The influence of childhood and adolescent environmental exposure to a westernized environment on the relation between body mass index and adiposity in young Asian American women

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ABSTRACT
Background: Asians who have a healthy body mass index (BMI) range have been observed to have higher levels of obesity and risk of cardiovascular disease than whites, which suggests that the relation between BMI and adiposity may be different for Asians.
Objective: The primary aim of this study was to investigate the influence of childhood and adolescent exposure to a westernized environment on the relation between BMI and percentage body fat in young Asian American women.
Design: Secondary data from 129 Asian women, aged 20–25 y, with variable lengths of residence in the United States and 327 white women of comparable ages who had participated in the Latina and Asian Bone Health Study (1999–2000) and the Berkeley Bone Health Study (1998–2000), respectively, were analyzed by using multiple linear regression with percentage body fat as the outcome variable and place of birth, ethnicity, length of US residency, and BMI as predictor variables.
Results: Asians who lived in the United States <12 y showed the same relation between BMI and percentage body fat as did whites. In contrast, Asians who had lived in the United States ≥12 y had higher percentage body fat than did whites for BMIs (in kg/m²) <20.5 and lower percentage body fat for BMIs in the overweight and obese range.
Conclusions: Our findings suggest that childhood environments may influence the relation between BMI and adiposity. Research is warranted on the role that childhood environments play in the accumulation and distribution of body fat and hence metabolic disease risk later in life. Am J Clin Nutr 2011;93(suppl):1168S–74S.

INTRODUCTION
Increasing rates of overweight and obesity in Asian countries such as China have paralleled increasing rates of obesity-related diseases such as diabetes, heart disease, and cancer (1–3). Thus, screening for overweight and obesity is an important preventive approach. The most common screening indicator for overweight and obesity is body mass index (BMI; in kg/m²). BMI cutoffs that define underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9) and obesity (≥30) have been established by the Centers for Disease Control and the World Health Organization (WHO) (4, 5). However, the appropriateness of these cutoffs for Asians has been questioned in several studies. On average, Asians have been shown to have higher percentage body fat but lower BMI than do whites (6) and a higher risk of cardiovascular disease risk at any given BMI level than do whites (6–10). This increased risk of cardiovascular disease may also be influenced by the distribution of adipose tissue (visceral compared with subcutaneous), which has been shown to vary by race-ethnicity (11, 12). In addition, studies have shown that the lowest all-cause mortality in Asian populations is associated with a BMI of 23.0–24.9 (13,14).

In a report published by the Regional Office of WHO Western Pacific Region, International Association for the Study of Obesity, and International Obesity Task Force in 2000, lower cutoffs for definitions of overweight and obesity for Asians were recommended. These definitions were BMI <15.5 (underweight), 15.5–22.9 (normal weight), 23.0–24.9 (overweight) and ≥25 (obesity). However, these lower cutoffs have not been adopted (16).

Almost all of the research studies that support lower cutoffs for Asians are in Asians living in Asia (9,10,13–15) or in mostly Asian immigrants living in North America (but born and raised in Asia) (6–8). Do these lower cutoffs apply to Asian Americans born and raised in the United States or other Western countries? Does early life (childhood and early adolescent) exposure to a westernized environment modify the relation between BMI and percentage body fat? We set out to compare the association between BMI and percentage body fat in a group of young adult Asian women who had lived for variable lengths of time in the United States and non-Hispanic white American women of comparable ages.

The association between BMI and percentage body fat is influenced by relative sitting height (sitting height/stature) to the
extent that shorter-legged individuals may have BMI values that
are higher by as much as 5 units (17). Earlier studies of growth in
children have pointed to the role of the environment in changing
body proportions (18, 19). If the environment does influence body
proportions, then we can expect the association between BMI and
the percentage body fat in Asian Americans raised in the United
States to be more similar to that observed in white Americans
than in foreign-born Asian Americans with lesser exposure to
the United States during the growth period of childhood and early
adulthood.

The objective of this study was to determine whether Amer-
ican-born and foreign-born Asian Americans similarly displayed
higher levels of body fat than do whites, with BMI controlled for.
We further sought to determine whether the place of birth and
early life (childhood and early adolescent) exposure to the
westernized American environment modified the association
between BMI and percentage body fat in Asian Americans with
variable lengths of residence in the United States in comparison
with non-Hispanic white Americans.

SUBJECTS AND METHODS

Subjects

We used secondary data gathered by the Berkeley Bone Health
Study (BBHS) and the Latina and Bone Health Study (LABHS).
The BBHS, which was funded by the National Institutes of
Health, was conducted in 1998–2000 to examine relations of
genes and adolescent behavior with peak bone mass. The BBHS
used a retrospective cohort design and measured bone mass in
690 young African American and non-Hispanic white (referred to
as simply white in the rest of the current article) women, aged 20–
24 y, who had participated in the National Heart, Lung, and Blood
Institute Growth and Health Study (20–22).

The LABHS was a cross-sectional investigation of risk factors
for bone health in Asian and Latin American young women
conducted in 1999–2000 to augment the BBHS to allow for
comparisons in African Americans, whites, Asians, and Latinos.
The LABHS recruited a convenience sample of 291 Asian and
Latin American women who were aged 20–25 y at the time of
examination (21, 22). For the purposes of the current study, we
used data gathered from only whites and Asians.

Relevant measurements

The BBHS and the LABHS used similar protocols for measuring
height, weight, and body composition. Women with the following
conditions were ineligible: 1) systemic or metabolic disorders
known to affect bone including rheumatoid disease, 2) the use of
medications that affected bone turnover such as corticosteroids
and thiazide diuretics, 3) in surgical menopause as indicated by
the loss of both ovaries or a hysterectomy; and (4) pregnant or
lactating at the time of, or ≤6 mo of, the examination.

Data relevant to this article, which were gathered in both the
BBHS and the LABHS, included height, weight, body composition
(lean tissue mass and fat mass), ethnicity, place of birth, and years
lived in the United States. Height was measured by using a standard
protocol, and weight was measured with electronic scales. Body
composition was measured by using dual-energy X-ray absorp-
tiometry (DXA) (IPX-IQ; GE Lunar Corp, Madison, WI); lean
tissue mass and fat mass were estimated from whole-body DXA
scans. Because of machine limitations, DXA scans were only
performed on subjects who weighed ≤300 lb (≤136 kg), and
whole-body scans were only performed on body sizes that were
not so large as to compromise the accuracy of the readings. A
total of 60 subjects were excluded for either of these reasons. More
detailed descriptions of the methodology for measuring body
composition have been published elsewhere (21, 22).

Sociodemographic information, including the place of birth and
length of residence in the United States, was obtained by an in-
terviewer-administered questionnaire that was designed to retro-
spectively gather information on childhood and early adolescent
diet, physical activity, and other events that took place before the
age of 12 y. Height and weight and valid DXA measurements of
body composition were available from 129 Asians and 327 whites.

The protocols for the BBHS and the LABHS were approved by
the Committee for the Protection of Human Subjects at the
University of California at Berkeley. In addition, the protocols
were also approved by the Institutional Review Boards at Stanford
University and San Jose State University, respectively.

Statistical analysis

Percentage body fat was calculated from fat mass measured by
DXA, and total body weight was measured by digital scales. Its
distribution was approximately normal, and analysis of variance
(ANOVA) and multiple linear regression were used for analyses
with percentage body fat as the dependent variable. We categorized
the place of birth by region as follows: East Asia (China, Hong
Kong, Japan, Korea, and Taiwan), Southeast Asia (Malaysia,
Philippines, Singapore, and Vietnam), and North America (the
United States and Canada). For some analyses, we defined the place
of birth as a dichotomous variable as follows: North America
compared with other countries. Early life exposure to the United
States was defined by using the number of years that subjects re-
sided in the United States, which we analyzed as a dichotomous
variable as follows: ≥12 compared with <12 y. Because the oldest
participant was 25 y of age, this cutoff meant that participants who
had lived in the United States ≥12 y would have been ≤13 y of age
and likely to have been exposed to the United States environment
during puberty and when body fat accumulated.

One-factor ANOVA was used to compare the mean height,
weight, and body fat within strata defined by BMI. Two sets of
ANOVAs were conducted as follows: one set compared foreign-
born Asians, North American-born Asians, and whites, and the
other set compared Asians who had lived <12 y in the United
States, Asians who had lived ≥12 y in the United States, and
whites. When global tests indicated differences in means, Tukey’s
honestly significant difference post hoc test was used to determine
which means were significantly different. BMI categories of <20,
20–24.9, and 25–34.9 were used rather than standard Centers for
Disease Control and Prevention and WHO weight-status catego-
ries because of limited sample sizes in the underweight (<18.5)
and obese (≥30) categories in Asians in the sample.

To further investigate whether early life exposure to a west-
ernized environment influenced the association of BMI with
percentage body fat, we fit regression models for percentage body
fat that included BMI, place of birth and ethnicity (categorized as
East Asian–born, Southeast Asian–born, and North American–
born Asians or whites), and early life environmental exposure
(categorized as having lived in the United States <12 compared with ≥12 y). Beginning with a full model that included all main effects and pairwise and 3-way interaction terms, we dropped insignificant terms until a parsimonious model was obtained. BMI was transformed as its negative inverse, −BMI−1, because preliminary analyses indicated that this transformation linearized its relation with percentage body fat. Lowess scatter plot smooths, which estimate the mean of the dependent variable as a function of the independent variable without making parametric assumptions, were used to visualize the relation between percentage body fat and BMI for subsamples defined by ethnicity, place of birth, and length of US residency and to choose an appropriate transformation. For all analyses, P < 0.05 was considered significant. SAS version 9.2 software (SAS Institute, Cary, NC) and the R program (R: A Language and Environment for Statistical Computing, Vienna, Austria; http://www.R-project.org) were used to conduct statistical analyses.

RESULTS

Participant characteristics

A total of 327 whites and 129 Asians were included in our analysis. Asians were a heterogeneous group. In Table 1, we show distributions of place of birth, subethnic group, and years of residence in the United States. About 43% of Asians identified themselves as Chinese, 16% identified themselves as Korean, and 8% identified themselves as Filipino; another 33% belonged to other Asian ethnic groups such as Vietnamese and Thai or did not provide their ethnicity. Approximately 48% of Asians were born in the United States or Canada, 37% were born in East Asia (China, Hong Kong, Japan, Korea, and Taiwan), and 15% were born in Southeast Asia.

In Asians who were born in North America, only 16% of them had mothers who were born in the United States or Canada; ~50% of them had mothers who were from East Asia, and 12% of them had mothers from Southeast Asia. In comparison, in foreign-born Asians, 68% and 29% of them had mothers from East Asia and Southeast Asia, respectively (data not shown). Nearly 50% of Asians had a mother who graduated from college; mothers of Asian women born in North America were more highly educated; 59% of them had a college degree compared with 37% of mothers of women born outside North America.

Asians born outside North America had lived an average of 12.5 y in the United States, with the length of residence averaging 4.5 y before the age of 12 y and 8.0 y after the age of 12 y. Of the 62 Asians who were born in the United States or Canada, 5 Asians had spent ≤9 y living in other countries (data not shown). Of the 67 foreign-born Asians, two-thirds of them had lived in the United States ≥12 y. Of the 23 Asians who had lived in the United States <12 y, all were foreign-born Asians. Of the 106 Asians who lived in the United States ≥12 y or more, 42% were foreign-born Asians.

### TABLE 1

Characteristics of Asian and non-Hispanic white participants

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Place of birth (%)</th>
<th>Ethnicity (%)</th>
<th>Years lived in the United States (%)</th>
<th>Mother’s educational level (%)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI (kg/m²)</th>
<th>Body fat percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.0 ± 1.0</td>
<td>48.1</td>
<td>Chinese</td>
<td>12.4 ± 5.7</td>
<td>14.3</td>
<td>159.3 ± 6.1</td>
<td>55.7</td>
<td>28.4 ± 6.1</td>
<td></td>
</tr>
<tr>
<td>22.0 ± 1.1</td>
<td>0.0</td>
<td>Filipino</td>
<td>9.9</td>
<td>20.5</td>
<td>158.1 ± 6.3</td>
<td>7.6</td>
<td>22.0 ± 6.4</td>
<td></td>
</tr>
<tr>
<td>21.8 ± 1.0</td>
<td>100.0</td>
<td>Korean</td>
<td>12.5 ± 5.8</td>
<td>38.4</td>
<td>160.1 ± 6.0</td>
<td>7.6</td>
<td>22.0 ± 6.4</td>
<td></td>
</tr>
<tr>
<td>21.9 ± 0.9</td>
<td>—</td>
<td>Other (eg, Japanese, Vietnamese, and Thai)</td>
<td>21.4 ± 1.7</td>
<td>47.3</td>
<td>165.3 ± 6.4</td>
<td>19.2</td>
<td>28.8 ± 6.4</td>
<td></td>
</tr>
</tbody>
</table>

1 Differences between foreign-born Asians, North American–born Asians, and non-Hispanic whites were assessed by using the chi-square test for categorical variables and one-factor ANOVA for continuous variables.
2 Mean ± SD (all such values).
3,4 Significantly different between foreign-born and North American–born Asians: 3P < 0.01, 4P < 0.001.
5 Significantly different between foreign-born Asians and non-Hispanic whites and between North American–born Asians and non-Hispanic whites, P < 0.001.
The non-Hispanic white women were participants of the National Heart, Lung, and Blood Institute Growth and Health Study who also took part in the BBHS (21). They were recruited at ages 9–10 y from schools in Contra Costa County, California, in 1987–1988; information on the place of birth and length of residence in the United States was not available, but it was assumed that nearly all of these women were born and raised in the United States.

**Anthropometric and percentage body fat measurements**

In the overall sample, the mean height, weight, BMI, and percentage body fat for both foreign-born and North American-born Asians were significantly different from those of whites (both \( P < 0.001 \)), with Asians being shorter and lighter and having a lower BMI and percentage body fat than whites (Table 1). Comparisons between Asians and whites stratified by BMI are presented in **Table 2**. For the stratified comparisons, comparisons were made in foreign-born Asians, North American-born Asians, and whites and in Asians who lived in the United States \(<12 \text{ y} \), Asians who lived in the United States \(\geq12 \text{ y} \), and whites. There were significant differences in the mean height and weight between Asian subgroups and whites for most comparisons. In the 20–24.9 BMI stratum, North American-born Asians were shown to have lower mean percentage body fat than did whites (\( P < 0.05 \)). In the 25–34.9 BMI stratum, Asians who had lived in the United States \(\geq12 \text{ y} \) were shown to have lower percentage body fat than did whites (\( P < 0.05 \)). Some comparisons had low power because of small sample sizes.

Regression modeling for the outcome variable percentage body fat, which began with all main effects and interaction terms for BMI, place of birth and ethnicity and early life environmental exposure (lived in United States \(<12 \text{ y} \) compared with \(\geq12 \text{ y} \) in the model and dropped insignificant terms, yielded the final model presented in **Table 3**. A numerically equivalent reparametrization of the model is presented in **Table 4** and graphed in **Figure 1** to facilitate interpretation. As shown by the slope estimates in Table 3, there was a strong positive relation between BMI and percentage body fat for whites (977 units on the transformed scale; \( P < 0.001 \)). Asian ethnicity had a significant attenuating effect on the slope, which reduced it by 279 units (\( P < 0.001 \)); however, living in the United States \(<12 \text{ y} \) was associated with a positive effect on the slope of 323 units (\( P = 0.037 \)). The equivalent reparametrization presented in Table 4 and graphed in Figure 1 divided the sample into 3 groups of whites (\( n = 327 \)), Asians who lived in the United States \(\geq12 \text{ y} \) (\( n = 23 \)), and Asians who lived in the United States \(\geq12 \text{ y} \) (\( n = 106 \)). These results suggested that the relation between BMI and percentage body fat for Asians was different depending on whether there was early life exposure to the US environment. Asians who lived in the United States \(<12 \text{ y} \) had approximately the same relation between BMI and mean percentage body fat as did whites. Asians with more years in the United States had higher mean percentage body fat than did whites at low BMIs and lower mean percentage body fat at high BMIs with the regression lines intersecting at BMI \(=20.5 \) and body fat of 26.5%.

Because regression estimates can be influenced by outliers, we examined influence measures for all observations. Cook’s distance for all observations was \(<0.08 \), which was well below the benchmark of 1 for identifying influential points (23). Nevertheless, we refit the model after removing 4 observations with

<table>
<thead>
<tr>
<th>BMI (in kg/m(^2)) &lt;20</th>
<th>By country of birth</th>
<th>By length of residence in the United States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Foreign born</td>
<td>North American born</td>
</tr>
<tr>
<td>n</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.3 ± 5.8(^{a})</td>
<td>161.7 ± 6.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>47.7 ± 3.3(^{a})</td>
<td>49.4 ± 5.6</td>
</tr>
<tr>
<td>Body fat percentage</td>
<td>21.9 ± 4.0</td>
<td>22.8 ± 4.3</td>
</tr>
<tr>
<td>BMI of 20–24.9</td>
<td>n</td>
<td>39</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158.0 ± 5.3(^{a})</td>
<td>160.2 ± 6.1(^{a})</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.7 ± 6.0(^{a})</td>
<td>56.6 ± 4.9(^{a})</td>
</tr>
<tr>
<td>Body fat percentage</td>
<td>30.2 ± 4.2</td>
<td>28.1 ± 4.5(^{a})</td>
</tr>
<tr>
<td>BMI of 25.0–34.9</td>
<td>n</td>
<td>8</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>154.6 ± 9.7(^{a})</td>
<td>157.6 ± 6.4(^{a})</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65.2 ± 6.3(^{a})</td>
<td>67.9 ± 5.2(^{a})</td>
</tr>
<tr>
<td>Body fat percentage</td>
<td>36.7 ± 4.5</td>
<td>35.7 ± 4.0</td>
</tr>
</tbody>
</table>

1 Analyses were conducted by using one-factor ANOVA with Tukey’s honestly significant difference post hoc test. Two sets of ANOVAs were conducted as follows: one set compared means in foreign-born Asians, North American-born Asians, and non-Hispanic whites; the other set compared means in Asians who lived in the United States \(<12 \text{ y} \), Asians who lived in the United States \(\geq12 \text{ y} \), and non-Hispanic whites. \(^{a, b}\)Comparisons between foreign-born Asians, North American-born Asians, and non-Hispanic whites; values with different superscripts were significantly different at \( P < 0.05 \). 

\(^{a}\)Comparisons between Asians who lived in the United States \(<12 \text{ y} \), Asians who lived in the United States \(\geq12 \text{ y} \), and non-Hispanic whites; values with different superscripts were significantly different at \( P < 0.05 \). Only data for subjects with a BMI (in kg/m\(^2\)) \(<35 \) are shown in this table.
showed a distinctly different relation than did whites; the Asian women who had early life exposure to the US environment of white women of a similar age. In contrast, Asian American BMI and mean percentage body fat that was comparable with that during early childhood and adolescence, had a relation between and, thus, had limited or no exposure to the US environment 

DISCUSSION

In this study of a convenience sample of 129 young, adult, Asian American women and a retrospective cohort of 327 non-Hispanic white Americans, aged 20–25 y, we unexpectedly observed that Asian-immigrant adults who had lived in the United States <12 y, and, thus, had limited or no exposure to the US environment during early childhood and adolescence, had a relation between BMI and mean percentage body fat that was comparable with that of white women of a similar age. In contrast, Asian American women who had early life exposure to the US environment showed a distinctly different relation than did whites; the Asian American women had higher mean body fat than did whites at low BMIs (less than ≈20.5) but a less rapid increase in body fat as BMI increased, which resulted in lower mean body fat than whites at BMIs in the overweight and obese categories. Findings from other studies suggested that environment in early life may influence growth, body proportions, and body composition (18, 19, 24). In a comparison of >300 Chinese American and Singaporean Chinese youth, aged 17–22 y, Wang et al (24) observed that Singaporean Chinese youth exhibited greater skinfold thicknesses than did Chinese Americans, but Chinese Americans exhibited greater BMI than did Singaporean Chinese, contributing to the literature that the environment may play an important role in body composition. Asian-immigrant adults who were living in North America were observed to have higher adiposity levels at the same BMI level than did whites (6). However, most of the Asian-immigrant adults studied were raised outside of North America. To our knowledge, our study was among the first studies to observe a difference in how

TABLE 3

<table>
<thead>
<tr>
<th>All subjects (n = 458)</th>
<th>Five influential observations removed (n = 453)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef ± SE</td>
</tr>
<tr>
<td>Intercept (intercept for whites)</td>
<td>74.2 ± 1.2</td>
</tr>
<tr>
<td>Indicator for Asians and lived in the United States &lt;12 y (difference between intercepts for Asians who lived in the United States &lt;12 y and whites)</td>
<td>2.4 ± 6.8</td>
</tr>
<tr>
<td>Indicator for Asians and lived in the United States ≥12 y (difference between intercepts for Asian who lived in the United States &lt;12 y and whites)</td>
<td>13.6 ± 3.0</td>
</tr>
<tr>
<td>Transformed BMI (negative inverse BMI (−BMI−1)) (slope for whites)</td>
<td>977.1 ± 27.7</td>
</tr>
<tr>
<td>Interaction: transformed BMI (−BMI−1) × indicator for Asians and lived in the United States &lt;12 y (difference between slopes for Asians who lived in the United States &lt;12 y and whites)</td>
<td>278.7 ± 65.8</td>
</tr>
</tbody>
</table>

1 Coef, coefficient. Model is equivalent to that shown in Table 3 but reparametrized for interpretability. $R^2 = 0.78$.  

A high leverage and one observation with a large studentized residual. Removal of these 5 observations has little effect on the regression coefficient estimates (Table 4).
BMI relates to percentage body fat between Asian Americans who had spent more years of childhood in the United States compared with Asian Americans who were minimally exposed to the United States during childhood and adolescence. In particular, we showed that the slope that represented the relation between BMI and percentage body fat was more gradual for Asian Americans who had spent more years in the United States during childhood and early adolescence than for whites. The slope for Asians who had spent fewer years in the United States during childhood and early adolescence was comparable with that for whites.

Our findings have to be interpreted with caution. Our study suffered from the small convenience sample of Asians from diverse sociocultural backgrounds and countries of origin. Asians from a developed country such as Japan or from newly industrialized countries such as Singapore would have experienced different environmental exposures than would their counterparts from less developed countries such as Vietnam or the Philippines. In addition, the socioeconomic backgrounds of women were not comparable: American-born Asians had a higher percentage of mothers with college degrees (59% of mothers compared with 37% of mothers in foreign-born Asians and 32% of mothers in whites). Further, there was a high proportion of college students (mostly recruited from an elite university) in our study, which suggested that obesity rates in our sample of Asians were likely lower than in the general population. Therefore, our findings raised the following questions rather than provided answers: Is the general observation that, at the same BMI level, Asians have higher total body fat and visceral fat and higher risk of cardiovascular disease risk than do whites applicable to Asians in general, or is this observation applicable only to Asians living in Asian societies? If the latter, does the environment during early life influence how body fat accumulates and distributes and, therefore, affects the relation between BMI and body fat? How strong a predictor of child growth and body composition is socioeconomic background and, in particular, the mother’s education? Are our findings also applicable to men?

We concluded that the early life environment may influence the relation between BMI and adiposity in later life. In particular, we speculated that Asian women substantially exposed to the American environment early in life exhibited different patterns of accumulation of body fat than did Asian women raised in Asia; these differences may be partially attributable to environmental and lifestyle factors that affected diet and physical activity. For example, compared with Asian children raised in the United States, children who live in Asia tend to spend more time studying, whether in school or at home, and less time doing sports and engaging in recreational activities (25). In the past, diets of Asians raised in Asia also tended to be different, with a lower consumption of breakfast cereals, dairy products, and processed meats, than diets of Asians raised in the United States (26). However, with the rapid changes that have been taking place in Asian economies and the globalization of the food supply, we expect to see further changes in the diets of children in Asia (27) and, consequently, in body composition. The understanding of how childhood environments influence the relation between BMI and percentage body fat has implications for the use of BMI as a screening indicator for obesity and obesity-related conditions. In addition, research to understand the influence of environmental factors on the accumulation and distribution of total body fat and metabolically active visceral fat during critical life stages will add insight into the use of clinically relevant screening tools for chronic disease risk.

The authors’ responsibilities were as follows—MCW: conceived the study, designed the initial manuscript, conducted preliminary data analysis, and took primary responsibility for the manuscript; CMC: modeled the data, conducted statistical analysis, and added to the “Subjects and Methods” and “Results” sections. Neither of the authors declared a conflict of interest.

REFERENCES