A Comparison of Health and Fitness–Related Variables in a Small Sample of Children of Japanese Descent on 2 Continents

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Objective: To compare physical characteristics, health and fitness–related variables, and nutrient intake between children of Japanese ancestry living in the United States and Japan.

Design: Cross-sectional study.

Setting: Miami, Fla, and Tsukuba, Japan.


Main Outcome Measures: US and Japanese resident groups were compared on physical characteristics, health and fitness–related variables, and nutrient intake using the t test for paired samples. To assess differences between groups in variables not statistically significant, effect sizes were calculated using the Cohen d test of standardized differences.

Results: The following significant differences were found between US and Japanese resident groups, respectively: body mass index, 19.3 and 16.9, \( P = .02 \); percentage of body fat, 22.0% and 14.3%, \( P = .002 \); diastolic blood pressure, 65.8 and 58.9 mm Hg, \( P = .01 \); total cholesterol, 169.8 and 138.7 mg/dL (4.39 and 3.59 mmol/L, \( P = .001 \)); low-density lipoprotein cholesterol, 108.2 and 88.0 mg/dL (2.80 and 2.28 mmol/L, \( P = .01 \)); triglycerides, 92.5 and 59.0 mg/dL (1.04 and 0.67 mmol/L, \( P = .02 \)); percentage of fat intake, 26.1% and 20.3%, \( P = .001 \); percentage of saturated fat intake, 7.9% and 6.1%, \( P < .002 \); percentage of carbohydrate intake, 57.9% and 63.9% (\( P = .004 \)); vertical jump, 28.9 and 34.4 cm, \( P = .02 \); and flexibility, 58.2 and 42.6 cm, \( P = .002 \). Using the Cohen d test, US residents showed a moderately greater systolic blood pressure (107.5 vs 101.9 mm Hg, \( P = .10 \)) and leg strength (81.5 vs 55.8 kg, \( P = .11 \)) than did Japanese residents.

Conclusions: A small sample (\( n = 14 \)) of children of Japanese descent living in Florida showed more adverse health-related characteristics than did a comparable group of their peers living in Japan. The results are probably related to differences in their diets. It remains to be seen whether the differences in diets are related to where the children live.


Among industrialized nations, cardiovascular disease is the number one cause of adult deaths.\(^1\)\(^-\)\(^3\) Interestingly, Japan has one of the lowest mortality rates from heart disease among industrialized nations.\(^4\) According to the American Heart Association,\(^5\) mortality rates from cardiovascular disease total 561 per 100,000 adults in the United States vs less than half, 271 per 100,000 adults, living in Japan.

Although the levels of cardiovascular disease in Japan remain low, adult Japanese men who have relocated to the United States, and have adopted the habits and lifestyles common to Western civilization, show a significantly higher risk for developing cardiovascular disease compared with their peers living in Japan. Research\(^6\)\(^-\)\(^8\) has indicated a 3-fold increase in the incidence of myocardial infarction in adult men of Japanese descent residing in California compared with their counterparts living in Japan. Given the elevated rates of cardiovascular disease observed in adult Japanese men in California, it may be relevant to examine variables related to health and fitness in children of a similar cultural background.

Past research\(^9\)\(^-\)\(^10\) has shown that risk factors for cardiovascular disease do not suddenly appear in adulthood but rather progress on a continuum of unfavorable lifelong habits and experiences that may begin as early as childhood. Poor nutrient profiles, reduced aerobic fitness, and obesity in children have all been postulated to contribute to the cardiovascular disease process.\(^11\) Furthermore, an unhealthy diet and...

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SUBJECTS AND METHODS

SUBJECTS

Volunteer subjects were recruited via flyers, newspaper advertisements, and telephone calls in Miami, Fla, and Tsukuba, Japan. Accordingly, identical flyers were put up in those markets in closest proximity to the University of Miami and the University of Tsukuba. An identical advertisement was put in the school newspaper in both locations, and telephone calls were taken by the project coordinator (T.O.), who was fluent in Japanese, in both locations. The flyers and advertisements appealed to participants who were interested in learning more about their fitness levels, cholesterol levels, dietary intake, and overall health. There were no monetary inducements to participate in the study. The advertisement also explained that participants should be “apparently healthy,” free from taking any medications regularly, and permissive of a physician’s review of their medical history. No children were excluded from the study for medical reasons. In attempting to maintain uniform recruiting and testing, 2½ weeks were allotted for the testing of children in both locations.

In both locations, several parents failed to commit to the study after learning more about the data collection. Several children (1 in the United States and 2 in Japan) were excluded from participating because they were not yet aged 8 years or had turned 13 years during testing. Investigators used the information collected on participants in Miami to recruit the first 14 children who could be age and sex matched in Tsukuba. All adults were screened about their children by telephone, when the subjects’ age, significant medical history, availability, and testing requirements were reviewed.

Fourteen children, aged 8 to 12 years (7 boys and 7 girls), from Miami and 14 age- and sex-matched children from Tsukuba agreed to participate and undergo all testing. Bilingual written informed consent forms were obtained from children and parents in accordance with the guidelines stated by the University of Miami Office of Research Standards for the Protection of Human Subjects. Nine children from Miami were born in the United States and were US citizens. One child had continuous residence in the United States for 10 years, 2 had continuous residence for 5 years, and 2 had continuous residence for 2½ years. All children living in Japan were born there, had continuous residence in Japan, and had never been to the United States. All children had parents of Japanese descent.

RESULTS

An examination of physical characteristics showed that body weight and BMI (Table) were significantly greater in AR. Children in the United States were, on average, 7.6 kg heavier than JR, and their BMI was greater by 2.4. In accordance with greater weight and BMI, AR had a greater percentage body fat, which was higher by 7.7%, and a higher diastolic BP, which was higher by 6.9 mm Hg, compared with JR (Table). Although the systolic BP did not show a statistically significant difference between groups, the Cohen d was 0.65, which indicated a moderately greater systolic BP for AR.

Analysis of serum lipid and lipoprotein levels showed significantly higher T-Chol, LDL-C, and TG levels for AR compared with JR (Table). In fact, AR had TG values more than 1.5 times greater, T-Chol values 31.1 mg/dL (0.80

PHYSICAL CHARACTERISTICS

Height was obtained in children without their shoes using a wall-mounted stadiometer and measured according to standard procedures, recorded to the nearest 0.1 cm. Weight was measured on a balance beam scale, with calibration procedures performed before data collection and reported to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Resting heart rate (measured in beats per minute) was recorded manually. Blood pressure (BP) was taken by a trained investigator (T.O.) using standard procedures. All measurements were recorded by the same investigator and taken to the nearest 2 mm Hg.

Body composition was measured according to standardized procedures using bioelectrical impedance (Quantum NIA-101Q; RJL Systems, Inc, Clinton Township, Michigan). Bioimpedance uses the resistance of bodily tissues to an electric current to determine the amount of lean (fat-free) tissue. Values were then entered into a weight- and height-adjusted formula developed for children by Hoitkooper et al to determine body density, fat mass, percentage of body fat, and fat-free mass.

SERUM LIPID AND LIPOPROTEIN MEASUREMENTS

Serum lipid and lipoprotein measurements were obtained by venipuncture following an overnight fast. Blood was then placed in 10-mL silica-coated self-separating tubes, centrifuged immediately, and analyzed 24 hours later in accordance with standard procedures. The concentrations of

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total cholesterol (T-Chol), high-density lipoprotein cholesterol, and triglycerides (TG) were measured via light absorbency in serum samples using a photometer (Premiere Filter Photometer; Stanbio Laboratory, San Antonio, Tex). The very low-density lipoprotein cholesterol (LDL-C) level was calculated by dividing TG by 5, and the LDL-C level was estimated by subtracting the high-density lipoprotein cholesterol and very LDL-C levels from the T-Chol level. These measurements have been validated against a large range of low, normal, and high lipid levels and have been used elsewhere to estimate serum lipoprotein levels in children.

**PHYSICAL FITNESS MEASURES**

Grip strength was assessed using a standard grip dynamometer. Each subject’s forearm was placed on a flat table while in a seated position, and each subject was asked to squeeze as hard as possible. The best of 3 trials was recorded to the nearest 0.1 kg.

Assessment of leg strength was made using a standard dynamometer. By attaching a grip bar to a chain that is connected in series with a dynamometer, isometric leg strength was measured in kilograms. The maximum voluntary isometric contraction recorded in 3 trials was used to indicate leg strength.

The Vertec (Questek Corp, Northridge, Calif), an apparatus used to measure vertical jump height, was also used to calculate peak leg power. Each child was required to perform 3 vertical jumps to their maximum height while extending one arm as high as possible to indicate a vertical jump mark. The greatest distance between the baseline and the vertical jump mark constituted the vertical jump distance. Peak leg power was calculated using vertical jump distance and body weight in a formula reported by Fox and Mathews. A sit-and-reach test was used to measure hamstring and lower back flexibility. The baseline was set at 15 cm from the vertical surface of the box, and the examiner (A.C.P.) instructed children to place the right hand over the left and reach as far forward as possible. The best of 3 trials was recorded.

Within 1 week of the initial testing, the children completed a graded exercise test to maximum on a motor-driven treadmill to determine VO2max as a measure of aerobic fitness. Using a modified protocol from Gutin et al, each child walked at 3.5 mph and 0% grade for 3 minutes, after which time the child’s speed was increased to a comfortable run (4.5 mph) at 0% grade. Thereafter, the speed remained constant and the grade was increased 2.5% every other minute until VO2max was reached.

Metabolic measurements were continuously recorded (2900 Metabolic Cart; SensorMedics, Yorba Linda, Calif). The criterion for achieving VO2max included a plateau in levels of oxygen consumption per minute, a respiratory exchange ratio above 1.1, and/or the child’s communication of being unable to continue further. During recovery, each child walked at a comfortable speed at 0% grade until the child’s heart rate returned to the warm-up level.

**NUTRIENT ANALYSIS**

A sample of food items, liquid and solid measurement utensils, and cups and plates were used to familiarize the children and their parents with portion sizes and adequate food descriptions. Children were told to select 2 weekdays and 1 weekend (nonschool) day that were representative of typical eating habits, and an interviewer (T.O.) reviewed records of children with their parents to ensure that appropriate information was recorded. A software package (Nutritionist IV; First Data Bank, San Bruno, Calif) was used to analyze food records. Other studies have shown that 3-day food records can be used to assess nutrient intake in children when assisted by their parents.

Japanese Food Nutrient Charts (The Science and Technology Agency and Ishiyaku Shuppan Corporation, both in Tokyo, Japan) were used for manual data entry of Japanese foods into the software system (Nutritionist IV). This manual data entry method was used to ensure that non-traditional and unlabeled Japanese foods consumed were also entered into the database.

**STATISTICAL ANALYSIS**

All results are presented as mean±SD. All other statistical analyses were completed using the Statistical Package for the Social Sciences, version 10.0. Univariate statistics using a t test for paired samples were used to compare children residing in both locations on all measured variables. For variables not showing equal variances, the Welch t was used to determine significant differences between groups. This was done for TG, T-Chol–high-density lipoprotein cholesterol ratio, flexibility, total calorie (energy) intake, and calcium intake. P≤0.05 was considered significant. A Cohen’s d test was used to indicate standardized differences between groups for each variable. A medium effect size, d ≥0.5, was used to determine moderate to medium differences between groups. A Pearson product moment correlation was performed to examine relationships among all measured variables.

Results of the physical fitness variables showed that AR were more flexible but failed to jump as high as JR (Table). Interestingly, JR could outjump AR by 5.5 cm, yet were less flexible by almost the same margin. Children of Japanese descent residing in the United States could generate 25.7 kg greater leg strength, which, although not statistically significant, indicated a substantial difference (d=0.62) in leg strength between the 2 groups. There were no other statistical and effect size differences observed between groups for any other fitness variables. All children were strongly encouraged to obtain their VO2max during testing. Only one girl residing in Japan could not be pushed during the graded exercise test and could not continue to perform and meet the necessary criteria for obtaining VO2max. Therefore, her data were excluded from statistical analysis. All children achieved a maximum heart rate above 200 beats/min during the graded exercise test.

Children of Japanese descent residing in the United States consumed a greater percentage of calories as carbohydrates, total fat, and saturated fat, as calculated by the t test (Table). The same significant differences were observed whether nutrient intake was expressed as an absolute amount or as a percentage of total calories consumed.
sumed. Although AR consumed 6% less calories as carbohydrate, they also consumed 5.8% more total fat and 1.8% more saturated fat than did JR. There were no other statistically significant differences and no other moderate to medium effect size differences observed between groups for any other nutrient measured.

In the present study, several physical characteristics were similar between children living in the United States and Japan. The AR group, however, showed a higher body weight, BMI, and diastolic BP than the JR group. They also showed a higher percentage of body fat, which, along with BMI, may have accounted for their higher diastolic BP when compared with their peers in Japan.30-33 A moderately higher systolic BP was also noted for AR. In fact, the mean systolic BP of 107 mm Hg was close to the 75th percentile (109 mm Hg) observed for US children.34 Although aerobic fitness levels, as indicated by V˙O₂max, were similar between groups, AR had lower ver-

<table>
<thead>
<tr>
<th>Variable</th>
<th>AR (n = 14)</th>
<th>JR (n = 14)</th>
<th>Paired t Test</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age, y</td>
<td>9.8 ± 1.4</td>
<td>10.2 ± 1.4</td>
<td>−0.83</td>
<td>.42</td>
</tr>
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<td>Height, cm</td>
<td>144.2 ± 10.8</td>
<td>138.5 ± 10.4</td>
<td>1.17</td>
<td>.25</td>
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<td>Weight, kg</td>
<td>40.9 ± 11.5</td>
<td>33.3 ± 7.7</td>
<td>2.06</td>
<td>.05</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>19.3 ± 2.9</td>
<td>16.9 ± 1.7</td>
<td>2.59</td>
<td>.02</td>
</tr>
<tr>
<td>Resting heart rate, beats/min</td>
<td>82.4 ± 11.6</td>
<td>78.4 ± 8.9</td>
<td>1.00</td>
<td>.32</td>
</tr>
<tr>
<td>Body fat, %</td>
<td>22.0 ± 6.9</td>
<td>14.3 ± 5.0</td>
<td>3.41</td>
<td>.002</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
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<td></td>
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<td></td>
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<tr>
<td>Systolic</td>
<td>107.5 ± 8.8</td>
<td>101.9 ± 8.6</td>
<td>1.72</td>
<td>.10</td>
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<tr>
<td>Diastolic</td>
<td>65.8 ± 7.5</td>
<td>58.9 ± 6.4</td>
<td>2.63</td>
<td>.01</td>
</tr>
<tr>
<td>Lipid and lipoprotein measurements†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol, mg/dL</td>
<td>169.8 ± 24.0</td>
<td>138.7 ± 21.2</td>
<td>3.63</td>
<td>.001</td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>92.5 ± 43.2</td>
<td>59.0 ± 19.9</td>
<td>2.63</td>
<td>.02</td>
</tr>
<tr>
<td>Low-density lipoprotein cholesterol, mg/dL</td>
<td>108.2 ± 19.8</td>
<td>88.0 ± 20.9</td>
<td>2.63</td>
<td>.01</td>
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<tr>
<td>High-density lipoprotein cholesterol, mg/dL</td>
<td>43.1 ± 7.4</td>
<td>39.0 ± 7.1</td>
<td>1.50</td>
<td>.14</td>
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<tr>
<td>Total high-density lipoprotein cholesterol ratio</td>
<td>4.0 ± 0.5</td>
<td>3.7 ± 1.0</td>
<td>0.92</td>
<td>.37</td>
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<tr>
<td>Physical fitness measurements</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Grip strength, kg</td>
<td>21.5 ± 6.1</td>
<td>21.3 ± 5.1</td>
<td>−0.07</td>
<td>.91</td>
</tr>
<tr>
<td>Leg strength, kg</td>
<td>81.5 ± 42.0</td>
<td>55.8 ± 31.7</td>
<td>1.65</td>
<td>.11</td>
</tr>
<tr>
<td>Vertical jump, cm</td>
<td>28.9 ± 5.2</td>
<td>34.4 ± 6.6</td>
<td>−2.55</td>
<td>.02</td>
</tr>
<tr>
<td>Power output, W</td>
<td>5.0 ± 1.6</td>
<td>4.4 ± 1.3</td>
<td>1.02</td>
<td>.32</td>
</tr>
<tr>
<td>Flexibility, cm</td>
<td>58.2 ± 15.7</td>
<td>42.6 ± 6.0</td>
<td>3.69</td>
<td>.002</td>
</tr>
<tr>
<td>V˙O₂max, mL/kg • min</td>
<td>49.1 ± 8.0</td>
<td>50.3 ± 10.2</td>
<td>−0.35</td>
<td>.73</td>
</tr>
<tr>
<td>Nutrient intake</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Energy, ×10³ cal/d</td>
<td>1.91 ± 0.45</td>
<td>2.02 ± 0.22</td>
<td>−0.81</td>
<td>.43</td>
</tr>
<tr>
<td>Carbohydrates, % of energy intake</td>
<td>57.9 ± 5.9</td>
<td>63.9 ± 4.2</td>
<td>−3.14</td>
<td>.004</td>
</tr>
<tr>
<td>Protein, % energy intake</td>
<td>16.0 ± 2.2</td>
<td>15.6 ± 2.4</td>
<td>0.41</td>
<td>.68</td>
</tr>
<tr>
<td>Fat, % of energy intake</td>
<td>26.1 ± 5.0</td>
<td>20.3 ± 3.0</td>
<td>3.70</td>
<td>.001</td>
</tr>
<tr>
<td>Total</td>
<td>7.9 ± 1.1</td>
<td>6.1 ± 1.1</td>
<td>4.58</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Saturated</td>
<td>252.7 ± 108.5</td>
<td>301.8 ± 87.9</td>
<td>−1.32</td>
<td>.20</td>
</tr>
<tr>
<td>Cholesterol, mg</td>
<td>11.0 ± 6.6</td>
<td>12.9 ± 13.5</td>
<td>−0.46</td>
<td>.65</td>
</tr>
<tr>
<td>Sodium, mg</td>
<td>2163.5 ± 504.5</td>
<td>2100.4 ± 863.6</td>
<td>0.24</td>
<td>.82</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td>716.1 ± 473.5</td>
<td>562.5 ± 240.4</td>
<td>1.08</td>
<td>.29</td>
</tr>
</tbody>
</table>

*Data are given as mean ± SD unless otherwise indicated. AR indicates children of Japanese descent residing in the United States; JR, children living in Japan; and V˙O₂max, maximum oxygen consumption.

†To convert total, low-density lipoprotein, and high-density lipoprotein cholesterol from milligrams per deciliter to millimoles per liter, multiply milligrams per deciliter by 0.02586; to convert triglycerides from milligrams per deciliter to millimoles per liter, multiply milligrams per deciliter by 0.01129.

**COMMENT**

In the present study, several physical characteristics were similar between children living in the United States and Japan. The AR group, however, showed a higher body weight, BMI, and diastolic BP than the JR group. They also showed a higher percentage of body fat, which, along with BMI, may have accounted for their higher diastolic BP when compared with their peers in Japan.30-33 A moderately higher systolic BP was also noted for AR. In fact, the mean systolic BP of 107 mm Hg was close to the 75th percentile (109 mm Hg) observed for US children.34 Although both groups of children showed serum lipid profiles that would not be considered clinically el-
Past research has shown that adult Japanese men who have relocated to the United States demonstrate a 3-fold increase in the incidence of myocardial infarction compared with their peers living in Japan. This may be related, in part, to the adoption of unhealthy habits and lifestyles common to Western civilization. It is unknown whether AR show similar differences in health-related variables when compared with their age- and sex-matched peers living in Japan.

This article indicates that as early as childhood, more adverse health-related characteristics are observed in a sample of AR compared with a sample of JR. These results are in accordance with previous studies conducted in adults and seem to be related to differences in the children’s diets. It is unknown whether differences in diet are related to place of residence.

According to the School Nutrition Dietary Assessment Study, US children consume an average of 753 calories for lunch, with approximately 36% of the calories as fat, 13% as saturated fat, 44.5% as carbohydrates, and 19% as protein. In contrast, the Japanese school lunch contains a total of 690 calories, with less than 30% of the calories as fat and less than 15% as protein. Thus, school lunches represent 2 different nutrient profiles for schoolchildren living in the United States and Japan.

One limitation of this study was that research was performed on a small sample size. While tremendous effort was made to ensure uniform testing procedures and instrumentation, the small number of subjects reduced the power of our statistical analysis and increased the likelihood of committing a type II error. Despite this limitation, statistically significant differences were found for several variables. Effect sizes were also calculated so that moderate, but nonsignificant, differences between groups could be noted.

A more relevant limitation was that the sample may not have been representative of children of Japanese descent living in the United States and/or Japan. Although recruitment procedures were virtually identical in both locations, the possibility exists that the more sedentary, unfit, and overweight children may have volunteered in one location and not the other. On further evaluation, it was found that the average BMI observed for Asian children living in the United States ranged from 14.9 to 19.2 depending on the age and sex of the child. These results, however, may be confounded by the inclusion of children of various Asian backgrounds. Evidence in adults has suggested that those of Japanese descent tend to be more overweight and have a greater BMI than those of different Asian ancestry. Furthermore, regional variations suggest a somewhat higher mean BMI for Asian adolescents residing in the South compared with those in the North. In either case, our AR displayed mean BMI values lower than those reported for either white, black, or Hispanic adolescents in the United States, which is consistent with what is observed in adults. Average BMI levels reported for children living in Japan ranged from 15.7 to 18.9, and seemed to be reflective of values observed for JR.

National data examining VO\textsubscript{2max} in the United States and Japan showed that children in both continents had values similar to those of their country of residence. Although our data suggest that volunteers were representative of children in both countries, it is possible that our sample was not reflective of children of Japanese ancestry living in either location. Furthermore, parental education and income were not assessed, and research has shown an inverse association between socioeconomic status and obesity levels. This may have influenced variables in this study independent of place of residence.

The data presented document a diet higher in fat, lower in carbohydrate, and higher in total calories for children residing in the United States compared with the group living in Japan. Not surprisingly, AR were considerably heavier, possessing higher BMI, diastolic BP, and lipid levels in the serum; they were also more obese.
though health-related variables observed in AR were not clinically relevant, requiring neither dietary nor pharmacological intervention, this may become problematic as these trends continue. Studies of US-born adults of Japanese ancestry show they possess greater rates of overweight and obesity compared with their native-born peers, and these prevalence rates tend to rise with increasing duration in the United States.31

Clearly, nutrient intake reflective of a more Westernized diet may be responsible for the more adverse health-related characteristics observed in AR compared with JR. One cannot conclude, however, that these differences in nutrient intake are related to place of residence. As mentioned previously, socioeconomic status was not measured and the sample size was small. Although it is uncertain whether both groups of volunteers were strictly comparable, our results are in accord with previous studies conducted in adults34.8.35 and with what is known about the influence of total and saturated fat in the diet.35.43.46

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REFERENCES


