weight) * 100

The standard weight was obtained from the modified Broca index. Persons with a degree of obesity above 120% were classified as obese. Those with a degree of obesity under 90% were classified as thin. Individuals with a systolic blood pressure above 160 mmHg or with a diastolic blood pressure above 95 mmHg were classified as hypertensive. Blood sugar over 120 mg/dl was classified as hyperglycemia. Serum total cholesterol over 250 mg/dl was classified as hypercholerterinemica. Fasting was not required before blood specimen collection for clinical laboratory tests. The hematological tests were not standardized, so they were conducted at multiple facilities when their own methods were employed. There was a risk of misclassification. There was a tendency to underestimate differences between two physical fitness groups, owing to misclassifications. Even in such a case, we believe that the difference should be accepted if it was statistically significant.

Each examinee was questioned about life style, including tobacco use, alcohol drinking, and dietary habits. Each was also asked the following two questions: “do you recover from your fatigue sensation quickly?” and “do you usually make a quick recovery from a depressed mood?” We believed that the answers to these questions can be used as indices for mental health. The relationships between the physical fitness level and mental health and clinical tests were evaluated. These relationships were examined comprehensively first, followed by classification by sex and age. In the present study, this score was used as an index for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to age, the 40-to-49-year group was 44.7%; the 50-to-59-year group, 48.5%; and the group over 60 years, 59.4%. There was a tendency for an increase in the number of individuals with low physical fitness level with age.

Table 2 shows the percentage of various factors observed at the two levels of physical fitness. In the group with a high level

**DATA ANALYSIS**

For the relationship between the physical fitness level and each item, odds ratios and their 95% confidence levels for the high and low physical fitness level groups were computed, using the unconditional logistic models. First, adjustments were made for sex and age, age only, and sex only; and odds ratios and the 95% confidence levels were computed for the entire group, then for the two sex- and age-classified groups. Next, the statistically significant items were selected and simultaneously incorporated into the model for analysis, using an unconditional logistic model to detect any confounding factors.

**RESULTS**

Table 1 shows the number of subjects classified according to sex, age, and physical fitness level. Of the entire group, 51.3% were rated with higher levels of physical fitness. Among them, the proportion for men (61.5%) exceeded that of women (38.5%). When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age. When viewed in relation to sex, 55.0% of males and 46.3% of females were classified at a high physical fitness level. Among the males, the mean age for the low physical fitness level group was 51.1 years and that of the high fitness level group was 51.2 years. Among the females, the mean age for the low physical fitness level group was 52.0 years and that of the high fitness level group was 51.1 years. In these subgroups, there was little bias in age.
Effects of Physical Fitness on Health Level

Table 1. Number of subjects classified according to sex, age, and physical fitness level

| physical fitness level | low (-19) | high (20+) |
|------------------------|-----------|------------|
| total                  | 3132 (100)| 1526 (48.7)| 1606 (51.3)|
| sex                    |           |            |            |
| male                   | 1796 (100)| 809 (45.0) | 987 (55.0) |
| female                 | 1336 (100)| 717 (53.7) | 619 (46.3) |
| age                    |           |            |            |
| 40-49 yrs              | 1427 (100)| 638 (44.7) | 789 (55.3) |
| 50-59 yrs              | 1144 (100)| 555 (48.5) | 589 (51.5) |
| 60-69 yrs              | 561 (100) | 333 (59.4) | 228 (40.6) |
percentage in parentheses

of physical fitness, factors such as mood recovery (fast) was more frequent, while smoking (everyday), thinness (less than 89%), obesity (over 120%), high blood sugar level (over 120 mg/dl), and blood pressure (hypertension) were noted less frequently.

Figure 2 shows odds ratios and 95% confidence levels for groups with high and low physical fitness levels. The ratios have been adjusted for age and sex. The factors that are associated with high odds ratios are sensation of fatigue (swift recovery) [1.16 (1.00 to 1.35)] and mood recovery (fast) [1.29 (1.12 to 1.49)]. Those associated with low odds ratios, on the other hand, are smoking (every day) [0.78 (0.65 to 0.93)], obesity (over 120%) [0.73 (0.62 to 0.87)], subcutaneous fat (over 20 mm on the back) [0.77 (0.66 to 0.90)], blood sugar level (over 120 mg/dl) [0.64 (0.50 to 0.82)], and blood pressure (hypertension) [0.67 (0.49 to 0.91)].

Figure 3 shows odds ratios for 7 categories of body constitution (divided into 7 levels, from thinness to obesity, with a degree of obesity of 100 to 109 as the base) against comprehensive physical fitness. The odds ratio was reduced as the obesity classification deviates from the base level (either toward obesity or thinness). The ratio was significantly low at both ends; thinness below 79% (0.35 (0.16 to 0.76)) and obesity (over 120%) [0.48 (0.36 to 0.65)].

Table 3 shows the odds ratios for major factors examined against physical fitness levels for 2 age levels that were adjusted for sex and sex adjusted for age. Among the factors related to life style, cigarette smoking (every day) was associated with
Table 2. The percentage of the major parameters observed at the two levels of physical fitness.

| Parameter                              | Physical Fitness Level |
|----------------------------------------|------------------------|
|                                        | high (20+) | low (-19) |
|                                        | (1526)      | (1606)    |
| 1 lifestyle                            |             |           |
| smoking (every day)                    | 16.8%       | 23.4%     |
| drinking alcoholic beverages (every day)| 27.5%       | 30.7%     |
| habit of snacking (every day)          | 38.8%       | 35.5%     |
| soft drink consumption (every day)     | 19.4%       | 21.5%     |
| 2 mental health                        |             |           |
| fatigue sensation (swift recovery)     | 34.0%       | 31.1%     |
| mood recovery (fast)                   | 43.5%       | 37.0%     |
| 3 clinical tests                       |             |           |
| thinness (less than 89%)               | 5.6%        | 6.8%      |
| obesity (over 120%)                    | 20.4%       | 24.1%     |
| subcutaneous fat (over 20mm on the back)| 34.9%       | 37.1%     |
| blood sugar (over 120mg/dl)            | 7.7%        | 12.2%     |
| total cholesterol (over 250mg/dl)      | 7.8%        | 9.1%      |
| hypertension (BP, systolic 160mmHg+/diastolic 95mmHg+) | 4.8% | 7.2% |

Figure 2. The odds ratio and 95% confidence levels for each factor against comprehensive physical fitness level.
significantly low odds ratios in men and those over 50 years, while no correlation was noted with the habit of eating between meals (every day), alcohol drinking (every day), and soft drink consumption (every day), regardless of sex or age. For mental health, the odds ratios were significantly high for sensation of fatigue (swift recovery) in men and mood recovery (fast) in both men and women and those over 50 years. Among the clinical tests, the ratio for thinness (less than 89%) was [0.66 (0.45 to 0.96)] for men, while it was [1.62 (0.90 to 2.92)] for women, showing a reverse trend between the sexes. Obesity (over 120%) and the presence of subcutaneous fat (over 20 mm on the back) showed similar tendencies, with low ratios among women and those over 50 years. The odds ratio was low for the blood sugar level in men and in the two age groups. There was no significant relationship between the total cholesterol level and physical fitness. The blood pressure category (hypertensive level) in the group over 50 years of age showed a significantly low odds ratio [0.55 (0.38 to 0.80)].

The factors that were correlated with a high physical fitness level as independent variables were incorporated into a multivariate model simultaneously with sex and age classifications to perform logistic analyses. The results are shown in Table 4. When both the fatigue sensation (swift recovery) and mood recovery (fast) were incorporated into the model, the odds ratio was reduced. For the other factors, the 95% confidence level showed a wider spread in comparison with the univariate analyses but the general trend in both models was similar.

**DISCUSSION**

With advancing westernization of life style, an increase in

---

### Table 3. Odds ratios for the major factors observed in relation to physical fitness level by sex and age.

| sex* | age(yrs.)* | males | females | 40-49 | over 50 |
|------|------------|-------|---------|-------|--------|
| 1 life style | smoking | (every day) | 0.77(0.63-0.93) | 0.77(0.43-1.36) | 0.78(0.60-1.02) | 0.77(0.60-0.99) |
| | drinking alcoholic beverages | (every day) | 1.02(0.85-1.23) | 1.04(0.62-1.74) | 0.97(0.75-1.26) | 1.12(0.88-1.43) |
| | habit of snacking | (every day) | 0.97(0.77-1.22) | 1.03(0.83-1.29) | 1.08(0.84-1.38) | 0.89(0.72-1.10) |
| | soft drink consumption | (every day) | 0.93(0.75-1.16) | 0.86(0.64-1.15) | 0.94(0.72-1.22) | 0.87(0.68-1.11) |
| 2 mental health | fatigue sensation | (swift recovery) | 1.26(1.03-1.53) | 1.04(0.82-1.32) | 1.01(0.79-1.28) | 1.18(0.96-1.44) |
| | mood recovery | (fast) | 1.33(1.09-1.61) | 1.26(1.01-1.57) | 1.12(0.89-1.41) | 1.31(1.08-1.59) |
| 3 clinical tests | thinness | (less than 89%) | 0.66(0.45-0.96) | 1.62(0.90-2.92) | 0.75(0.47-1.21) | 0.81(0.54-1.23) |
| | obesity | (over 120%) | 0.97(0.75-1.24) | 0.55(0.43-0.71) | 0.80(0.60-1.07) | 0.70(0.56-0.87) |
| | subcutaneous fat | (over 20mm on the back) | 0.88(0.71-1.09) | 0.68(0.54-0.84) | 0.79(0.62-1.00) | 0.78(0.64-0.95) |
| | blood sugar | (over 120mg/dl) | 0.59(0.44-0.78) | 0.88(0.53-1.46) | 0.57(0.36-0.89) | 0.68(0.50-0.92) |
| | total cholesterol | (over 250mg/dl) | 0.73(0.50-1.06) | 0.82(0.57-1.17) | 0.83(0.51-1.33) | 0.79(0.58-1.08) |
| | hypertension | (BP, systolic 160mmHg+ /diastolic 95mmHg+) | 0.70(0.48-1.02) | 0.61(0.37-1.01) | 1.02(0.61-1.73) | 0.55(0.38-0.80) |

* adjusted for age  ** adjusted for sex  95% intervals in parentheses
Table 4. Odds ratios in relation to physical fitness level conducted by multivariate logistic model

| parameter                | odds ratio | 95%CI     |
|--------------------------|------------|-----------|
| (males)                  |            |           |
| smoking (every day)       | 0.79       | 0.65-0.96 |
| fatigue recovery (swift recovery) | 1.15 | 0.92-1.44 |
| mood recovery (fast)      | 1.25       | 1.00-1.56 |
| thinness (less than 89%)  | 0.67       | 0.46-0.98 |
| blood sugar (over 120mg/dl)| 0.57     | 0.43-0.76 |
| (females)                |            |           |
| mood recovery (fast)      | 1.34       | 1.07-1.68 |
| obesity (over 120%)      | 0.61       | 0.47-0.80 |
| subcutaneous fat (over 20mm on the back)| 0.78 | 0.61-0.99 |
| (40-49yrs.)              |            |           |
| subcutaneous fat (over 20mm on the back) | 0.81 | 0.63-1.02 |
| blood sugar (over 120mg/dl)| 0.58     | 0.37-0.91 |
| (over 50yrs.)            |            |           |
| smoking (every day)       | 0.76       | 0.59-0.99 |
| mood recovery (fast)      | 1.35       | 1.11-1.64 |
| obesity (over 120%)      | 0.77       | 0.61-0.98 |
| subcutaneous fat (over 20mm on the back) | 0.82 | 0.66-1.03 |
| blood sugar (over 120mg/dl)| 0.70     | 0.52-0.95 |
| hypertension (BP, systolic 160mmHg+ /diastolic 95mmHg+) | 0.59 | 0.40-0.86 |

the prevalence of ischemic heart disease is expected in Japan. But it is still much lower in Japan than in the United States or Europe. So it is not certain if many of the risk factors of cardiovascular diseases found in previous studies apply to the Japanese. This study deals with physical fitness (rather the absence of it) as a risk factor, and its purpose is to show the relationship between physical fitness level and lifestyle, mental health, and other cardiovascular risk factors among the Japanese.

The subjects were those who visited the 7 centers for health promotion that are located throughout Japan. We can safely assume that these subjects were willing to take positive steps to improve their health. In fact, it is highly likely that they represent a segment of the population who enjoy a higher level of physical fitness. We also believe, however, that it is possible to compare the characteristics of those with higher and lower physical fitness levels.

The type of physical fitness varies according to each test item. By evaluating each item individually, it is possible to determine the effect of a specific expression of fitness (e.g., muscular strength, agility, power, flexibility, and endurance). On the other hand, a type of physical fitness testing and a characteristic of physical fitness are not necessarily in a one-to-one relationship; instead, multiple characteristics of physical fitness overlap in a single test item. In the present study, therefore, the results of each physical fitness test were incorporated to prepare a single index expressing physical fitness. Furthermore, by integrating the test results, we could minimize the bias that may develop from assigning a median value to a test that had not been conducted. For the criteria to rate the level of physical fitness, we used the deviations from the standard for each age level. We originally thought that we could remove the effect of the difference in physical fitness according to age but we noted some skewing in the distribution in some items (e.g., bias toward the low side in standing trunk flexion and toward the high side in the vertical jumps). We assigned scores to the results of the physical fitness test, added them to obtain a comprehensive fitness level, and divided the sum into 2 groups at a point where the whole group was divided generally into two (-19 and 20+). The percentage of the “high” was higher among women and the older subjects, which is explained by a deviation of the standard value that is used in obtaining the comprehensive physical fitness level from the population. However, we do not believe that this deviation poses any problem because we have made adjustments for age and sex or separated the subjects according to these factors before the analyses.

On the whole, in the group composed of smokers the odds ratio was significantly small (less than 1) against the high physical fitness level. Even after separating the group by sex, the ratio was significantly low (less than 1). The female smok-
ers were limited in number (only 49 women, 3.7%). The 95% confidence level was spread too widely and no significance was detected. However, the odds ratio was low, showing a similar pattern as in men. According to past reports, the physical fitness level of smokers, in comparison with those who gave up smoking earlier in life or those who never smoked, is low.

The results of the present study support these findings.

The groups composed of individuals who swiftly recover from a sensation of fatigue or from a depressed mood showed odds ratios that were significantly higher than 1 in relation to the comprehensive physical fitness level. It has been reported that exercise uplifts one from depression or apprehension and brings a sense of being in a healthy state, which is substantiated by the results of the present study, because exercise improves the physical fitness level. The fact that a high physical fitness level contributes to a reduction in mortality or the risk of arteriosclerosis and promotes mental health is significant in that the quality of life is improved. We believe that guidance for a proper physical fitness level will assume increasing significance in the future.

Both high and low degrees of obesity (120% < and < 90%, respectively) were associated with an odds ratio that was significantly lower than 1 in relation to physical fitness. To confirm these trends, the odds ratios of the body constitution, ranging from thinness to obesity (with a degree of obesity from 100 to 110 as the bases) were computed against physical fitness. It was found that the ratios became significantly less than 1 as the degree of obesity deviated from the baseline (either toward heaviness or thinness). It is well-known that exercise is instrumental in adjusting body weight to approach a standard, which was again substantiated by this result. The slight deviation toward thinness would be due to the advantage enjoyed by thinner individuals during the physical fitness tests.

When the odds ratio for the thin individuals (less than 89%) in the physical fitness level was examined, it was less than 1 (0.66) for men but greater than 1 (1.62) for women, with the results reversed between men and women. If one considers the effect of regular exercise in correcting body weight, the small ratio for men is understandable. The higher odds ratio for the group of women with a higher physical fitness level is perhaps explained by the women's efforts to exercise until they achieved a certain aesthetically desirable thinness.

The odds ratio for the group composed of obese individuals (over 120%) to the comprehensive physical fitness level was separated for men and women. The ratio for women was significantly lower than 1 (0.55) and also much lower than the corresponding figure for men (0.97). It was found (see Figure 3) that a high physical fitness level was noted less frequently in the group with obesity. We believe that this tendency is more evident among women because from childhood females engage in less physical activity than males.

Greater subcutaneous fat accumulation exhibited tendencies similar to obese individuals in relation to continuing exercise and physical fitness, which is totally understandable.

When the group with a high blood sugar level (over 120 mg/dl) was examined as a whole, its odds ratio to the comprehensive physical fitness level was significantly less than 1 (0.64). The history of diabetes mellitus in the group with a high blood sugar level (over 120 mg/dl) was 27.4%, while for the group with a blood sugar level of 119 mg/dl or less it was 2.0%. Aging, obesity, and a lack of exercise are the major risk factors of diabetes mellitus. Therefore one expects, as a rule, diabetic patients to suffer from a lack of exercise; and their physical fitness is somewhat inferior to that of the normal population. It is readily expected that the group with a larger number of individuals with high blood sugar levels (and a number of diabetic patients with inferior physical fitness) would show a significantly low odds ratio to the comprehensive physical fitness level.

For the group with a high physical fitness level, the odds ratio was less than 1, not only in the hypertensive group but also in those who were obese or had high blood sugar levels. These tendencies were more pronounced among those over 50 years of age. Hypertension, obesity, and hyperglycemia are all risk factors for cardiovascular diseases. It is very important to maintain a high level of physical fitness to prevent circulatory diseases. We believe that it is highly effective to maintain a high level of physical fitness at the age of 50 and beyond to prevent circulatory diseases.

We evaluated confounding factors by multivariate analytical models and found that when two factors [sensation of fatigue (swift recovery) and mood recovery (fast)] are applied to the models simultaneously, the odds ratios for both were reduced. The other factors showed patterns similar to the instances of a single variable, suggesting that there is no confounding. The odds ratio for mood recovery (fast) to sensation of fatigue (swift recovery) is extremely high (8.98), suggesting that these 2 factors are very closely related. We believe that these two represent a similar mental state.

**CONCLUSION**

We observed the relationship between physical fitness level and life style, mental health, and clinical tests and obtained the following results. (The odds ratio together with 95% confidence level were computed for the group with a high physical fitness level against those with low fitness level.)

Among those with a high physical fitness level the odds ratio for daily smoking was low [0.78 (0.65 to 0.93)]. Many individuals in this group have good mental health: the odds ratio for their sensation of fatigue (swift recovery) was [1.16 (1.00 to 1.35)] and that for mood recovery (fast) was [1.29 (1.12 to 1.49)].
Thinness and obesity were scarce in this group and most registered standard body weights. The odds ratio for thinness (below 79%) to normal weight (100 to 109%) was [0.35 (0.16 to 0.76)] and the odds ratio for obesity (over 120%) was [0.48 (0.36 to 0.65)]. The odds ratio for subcutaneous fat accumulation (over 20 mm on the back) was low [0.77 (0.66 to 0.90)].

Moreover, in this group, the following were rare: high blood sugar level [0.64 (0.50 to 0.82) and hypertension [0.67 (0.49 to 0.91)]. These tendencies were more pronounced among those over 50 years of age.

From these results, it became evident that the risk factors for circulatory diseases, such as tobacco use, mental illness, obesity, hyperglycemia, and hypertension are low among those with a high physical fitness level.

REFERENCES

1. Blair SN, Kohl HW, Paffenbarger RS, Clark DG, Cooper KH, Gibbons L.W. Physical fitness and all-cause mortality. JAMA. 1989; 262 (17) : 2395 - 2401.
2. Fujita Y, Nakamura Y, Hiraoka J, Kobayashi K, Sakata K, Nagai M, Yanagawa H. Physical strength tests and mortality among visitors to Health-Promotion centers. J Clin Epidemiology. 1995 : 48 (12) (in press).
3. Technical Guideline for the Health Promotion Facilities. Guideline for approval of the Health Promotion Facilities. Health Promotion and Nutrition Section. Ministry of Health and Welfare. Tokyo: Chuou-Houki: 1986 : 166-215 (in Japanese).
4. Oda S. Exercise handbook for health promoting. Tokyo : Japan Daiichi Shuppan; 1987 (in Japanese).
5. Breslow NE, Day NE. Statistical Methods in Cancer Research Volume1. the Analysis of Case-Control Studies, Lyon:IRC Scientific Publications ; 1980 : 33.
6. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research, Principles and Quantitative Methods. New York: Van Nostrand Reinhold Company; 1982.
7. Conway TL, Cronan TA. Smoking, exercise, and physical fitness. Prev Med. 1992 ; 21 (6) : 723 - 734.
8. Klesges RC, Eck LH, Isbell TR, Fulliton W, Hanson CL. Smoking status : effects on the dietary intake, physical activity, and body fat of adult men. Am J Clin Nutr. 1990 ; 51 (5) : 784 - 789.
9. Perkins KA, Rohay J, Meilahm EN, Wing RR, Matthews KA, Kuller LH. Diet, alcohol, and physical activity as a function of smoking status in middle-aged women. Health Psychol. 1993 ; 12 (5) : 410 - 415.
10. Thirlaway K, Benton D. Participation in physical activity and cardiovascular fitness have different effects on mental health and mood. J Psychosom Res. 1992 ; 36 (7) : 657 - 665.
11. Brown SW, Welsh MC, Labbe EE, Vitulli WF, Kulkarni P. Aerobic exercise in the psychological treatment of adolescents. Percept Mot Skills. 1992 ; 74 (2) : 555 -560.
12. Blair SN, Kohl HW, Gordon NF, Paffenbarger RS Jr. How much physical activity is good for health?. Annu Rev Public Health. 1992 ; 13 : 99 - 126.
13. Vigorous physical activity among high school students--United States, 1990.MMWR-Morb-Mortal-Wkly-Rep. 1992 ; 41 (3) : 33 - 35.