

Short Communication

Impact of Lifestyle Changes on Japanese-Americans: Results from the Hawaii–Los Angeles–Hiroshima Study

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Abstract

We have been conducting a medical examination of Japanese migrants or their descendants since 1970 in the Hawaii–Los Angeles–Hiroshima study. This is a long-term epidemiological study on Japanese-Americans genetically identical to native Japanese but whose lifestyle has undergone rapid intense westernization. By comparing Japanese-Americans living in Hawaii and Los Angeles in the United States with Japanese living in Hiroshima, Japan, we made several important observations about the effects of environmental changes on the incidence of lifestyle-related diseases and the progression of atherosclerosis. In comparison to native Japanese, Japanese-Americans (1) consumed more animal fat and simple carbohydrates, but less complex carbohydrates; (2) showed greater insulin resistance and more rapid progression of atherosclerosis; (3) had higher prevalence's of diabetes mellitus and metabolic syndrome. Moreover, we recently found that the prevalence of metabolic syndrome among Japanese-Americans who had lived in Japan during their childhood was significantly lower than among those who had never lived in Japan. These results indicate that a Japanese lifestyle might protect against the development of lifestyle-related diseases caused by a westernized lifestyle among Japanese individuals.

ABBREVIATIONS

EPA/AA: Eicosapentaenoic Acid to Arachidonic Acid; IMT: Intima-Media wall Thickness; AHA/NHLBI: The American Heart Association and the National Heart, Lung and Blood Institute

INTRODUCTION

Washoku, the traditional Japanese cuisine culture, has been added to UNESCO's Intangible Cultural Heritage list. The Japanese eating style, characterized by its ideal nutritional balance, has contributed to the longevity of the Japanese population as well as the prevention of obesity through its skillful use of the tastes of ingredients and low use of animal fat.

The overseas emigration of Japanese began in the late 19th century. At that time, the lifestyle, including diet and exercise, in Japan and the United States differed considerably. Thus, the lifestyle of these Japanese immigrants to various parts of the United States underwent sudden westernization.

We began our medical examination of Japanese-Americans in 1970, in an epidemiological study called the Hawaii–Los Angeles–

Hiroshima study [1]. Since then, we have investigated the effects of environmental factors such as lifestyle westernization on disease structures by conducting comparative analyses of data obtained from medical studies on Japanese-Americans whose lifestyle was undergoing rapid intense westernization and Japanese living in Hiroshima, Japan, in whom genetic factors were the same.

In this manuscript, we introduce several interesting findings of the Hawaii–Los Angeles–Hiroshima study in over 40 years of its rich history.

MATERIALS AND METHODS

We started our medical research on Japanese-Americans in Hilo and Kona, on the Island of Hawaii, in 1970, and in Los Angeles, California, in 1978. Medical examinations have been conducted every few years in each district with cooperation from the Hiroshima Kenjin-Kai Association, which consists of immigrants from Hiroshima prefecture and their descendants. By 2012, we had performed these medical examinations a total of 23 times, and the total number of study participants has exceeded 12,700 (Figure 1). All subjects provided written informed consent to

participate in the examinations. This study was approved by the ethics committee of Hiroshima University and the Councils of the Hiroshima Kenjin-Kai Association in Hawaii and Los Angeles.

In the morning following an overnight fast, each subject underwent an interview, physical examination, blood pressure measurements, and venous blood sampling. An oral glucose tolerance test was performed on the subjects without diabetes mellitus. Each blood sample was centrifuged, and the obtained serum samples were immediately frozen and stored until analysis.

RESULTS AND DISCUSSION

Previous and more recent results from the Hawaii–Los Angeles–Hiroshima study are presented here:

1) Comparison of nutrient intakes

According to the data from the studies conducted between 1978 and 1988, the intake of animal fat and simple carbohydrates (especially fructose) was markedly greater, but that of complex carbohydrates was lower among 1,483 Japanese-Americans living in Hawaii and Los Angeles than 1,200 Japanese living in Hiroshima, for both males and females, while the total energy intake was almost the same [2]. The nutrient proportions for Japanese-Americans, as compared to the Japanese, reflected a westernized dietary style.

More recently, in the Los Angeles study in 2010, the ratio of serum eicosapentaenoic acid to arachidonic acid (EPA/AA) was analyzed between 447 Japanese-Americans and 474 Japanese. The EPA/AA ratio after adjusting for age and sex was significantly lower in Japanese-Americans than in the Japanese (Figure 2). This result suggests that the eating style of Japanese-Americans is still different from that of the Japanese.

2) Comparison of diabetes mellitus prevalence

In the studies conducted between 1978 and 1988, we compared the prevalence of diabetes mellitus in subjects aged 40 years or older between 2,048 Japanese-Americans in Hawaii and Los Angeles and 2,510 Japanese [3]. The prevalence of diabetes mellitus after adjusting for age and sex was two to three times

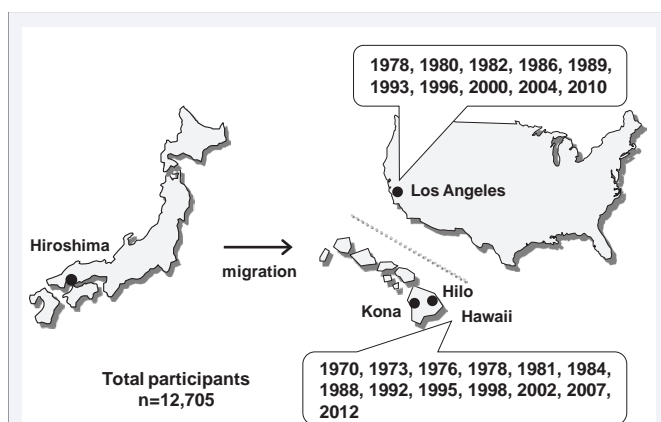


Figure 1 The Hawaii–Los Angeles–Hiroshima study. Medical studies on Japanese-Americans were begun in Hawaii in 1970 and Los Angeles in 1978. The cumulative number of these studies had reached 23 by 2012, and the total number of persons who underwent medical examinations, 12,705.

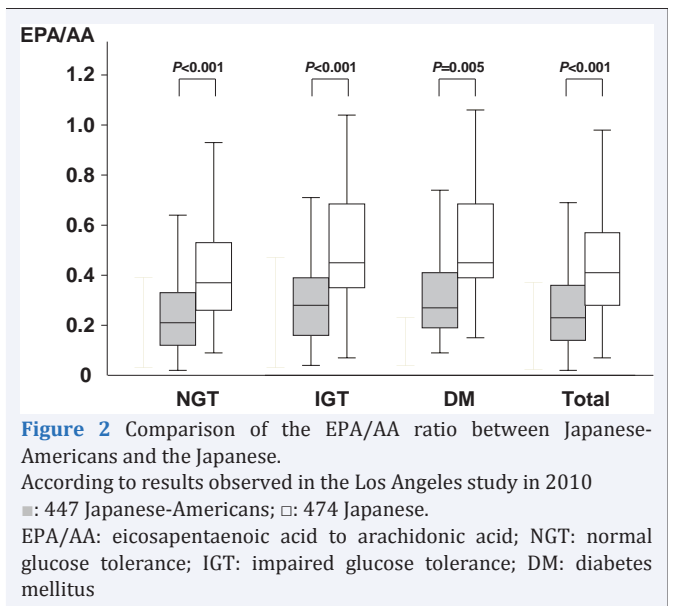


Figure 2 Comparison of the EPA/AA ratio between Japanese-Americans and the Japanese. According to results observed in the Los Angeles study in 2010 ■: 447 Japanese-Americans; □: 474 Japanese. EPA/AA: eicosapentaenoic acid to arachidonic acid; NGT: normal glucose tolerance; IGT: impaired glucose tolerance; DM: diabetes mellitus

higher in Japanese-Americans than in the Japanese.

3) Comparison of insulin resistance

Based on the data of the studies that were conducted between 1992 and 1993, the relationship between fasting serum glucose and insulin levels among 1,255 Japanese-Americans in Hawaii and Los Angeles and 1,284 Japanese is shown in Figure 3. The fasting insulin levels of Japanese-Americans were consistently higher, and the peak of the fasting insulin curve was slightly shifted to the right as compared to results obtained for the Japanese [4]. However, when we added the data on Caucasians reported by DeFronzo et al. [5] to the same coordinate axis, the fasting insulin curve of Japanese-Americans was positioned midway between that of the Japanese and Caucasians. This indicates that hyperinsulinemia among Japanese-Americans did not attain the same levels as those observed among Caucasians.

4) Comparison of atherosclerosis

Analyses of the data collected in the Hawaii study in 1998 revealed that the mean intima-media wall thickness (IMT) of carotid arteries in 222 non-diabetic Japanese-Americans was significantly higher than that in 271 non-diabetic Japanese [6]. Japanese-Americans reached an IMT of 1.1 mm at age 50, whereas the Japanese reached this value at age 70. The westernization of lifestyle has advanced the degree of atherosclerosis in Japanese-Americans by as much as 20 years as compared to the Japanese (Figure 4).

5) Comparison of metabolic syndrome prevalence

In the Los Angeles study in 2004, we compared the prevalence of metabolic syndrome among subjects aged 30 years or older between 574 Japanese-Americans and 416 Japanese [7]. When we made this comparison based on the diagnostic criteria of the American Heart Association and the National Heart, Lung and Blood Institute (AHA/NHLBI) published in 2005, we found that the prevalence of metabolic syndrome was significantly higher in Japanese-Americans than in the Japanese for both males and females.

For the Japanese immigrants, the time of commencing and duration of exposure to a westernized lifestyle differed between first-generation Japanese-Americans, who were born and grew up in Japan before migrating to the United States, and second- or later-generation Japanese-Americans, who were born and grew up in the United States. Furthermore, among second- or later-generation Japanese-Americans, some individuals experienced the distinctive practice of being placed with relatives and educated in Japan during childhood, returning later to the United States. This practice is called *Kibei* in Japanese. That is, Japanese-Americans who have experienced *Kibei* grew up in a Japanese environment, being temporarily apart from the westernized environment in the United States.

In the studies conducted in Hawaii in 2007 and Los Angeles in 2010, we compared the prevalence of metabolic syndrome among 515 Japanese, 442 first-generation Japanese-Americans, and 375 second- or later-generation Japanese-Americans. In addition, we further divided second- or later-generation Japanese-Americans into those with (n=114) and without (n=261) the *Kibei* experience (Figure 5). When we made these comparisons based on the diagnostic criteria of the AHA/NHLBI, the prevalence of metabolic syndrome was significantly higher in first-generation Japanese-Americans than in the Japanese. Further, this prevalence was significantly higher in second- or later-generation Japanese-Americans belonging to the non-*Kibei* group than in the *Kibei* group and first-generation Japanese-Americans. However, the rates of metabolic syndrome among individuals in the latter two groups (i.e., the *Kibei* group and first-generation Japanese-Americans) were almost the same. We believe this result is a particularly interesting observation: first-generation and second- or later-generation Japanese-Americans with the *Kibei* experience have the same experience as those having lived in a Japanese environment during childhood.

CONCLUSION

Based on the data obtained from previous epidemiological studies on Japanese-Americans, we have found that greater insulin resistance associated with a westernized lifestyle contributes to an increased prevalence of lifestyle-related

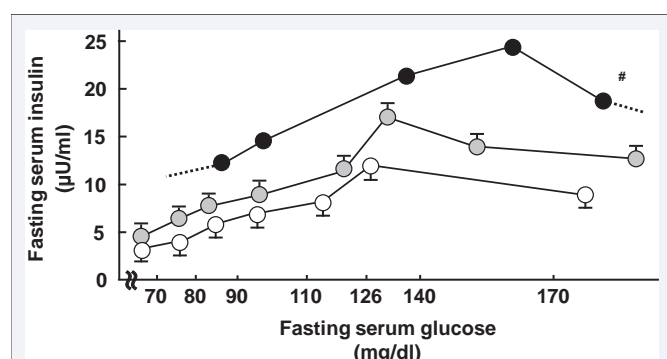


Figure 3 Relationship between fasting serum glucose and insulin levels among Japanese-Americans and the Japanese. Based on the data drawn from studies in Hawaii in 1992 and Los Angeles in 1993
●: 1,255 Japanese-Americans; ○: 1,284 Japanese; # ●: results on Caucasians quoted from reference 5.

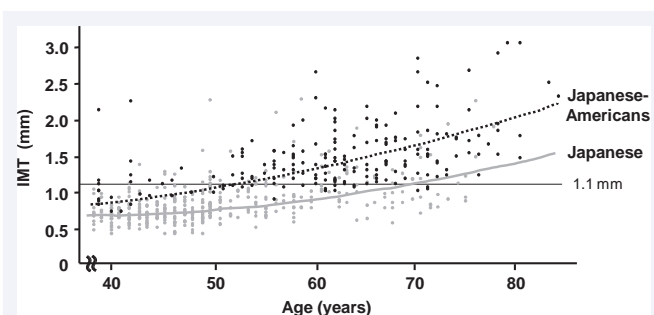


Figure 4 Comparison of age-related changes in carotid IMT between non-diabetic Japanese-Americans and Japanese. Based on data obtained in the Hawaii study in 1998
●: 222 Japanese-Americans; ○: 271 Japanese.

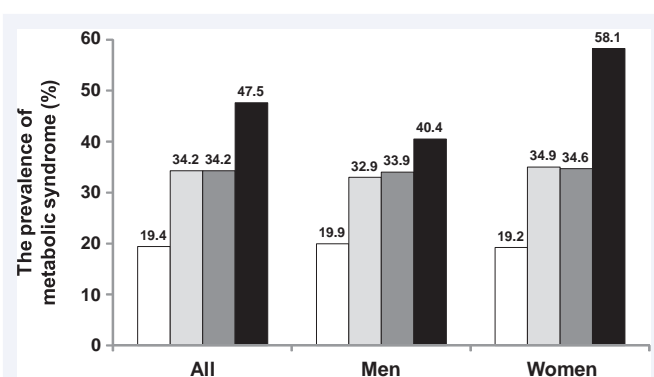


Figure 5 Comparison of metabolic syndrome prevalence. According to results from studies in Hawaii in 2007 and Los Angeles in 2010
□: 515 Japanese; ■: 442 first-generation Japanese-Americans; ▒: 114 second- or later-generation Japanese-Americans, *Kibei* group; ■: 261 non-*Kibei* group.

diseases, such as diabetes mellitus and metabolic syndrome, as well as the progression of atherosclerosis. Additionally, the Japanese traditional lifestyle represented by *Washoku* seems to have a protective effect against lifestyle-related diseases due to obesity in later life.

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