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原著：

Changes in Lipid Levels among Inhabitants of a Small Fishing Village in Shimane Over a 4-year Period

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The aim of this study was to determine the relationship between age and changes in serum lipid levels during a period of 4 years in a Japanese fishing village.

Total cholesterol (TC), triglycerides (TG) and high-density lipoprotein cholesterol (HDL-C) were measured in inhabitants (53 males and 130 females) of the Chibu Village on Oki Island, Shimane in 1988 and again in 1992. The subjects were divided into four age groups of respectively, 40-49 years (n=30), 50-59 years (n=35), 60-90 years (n=65), and 70 years or over (n=53).

TC and TG levels did not change in any age group over the 4-year interval. However, the HDL-C level increased significantly in men aged 40-49 years, women aged 50-59 years, and women aged 60-69 years.

There are no differences of TC in men and women in 1988 and 1992. TG in men aged over 70 years was significantly lower than that in women aged over 70 years in 1988, but TG in men aged 40-49 years was significantly higher than that in women aged 40-49 years in 1992. HDL-C in men aged 40-49 years in 1988 and 50-59 years in 1992 was significantly lower than that in women aged 40-49 years in 1988 and 50-59 years in 1992.

The body mass index (BMI) was significantly positively correlated with TC in 1988, and positively correlated with TG and negatively correlated with HDL-C in both 1988 and 1992.

In this small Japanese fishing village, we found TC and TG did not increase with age, but HDL-C increased with age. Our results suggest that high TG and low HDL-C are important factors in causing obesity.

① total cholesterol ② triglyceride ③ high-density lipoprotein cholesterol ④ body mass index ⑤ fishing village.

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Introduction

Many studies have shown that hyperlipidemia plays an important role in the development of coronary artery and cerebrovascular diseases¹⁻⁴. Changes in Japanese lifestyle between 1960 and 1980 have been associated with increased serum total cholesterol (TC) levels^{5,6}. However, epidemiological data from lipid studies vary among populations within Japan. For example, the mean TC level in inhabitants of the town of Shirakawa was highly elevated during the 1980s, but less elevated during the 1990s⁷. However, these data were cross-sectional and involved a variety of subjects in cities and other urban areas^{5,6,8,9}, but few data have been accumulated for the inhabitants of fishing villages¹⁰. The aim of this study was to determine the relationship between changes in serum lipid levels and age during a 4-year follow-up period in a small fishing village in Japan.

Subjects and Methods

A health screening program for the 882 inhabitants (390 men and 492 women) of the Chibu village on Oki Island in Shimane Prefecture was begun in July 1988 and continued until July 1992 by the Shimane Institute of Health Science and Shimane Medical University. The present study used the data of 1988 and 1992. Most of the inhabitants of this village were fishermen. The subjects consisted of 183 healthy people (53 men and 130 women, mean age $\pm$ SD: 51.7 ± 12.2) who attended the health screening examinations in 1988 and 1992. Thirty of these subjects (9 men and 21 women) were aged 40-49 years, 35 (10 men and 25 women) were aged 50-59 years, 65 (15 men and 50 women) were aged 60-69 years, and 53 (19 men and 34 women) were aged 70 years or over in 1988. After a 12

-hr fast, blood was drawn from the right antecubital vein while each subject was in a recumbent position. The samples were frozen and sent to a laboratory in the Shimane Institute of Health Science for analysis. TC, triglycerides (TG) and high-density lipoprotein cholesterol (HDL-C) were determined by enzymatic methods. The subjects were interviewed to exclude those with secondary hyperlipidemia due to nephrosis, hypothyroidism and so on.

We used the paired t-test and ANOVA for comparisons and a p level < 0.05 was accepted as statistically significant. All statistical analyses were performed using Statview II (Abacus Concepts, Inc).

Results

1. Follow-up data

Figs. 1, 2, and 3 show the values of TC, TG and HDL-C in each age group. TC and TG levels did not change in any age bracket after the 4-year interval. However, HDL-C increased from 1988 to 1992, especially in men aged 40-49 years (from 36.7 ± 8.8 to 46.7 ± 11.0 mg/dl), women aged 50-59 years (49.2 ± 13.6 to 59.1 ± 15.2 mg/dl), and women aged 60-69 years (48.0 ± 11.9 to 52.9 ± 10.9 mg/dl).

BMI did not change in any group after the 4-year interval (Fig. 4).

2. Difference in serum lipids level between men and women

There are no age-specific differences in TC level in men and women in 1988 and 1992 (Fig. 1). TC in men aged over 70 years was significantly lower than that in women aged over 70 years in 1988, but TG in men aged 40-49 years was significantly higher than that in women aged 40-49 years in 1992 (Fig. 2). HDL-C in men aged 40-49 years in 1988 and 50-59 years in 1992 was significantly lower than in women aged 40-49 years in 1988 and

50–59 years in 1992 (Fig. 3).

3. Correlations between serum lipids and obesity

BMI was significantly positively correlated with TC in 1988 ($p < 0.005$) (Fig. 5), and with TG in both 1988 and 1992 ($p < 0.0005$ for both) (Fig. 6A, B), and significantly negatively correlated with HDL-C in both 1988 ($p < 0.05$) and 1992 ($p < 0.01$) (Fig. 7 A, B).

Discussion

Increased TC and TG levels and decreased HDL-C are major risk factors in developing atherosclerosis. Since atherosclerosis leads to cerebrovascular accidents and coronary artery disease (the second and third most common causes of death in Japan), the etiology of atherosclerosis is very important.

Fig. 1 Total cholesterol levels in men and women in 1988 and 1992

However, there have been few epidemiological studies with follow-up data on lipids, especially in rural fishing villages in Japan.

There have been various epidemiological studies on Oki Island in Shimane^{11–13}, because the area is famous for longevity. Those studies have concluded that the well-balanced diets contribute to the observed longevity.

In a previous study of the relationships between lipid levels and aging in Japanese subjects, TC and TG levels increased up to age 50–60 years and then decreased slightly with further aging⁶. In the present study, TC levels did not increase in any band over the 4-year period under review, so this finding does not agree with the previous report⁶. This

Fig. 2 Triglyceride levels in men and women in 1988 and 1992

*** $p < 0.05$

might be because Chibu is a fishing village, in which families eat twice as much fish as other Japanese do¹⁴⁾. According to Oshima's report¹⁵⁾, lipid levels in fishing villages were remarkably lower than in cities and farm villages. Dyerberg¹⁶⁾ suggested that the low incidences of coronary heart disease and diabetes mellitus in Eskimos may be due to their high intake of eicosapentaenoic acid, which reduces lipids. The disease pattern in the population of Greenland, consisting mainly of Eskimos, differs considerably from that in the population of Denmark, possibly for the same reason that TC was not related to age in the Chibu village.

Recently, association between hypertriglyceridemia and atherosclerosis has been

reported¹⁷⁻¹⁹⁾. Age is associated with a steady increase in TG levels, especially in women. Data from the Framingham study¹⁸⁾ indicate that, for most of their lives, women have lower TG levels than men, generally catching up only after the menopause. The present findings were consistent with the Framingham data regarding women.

Elevated HDL-C levels are anti-atherosclerotic. In general, HDL-C in premenopausal women is higher than in men. However, this parameter decreases after menopause with advancing age, to the point that no difference in HDL-C is seen between men and women in their 70s. In the present study, HDL-C increased with advancing age, especially in men aged 40-49 years. The high alcohol

Fig. 3 HDL-cholesterol levels in men and women in 1988 and 1992

Fig. 4 Body mass index in men and women in 1988 and 1992

Fig. 5 Correlations between total cholesterol and body mass index in 1988 (A) and 1992 (B)

Fig. 7 Correlations between HDL-cholesterol and body mass index in 1988 (A) and 1992 (B)

Fig. 6 Correlations between triglycerides and body mass index in 1988 (A) and 1992 (B)

intake in men in village as reported by Fukuzawa²⁰⁾ may account for this observation. We cannot account for the high HDL-C levels seen in women aged 50–59 and 60–69 years clearly, but one possible explanation may be that a high intake of fish is associated with high HDL-C even in postmenopausal women. Another possibility is that most of the subjects had complied with dietary advice since they underwent the first examination year in 1988.

It is generally accepted that obesity is associated with hypertriglyceridemia and low levels of HDL-C. A causal relationship has been postulated between body fat distribution as assessed by the waist-to-hip ratio and hypertriglyceridemia²¹⁾. Recently, Imamura et al.²²⁾ reported that the ratio of intraabdominal adipose tissue area to subcutaneous adipose tissue area, measured by abdominal computed tomography was correlated posi-

tively with serum TG and negatively with serum HDL-C. In this study, there was a significant positive correlation between BMI and TG, a significant negative correlation between BMI and HDL-C, and furthermore, a significant positive correlation between BMI and TC in 1988. In this fishing village, the causes of obesity might be lack of exercise and a high snack intake when work is not available, especially in the winter season.

In summary, our study was not sufficiently large or powerful enough to draw a definite conclusion, but our findings suggest that in this small Japanese fishing village, because of high seafood intake and so on, TC and TG levels did not change in any age rank from 1988 to 1992 and HDL-C level increased with advancing age. Furthermore, high TG and low HDL-C were confirmed as important factors related to obesity.

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島根県の小漁村住民における4年間の血清脂質の変化

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島根県隠岐島の小漁村住民183人を対象に4年間の血清脂質の変化を検討した。初年度と4年後ともに、総コレステロール、中性脂肪に関しては、各年代ともに差はみられなかったが、HDL-コレステロールについては、4年間で40代男性、50代女性、60代女性では有意に上昇した。総コレステロールには男女差はみられなかった。中性脂肪は70歳以上の男性では女性よりも有意に低かったが、40代男性では女性よりも有意に高かった。また、HDL-コレステロールは初年度の40代男性と4年後の50代男性は女性よりも有意に低下していた。body mass index と初年度の総コレステロールと初年度および4年後の中性脂肪とは有意の正相関がみられ、HDL-コレステロールとは有意の負相関がみられた。

漁村においては総コレステロール、中性脂肪に関しては、加齢の影響はみられず、またHDL-コレステロールは一部の年代で上昇した。中性脂肪の上昇とHDL-コレステロールの低下とは肥満度と関連がみられた。

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