Regular Physical Activity and Coronary Risk Factors in Japanese Men

Shiun Dong Hsieh, MD; Hideyo Yoshinaga, MD; Takashi Muto, MD; Yutaka Sakurai, MD

Background—Physical activity decreases the risk of coronary heart disease (CHD), but its effects on risk factors require further exploration.

Methods and Results—The study included 3331 adult Japanese men in whom health benefits, especially CHD risk factors, were compared among those who were sedentary and those who were engaged in continuous physical activity of 30 minutes or more per day for 1, 2 and ≥3 days per week. Significantly higher HDL cholesterol values; lower triglycerides, scapula, and iliac subcutaneous fat thickness; and lower smoking rates were noted in all physically active groups compared with the sedentary group, whereas body mass index did not differ significantly. Waist-to-height ratios and the prevalence of fatty liver were significantly lower in the groups who exercised 2 or ≥3 days per week than in the sedentary group. The lowest triglyceride values were noted in the group who exercised ≥3 days per week. Multiple regression analysis revealed both the frequency of physical activity and smoking status to be independent positive and negative factors, respectively, for the HDL cholesterol value. The sum of the risk factor scores for hypertension, abnormal glucose tolerance, hypertriglyceridemia, hypercholesterolemia, and low HDL cholesterol level (one point for each if present) was highest in the sedentary group (1.38, 1.19, 1.19, 0.99 for the sedentary group and the groups who exercised 1, 2, and ≥3 days per week).

Conclusions—Those who engaged in regular physical activity ≥3 days per week appeared to have the fewest coronary risk factors. However, even those engaged in physical activity once per week had fewer CHD risk factors than sedentary individuals. (Circulation. 1998;97:661-665.)

Key Words: exercise ■ risk factors ■ obesity

Methods

Subjects and Data Collection

The subjects were 3331 adult Japanese men (age, 48.3±8.4 years [mean±SD]) who underwent routine health examinations at Toranomon Hospital between April 1994 and March 1995 for early detection of disease. Most were government employees and office workers. The basic survey questions included, “How often do you engage in regular physical activity lasting 30 minutes or more?” “What kind of regular physical activity do you do?” And “What is your present smoking status?” Subjects were classified into the sedentary group if they did not engage in regular physical activity at least once per week. They were divided into four groups according to the replies, ie, sedentary and those engaged in regular physical activity 1, 2, or ≥3 days per week. The subject numbers and the ages of the four groups are shown in Table 1. There was no significant difference in age among the sedentary and physically active groups. The sedentary group accounted for most of the subjects (72%). Tennis (26.4%) and jogging (21.3%) were the most frequent activities in the physically active groups.

Measurement

Waist circumference was measured at the umbilical level with the subjects standing and breathing normally, and the waist-to-height ratio was calculated as an index of abdominal obesity.6-9 The subcutaneous fat thickness was measured at the middle of the posterior portion of the upper arm for the triceps area, at the inner margin of the lower end of...
the scapula for the scapula area, and near the umbilicus and the upper margin of the ilium for abdominal areas by the skin-fold caliper method. Blood was drawn from subjects in the fasted state. Blood glucose, serum triglyceride, cholesterol, and HDL cholesterol levels were measured by enzymatic methods, and hemoglobin A1c (HbA1c) was assessed by high-performance liquid chromatography. Fatty liver was diagnosed by echography.

The criteria for determining the sum of risk factor scores for hypertension, abnormal glucose tolerance, hypertriglyceridemia, hypercholesterolemia, and low HDL cholesterol level (one point for each if present) are shown in Table 2. The HbA1c level of 6.1% is based on the mean ± SD HbA1c of individuals with normal oral glucose tolerance test results.

**Statistical Analysis**

Probabilities of significant differences were compared by one-way ANOVA and the Tukey-Kramer honestly-significance-difference test for quantitative variables and by the χ² test for proportions. Correlations and multiple regression analysis for the frequencies of physical activity, smoking status, and HDL cholesterol values were also studied.

**Results**

**Obesity Indexes and Physical Activity**

Comparisons of various obesity indexes among the sedentary and physically active groups are shown in Table 3. There were significant differences across the groups except in body mass index (BMI). Significantly lower subcutaneous fat thickness

**TABLE 1. Subject Numbers and Ages of the Four Groups**

<table>
<thead>
<tr>
<th>Frequency of Physical Activity per Week</th>
<th>Sedentary</th>
<th>1 d</th>
<th>2 d</th>
<th>3 d</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2400</td>
<td>428</td>
<td>299</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td>(mean ± SD)</td>
<td>48.4 ± 8.7</td>
<td>48.8 ± 7.5</td>
<td>48.1 ± 7.6</td>
<td>47.6 ± 8.2</td>
<td>.324</td>
</tr>
</tbody>
</table>

Overall significant difference based on one-way ANOVA.

**TABLE 2. Criteria for Determining the Sum of CHD Risk Factor Scores**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg</td>
</tr>
<tr>
<td>Abnormal glucose tolerance</td>
<td>Fasting blood glucose ≥ 100 mg/dL and/or HbA1c &gt; 6.1%</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>Triglycerides ≥ 150 mg/dL</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>Cholesterol ≥ 220 mg/dL</td>
</tr>
<tr>
<td>Low HDL cholesterol level</td>
<td>HDL cholesterol &lt; 40 mg/dL</td>
</tr>
</tbody>
</table>

CHD indicates coronary heart disease; HbA1c, hemoglobin A1c. Sum of risk factor scores: one point for each item if present.

**TABLE 3. Obesity Indexes and Physical Activity**

<table>
<thead>
<tr>
<th>Frequency of Physical Activity per Week</th>
<th>Sedentary</th>
<th>1 d</th>
<th>2 d</th>
<th>3 d</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI, kg/m²</td>
<td>23.1 ± 2.6</td>
<td>23.1 ± 2.3</td>
<td>22.9 ± 2.3</td>
<td>23.0 ± 2.0</td>
<td>.5967</td>
</tr>
<tr>
<td>Subcutaneous fat thickness, triceps, mm</td>
<td>7.7 ± 3.2</td>
<td>7.1 ± 2.9</td>
<td>7.0 ± 3.0</td>
<td>6.9 ± 3.1</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Subcutaneous fat thickness, scapula, mm</td>
<td>18.4 ± 6.6</td>
<td>17.4 ± 5.8</td>
<td>17.0 ± 5.8</td>
<td>15.9 ± 5.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Subcutaneous fat thickness, near umbilicus, mm</td>
<td>24.2 ± 7.9</td>
<td>23.3 ± 7.4</td>
<td>22.1 ± 7.6</td>
<td>21.3 ± 8.1</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Subcutaneous fat thickness, ilium, mm</td>
<td>19.1 ± 8.0</td>
<td>18.0 ± 7.1</td>
<td>17.4 ± 7.8</td>
<td>17.0 ± 8.0</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Waist-to-height ratio</td>
<td>0.50 ± 0.04</td>
<td>0.50 ± 0.04</td>
<td>0.49 ± 0.04</td>
<td>0.49 ± 0.04</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

BMI indicates body mass index; S, sedentary. Values are mean ± SD. Overall significant difference based on one-way ANOVA.

*P < .05 by Tukey-Kramer honestly-significant-difference test.
was noted in the triceps, scapula, and iliac areas in the physically active groups compared with the sedentary group. On the other hand, significantly lower waist-to-height ratios and subcutaneous fat thickness near the umbilicus were noted in those who engaged in physical activity 2 or 3 days per week compared with the sedentary group. In addition, waist-to-height ratios and subcutaneous fat thickness at the scapula and near the umbilicus were also significantly lower in those who engaged in physical activity 3 days per week than in those who engaged in physical activity only once per week.

CHD Risk Factor Values and Physical Activity
Comparisons of CHD risk factor values among sedentary and physically active groups are shown in Table 4. There were significant differences across the groups for triglyceride and HDL cholesterol values but not for other risk factor values. Triglyceride values were significantly lower in the group engaged in physical activity 3 days per week than in any other group. On the other hand, HDL cholesterol values were significantly higher in all physically active groups than in the sedentary group.

Sum of CHD Risk Factor Scores and Physical Activity
The sum of CHD risk factor scores differed significantly across the groups. It was significantly higher in the sedentary group than in any of the physically active groups (Fig 1).

Smoking Rate and Physical Activity
The smoking rate differed significantly across the groups, being significantly higher in the sedentary than in any of the physically active groups (Fig 2).

Correlations and Multiple Regression Analysis for the Frequency of Physical Activity and Smoking Status With HDL Cholesterol Value
The frequency of physical activity correlated positively and present smoking status correlated negatively with the HDL cholesterol value. Multiple regression analysis revealed both the frequency of physical activity and smoking status to be independent positive and negative factors, respectively, affecting the HDL cholesterol value (Table 5).

Prevalence of Fatty Liver and Physical Activity
There were significant differences across the groups in the prevalence of fatty liver. The prevalence of fatty liver was significantly higher in the sedentary group than in the groups who engaged in physical activity 2 or 3 days per week and in those engaged in physical activity only once per week compared with those who exercised 3 days per week group (Fig 3).

Discussion
Physical inactivity is prevalent among American adults. In 1991, 54% of American adults reported little or no regular leisure physical activity. Likewise, we found that more than 72% of adult Japanese men (mostly white-collar workers) are sedentary even during their leisure time. Although physical activity favorably modifies CHD risk factors, the frequency of
physical activity needed to accomplish these goals remains poorly defined and controversial.15 Our results confirm the public health message that “doing some physical activity is better than doing none at all.”16 Even the subjects who engaged in regular physical activity once a week had less subcutaneous fat and higher serum HDL cholesterol levels than the sedentary individuals. The subjects with a higher frequency of physical activity showed a further lowering of CHD risk factors and abdominal obesity and a lower prevalence of fatty liver, although BMI did not differ. The accuracy of BMI in defining obesity has been questioned because of the disparity between BMI and body fat17 in that BMI reflects muscle and bone as well as fat. The physically active groups might increase their muscle amount accompanied by loss of fat so that their BMIs would not be different from that of the sedentary group. On the other hand, prevention of fatty liver with exercise in rats has been reported.18 Our study in humans also indicated a reduced prevalence of fatty liver in the groups engaged in physical activity 2 or ≥3 days per week.

CHD risk factors were lowest in the group with regular physical activity ≥3 days per week. Our data support the recommendation of the American College of Sports Medicine4 and suggest that the frequency of training is an important determinant of maximal health benefits on the basis of not only cardiorespiratory fitness but also CHD risk factors.

It is interesting that the smoking rate was also lower in all the physically active groups. Both smoking status and the frequency of physical activity were independently associated with the HDL cholesterol level. However, it is difficult to ascertain whether the lower smoking rate in the physically active groups is due to smoking cessation after physical activity for the reduction of nicotine dependence or an overall greater concern with health on the part of the physically active subjects compared with the sedentary subjects. A prospective study is necessary to explore this issue.

The Japanese government encourages employees to receive annual health examinations for prevention and early diagnosis of disease. Subjects who undergo periodic health examinations do so voluntarily and may be more concerned with health than those who do not undergo such examinations. However, most of those who undergo health examinations are sedentary. Therefore, it is important to encourage these individuals to increase their physical activities, reminding them that “a little physical activity is better than none, and, to a degree, more is better than less”15 in reducing CHD risk factors and improving general health.

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References


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