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Contrasting Socioeconomic Profiles Related to Healthier Lifestyles in China and the United States

Soowon Kim[1], Michael Symons[2], and Barry M. Popkin[1]

[1] Department of Nutrition, University of North Carolina, Chapel Hill, NC.
[2] Department of Biostatistics, University of North Carolina, Chapel Hill, NC.

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Health disparity by socioeconomic status has recently become an important public health concern. Socioeconomic status may affect health status through several pathways including lifestyle choices. The authors tested the link between socioeconomic status and lifestyle in China (in 1993) and in the United States (in 1994–1996), countries with high contrasts in development, to understand health discrepancy issues cross-nationally. Healthfulness of lifestyle was measured using the Lifestyle Index, a summary score that integrates four key lifestyle factors: diet, physical activity, smoking, and alcohol consumption. Income and education were used as indicators of socioeconomic status. In China, as socioeconomic status improved, lifestyle was less healthy (relative odds for the highest socioeconomic status group = 0.19, 95% confidence interval: 0.10, 0.35). Conversely, in the United States, higher socioeconomic status was related to a healthier lifestyle (relative odds for the highest socioeconomic status group = 3.81, 95% confidence interval: 2.94, 4.94). The contrasting relation between socioeconomic status and lifestyle depicts different phases of the lifestyle transition (changes in lifestyles accompanying economic development). The differences may in part explain why nutrition-related noncommunicable diseases are more prevalent in the developing world among people with a high socioeconomic status, whereas often the opposite is found in developed societies. Public health programs may benefit by advising each socioeconomic status group separately, while considering the country's level of development.

China; education; health; income; life style; socioeconomic factors; United States

Socioeconomic status has been identified in the health literature as a powerful determinant of health status (1). Higher morbidity and mortality among people with a lower socioeconomic status (most frequently referring to lower income and lower education) have been reported across a wide range of health issues (2–4).

Various factors that can affect health outcomes are summarized in figure 1. The influence of lifestyle, including diet, physical activity, smoking, and alcohol consumption, on long-term health outcomes (pathway *e*) is strongly indicated in the literature (5). Other pathways by which socioeconomic status influences health outcomes include inequality of access to health care (6) and health care quality, such as diagnosis, treatment, and control (pathways *f* and *i*) (7). Differential exposure and responses by socioeconomic status to environmental, biologic, social, and psychological factors, such as neighborhood, pathogens, support, and stress, can also result in health inequality (1, 8, 9).

In recent years, the pathways where the effect of income and education on health status is mediated by lifestyle choices (pathways *a* through *d* in figure 1) have become more evident, as the disparity in health status presented across socioeconomic status groups seemed to reflect the apparent changes in lifestyle observed worldwide. The lifestyle transition, a set of changes occurring in lifestyle behaviors along with the progress of economic development, is spreading worldwide. The direction of the shift, however, seems to differ among socioeconomic status groups across countries depending on their various levels of development. The most rapid changes in diet are found in the lower-income countries as economic development increases (10). The shift is most often toward an unhealthy diet characterized by higher fat levels and greater amounts of added sugar, especially among the higher socioeconomic status groups in developing countries (11). As societies have grown more dependent on labor-saving devices, sedentary lifestyles have become more common around the world. Less time is spent

Correspondence to Dr. Barry M. Popkin, Carolina Population Center, University of North Carolina, 123 W. Franklin Street, Chapel Hill, NC 27516 (e-mail: popkin@unc.edu).

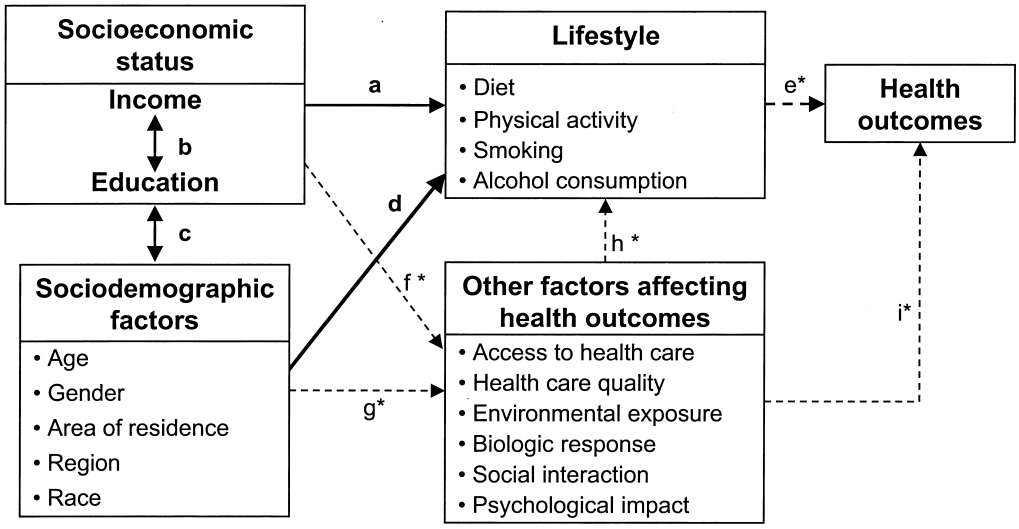

FIGURE 1. Pathways linking socioeconomic status, lifestyle factors, and health (*e*, *f*, *g*, *h*, and *i* not modeled in this study).

in voluntary physical exercise among all groups in developing countries and less privileged socioeconomic status groups in developed countries (12). These changes in lifestyle are in line with the discrepant patterns of health status seen around the world. In developed societies, people with a high socioeconomic status are healthier than those with a low socioeconomic status (13). However, in the developing world, nutrition-related noncommunicable health conditions (such as obesity) are often more prevalent as socioeconomic status improves (14).

These observations motivated us to test whether there is a link between socioeconomic status and lifestyle that may lead to contrasting health profiles worldwide. The authors hypothesized that there is a systematic difference in healthfulness of lifestyle by socioeconomic status, with the pattern depending on the country's level of development, which may explain the difference in the relation of health with socioeconomic status from country to country. This study examined the hypothesis by modeling pathways *a* through *d* (shown in figure 1) separately for China and the United States, countries with a high contrast in their levels of economic development.

MATERIALS AND METHODS

Data and subjects

National in-depth surveys from China and the United States were analyzed for this study. The 1993 China Health and Nutrition Survey included approximately 14,000 individuals drawn by a multistage, random cluster process in eight provinces, whose socioeconomic and other health, nutritional, and demographic factors vary substantially (15). The data collection for the China Health and Nutrition Survey followed human subject-approval procedures of the human subjects protection committees of the University of North Carolina at Chapel Hill School of Public Health and the Chinese Academy of Preventive Medicine. The 1994–1996 US Continuing Survey of Food Intakes by Individuals surveyed a representative national probability sample of the US population consisting of more than 16,000 individuals who were drawn by a complex, multistage, area probability sample design. The data collection details for each survey have been previously described (15, 16). Both data sets have comparable information on socioeconomic status and lifestyle behaviors. Our study subjects were adults aged 20 or more years who provided lifestyle data and who were not pregnant or lactating. To effectively contrast the socioeconomic status profiles of those with healthier and unhealthy lifestyles, we included in our statistical modeling analysis groups in the upper and lower tiers of healthfulness of lifestyle, which resulted in a sample size of 5,280 persons from the China Health and Nutrition Survey and 6,301 persons from the Continuing Survey of Food Intakes by Individuals.

Measures

Healthfulness of lifestyle was measured using the Lifestyle Index for the individuals of the study samples. The Lifestyle Index is a summary measure created for cross-national comparisons based on global health concerns, integrating four key lifestyle factors: diet, physical activity, smoking, and alcohol use (17). Each factor of the Lifestyle Index was given differential weights (0.2, 0.3, 0.3, and 0.2, respectively), reflecting its relative importance in health (18–21). Diet quality was assessed with respect to variety, adequacy, moderation, and overall balance by measuring intakes of various foods and nutrients. Physical activity was evaluated by level of physical activity. Both status and amount of smoking determined the smoking score. Alcohol consumption was assessed by the type of alcohol drinking (regular or binge), as well as by the amount of alcohol

consumed. Each component index (and thus the Lifestyle Index) has a gradient of scores based on the healthfulness of lifestyle: the higher the score, the healthier the lifestyle. The Lifestyle Index scores range from zero to 100 points, with 100 points implying the successful achievement of healthy lifestyle goals.

We categorized the continuous measures of healthfulness of lifestyle (the Lifestyle Index scores) into three groups: low (below 60 points), middle (from 60 to 80 points), and high (more than 80 points). These Lifestyle Index score groups, created by the absolute cutpoints, approximated the tertile groups of the Lifestyle Index score in both countries. This implies that the groups also reflect the relative positioning of healthfulness of lifestyle in each country. The outcome in the modeling analysis was a healthy (high Lifestyle Index scores) or unhealthy (low Lifestyle Index scores) lifestyle.

Information on income and education was used to represent socioeconomic status as the main independent variables. Because our focus was to compare how relative socioeconomic status (rather than exact level of income or education) relates to healthfulness of lifestyle across the countries, the socioeconomic status indicators were categorized with country-specific cutoff points. For China, the total household income per capita (average monthly income from work, including subsidies and bonuses, and household income from other sources, adjusted using a price index) was categorized into tertiles. For the United States, the annual approximated income from all sources, earned by all of the household members before taxes, was expressed as a percentage of the poverty threshold based on income and head count of the household members. Cutoffs of 185 percent and 350 percent of the poverty threshold were used to distinguish low-, middle-, and high-income groups for the United States.

The level of education was measured by the number of years of education in formal school. The distribution of years of education in China and the United States varied substantially. For China, those with no formal education (more than 20 percent of the analyzed sample) were put into the low-education group, those with formal education up to or including the sixth grade were put into the middle-education group, and those with more than a sixth grade education were put into the high-education group. For the United States, we used cutoffs of less than 12 years (low), 12 years (middle), and greater than 12 years (high) of education. For those with no education data available in the United States (n = 102, 1.6 percent of the analyzed sample), we imputed the educational level with the use of a regression equation relating years of education to age, gender, area of residence, region, income, occupation, and race.

As control variables, sociodemographic factors that may simultaneously be related to socioeconomic status and healthfulness of lifestyle were included in the analysis. For example, in China, gender is highly associated with both the level of education and smoking and alcohol consumption behaviors. Therefore, gender may confound the relation between education and lifestyle. The control variables included age, gender, area of residence, and region in both countries and, additionally, race in the United States. We categorized age in years into three groups, with cutoff points at 35 years and 55 years of age. For China, we used two categories for area of residence: urban and rural. For the United States, three urbanization categories were available based on Metropolitan Statistical Area status: central city, outside central city, and non-Metropolitan Statistical Area. For the region variable in China, the eight provinces surveyed were categorized into two geographic groups, southern and northern. For the United States, four regional distinctions (Northeast, Midwest, South, and West) were used. Additionally, for the United States, five racial groups (White, African American, Asian and Pacific Islander, American Indian and Alaskan Native, and other) and an imputed-income indicator (described in detail below) were included.

Statistical analysis

We summarized, separately for China and the United States, the distribution of the variables in each sample. The effect of income and education on healthfulness of lifestyle was examined using logistic regression. The effect of socioeconomic status on lifestyle was initially tested with more finely divided Lifestyle Index score groups. Moreover, the socioeconomic status of individuals in the highest tertile or quartile of the Lifestyle Index score was contrasted against the socioeconomic status of those in the lowest tertile or quartile of the Lifestyle Index score. However, all of the models with finer outcome categories or with different cutoffs of Lifestyle Index scores showed very similar results. Therefore, this study presents the results by logistic regression with the dichotomous outcome of low versus high Lifestyle Index scores based on absolute cutoffs of less than 60 points versus greater than 80 points, the most interpretable categories.

This study modeled, separately for China and the United States, pathways *a* through *d*, shown in figure 1. In other words, we did not combine the two samples into one large data set but examined each country separately with comparable specifications. The models were built as comparably as possible between China and the United States, but some deviation was allowed to make each model most appropriate for its country. The full models included income and education (used as the main effect variables) and interaction terms between income and education, as well as sociodemographic variables (used as control variables). None of the variables in the models was collinear. By including both income and education in the same model, we could assess the independent effect of each. Interaction between income and education was included to examine any modification of income effect by education or vice versa, as well as the cumulative effect of income and education in relation to healthfulness of lifestyle. To evaluate the interaction, we compared the full model with a reduced model without income-education interaction terms. First, the difference in odds ratio between the strata of the main effect variables was examined from the full model. A difference greater than 50 percent between the strata was considered significant (22). Next, we performed a likelihood ratio test at an alpha level of 20 percent, comparing the reduced model with the full model (23). Confounding by the control variables was examined by

excluding the control variables from the full model, one at a time. A change in estimate greater than 10 percent was considered significant (22).

For variables that were initially continuous measures but categorized for analysis (i.e., income, education, and age), we assigned indicator variables for the group distinction. We chose the lowest levels (low income, low education, and 20–35 years of age) as the referent group in all of the analyses. Indicator variables were also used for the other sociodemographic variables. For both countries, we chose females and rural area as the referent group. Additional referent groups included the northern province for China and the Northeast region and the White race for the United States. In the Continuing Survey of Food Intakes by Individuals, the income level of households that had not provided the exact information on income had been imputed by the US Department of Agriculture based on either a broader income category, monthly income, regression equation, or segment-level mean income (16). In our analysis sample, income values of 13, 2.6, 8.7, and 0.43 percent of the sample were found to have been imputed by the four imputation methods, respectively. Because a substantial proportion of the sample (24.7 percent) had imputed income values, we included additionally for the United States a dummy variable that distinguished households with an imputed income to adjust for any estimation error.

In both the China and US surveys, data were collected from multiple members of the same households whose lifestyles may be correlated. We incorporated a Huber correction to adjust for the correlation among the same household members, using a cluster option that corrects variances. Design effects were also taken into account for the China Health and Nutrition Survey data, combining the province and city/county distinctions as a cluster variable. For the United States, adjustment by the sampling weights made the results representative of the total US population. All analyses were performed using Stata statistical software, version 7 (24).

RESULTS

The distribution of the outcome, main effect, and control variables among the analysis sample in each country is summarized in table 1. All the variables were fairly evenly distributed except area of residence in China and race in the United States. The distributions were comparable between China and the United States.

The key findings from the logistic regression analysis are shown in table 2. The odds ratio and its 95 percent confidence interval are presented for the referent groups including low income, low education, younger age, female gender, and rural area for both China and the United States; the northern region for China and the Northeast for the United States; and, additionally, White race and reported income for the United States. For both China and the United States, the interaction between and the additional cumulative effect of income and education were not significant. Removal of gender and age from the model each changed the estimates of the main exposure variables greater than 10 percent for China (most notably those of education), illustrating the confounding effect of gender and age. None of the control variables in the United States changed the odds ratio estimates significantly.

In China, as the income level increased, the likelihood of having a healthier lifestyle decreased significantly in a linear trend. Compared with the lowest tertile income group, the highest tertile income group was 2.5 times less likely to have a healthier lifestyle. A similar trend was seen for education. As the level of education increased, the likelihood of having a healthier lifestyle decreased. Compared with people with no formal education, those with more than 6 years of education (high education group) were 1.8 times less likely to have a healthier lifestyle.

Conversely, in the United States, as the income level increased, the likelihood of having a healthier lifestyle increased. People in the highest income category were about 1.6 times as likely to have a healthier lifestyle than people in the lowest income group. A similar but even more pronounced trend was shown by educational level. People with more than a high school education were 2.8 times more likely to have a healthier lifestyle than were people with less than a high school education.

Next, we present the likelihood of having a healthy lifestyle with both income and education taken into account, by summarizing nine combinations of the income and education groups (low, middle, and high of each) into five socioeconomic status groups: low (both low income and low education), lower middle (one low and the other middle), middle (both middle, or one low and the other high), higher middle (one middle and the other high), and high (both high). Figure 2 shows the likelihood of healthy lifestyle from the full model by those five socioeconomic status groups by country, with the lowest socioeconomic status group (low income and low education) as the referent. The average of the odds ratios within the five groups is illustrated on a logarithmic scale. A contrasting gradient in the likelihood of having a healthier lifestyle for China and the United States is clearly seen. In China, as socioeconomic status improved, the odds of having a healthier lifestyle decreased; conversely, in the United States, the odds increased with a similar magnitude. The highest socioeconomic status group in China was more than five times less likely than the lowest to have a healthier lifestyle (odds ratio for the highest socioeconomic status group = 0.19, 95 percent confidence interval: 0.10, 0.35); in the United States, the highest socioeconomic status group was about four times more likely than the lowest to have a healthier lifestyle (odds ratio for the highest socioeconomic status group = 3.81, 95 percent confidence interval: 2.94, 4.94).

DISCUSSION

In studying China and the United States, we found a clear contrast in the relation of socioeconomic status and healthfulness of lifestyle, which may explain the differential patterns of change in health profiles observed worldwide. In developing countries, nutrition-related noncommunicable diseases are more prevalent among those with a high socioeconomic status; in developed societies, often the opposite is found. A rapid change in lifestyle is consistently predicted in

TABLE 1. Distribution of the outcome, main effect, and control variables among the analysis sample in China (from 1993 China Health and Nutrition Survey) and the United States (from 1994–1996 Continuing Survey of Food Intakes by Individuals)

Variables	China (n = 5,280)		United States (n = 6,301)	
	No. of subjects	% of analysis sample	No. of subjects	% of analysis sample
Lifestyle Index score				
Low (<60)	2,821	53.4	2,836	45.0
High (>80)	2,459	46.6	3,465	55.0
Income				
Low	1,996	37.8	2,204	35.0
Middle	1,817	34.4	1,759	27.9
High	1,467	27.8	2,338	37.1
Education				
Low	1,133	21.5	1,423	22.6
Middle	1,847	35.0	2,209	35.1
High	2,300	43.6	2,669	42.4
Age				
Younger (20–<35 years)	1,799	34.1	1,421	22.6
Middle (35–<55 years)	2,411	45.7	2,334	37.0
Older (≥55 years)	1,070	20.3	2,546	40.4
Gender				
Female	2,361	44.7	2,872	45.6
Male	2,919	55.3	3,429	54.4
Area of residence				
Rural	4,120	78.0	1,633	25.9
Suburban			2,781	44.1
Urban	1,160	22.0	1,887	30.0
Region				
Northeast*	1,771	33.5	1,147	18.2
Midwest			1,551	24.6
South	3,509	66.5	2,305	36.6
West			1,298	20.6
Race				
White			5,137	81.5
African American			735	11.7
Asian, Pacific Islander			123	2.0
American Indian, Alaska Native			38	0.6
Other			268	4.3

* The northern provinces in the case of China.

the literature to lead to a similar increase in chronic diseases among specific socioeconomic status groups (25, 26). The prevalence of lifestyle-related chronic disease may rise even faster, especially in the lower-income countries, as the lifestyle transition accelerates. Although research on Brazil and the Latin American countries indicates a shift toward more obesity among the poor (27), this trend has not been consistently found in Asia, Africa, or the Middle East. Studies on dietary behavior in China indicate that the burden of a higher-fat diet is expected to shift toward the poor by the year 2012 (28, 29).

The marked contrasts in the relation between socioeconomic status and healthfulness of lifestyle shown in China and the United States suggest that the various socioeconomic status groups experience different patterns of the lifestyle transition, depending on the country's level of development. In developing countries like China, only the low socioeconomic status group seems to maintain a healthy lifestyle.

TABLE 2. Results of logistic regression analysis of the relation between socioeconomic status and healthfulness of lifestyle among the sample in China (from 1993 China Health and Nutrition Survey) and the United States (from 1994–1996 Continuing Survey of Food Intakes by Individuals), controlling for sociodemographic factors

Main effect variables†,‡	China§,¶,#		United States††,‡‡,§§	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Middle income	0.67	0.41, 1.09	1.37	0.98, 1.90
High income	0.40*	0.19, 0.82	1.57**	1.05, 2.34
Middle education	0.73	0.49, 1.09	1.28	0.99, 1.65
High education	0.55**	0.36, 0.86	2.79**	1.96, 3.97

* $p < 0.05$; ** $p < 0.01$.

† All of the interactions of pairwise categories of income and education were insignificant.

‡ The test of linearity in the odds ratio (actually in log odds ratio) was significant across income and education groups in both China and the United States ($p < 0.001$).

§ Design effects were controlled.

¶ All models included age, gender, area of residence, and region as control variables.

The referent in the model was low income, low education, younger age (20–<35 years), females, rural residence, and northern region.

†† Adjusted for sampling weights from the Continuing Survey of Food Intakes by Individuals.

‡‡ All models included age, gender, area of residence, region, race, and income imputation distinction as control variables.

§§ The referent in the model was low income, low education, younger age (20–<35 years), females, rural residence, Northeast region, White race, and reported income.

Most available and affordable diets in these countries include natural food sources that are high in fruits, vegetables, and grains and low in fat, rather than processed foods, which are commonly high in fat, salt, and refined sugar (30). Processed foods are usually more costly in these countries. In addition, people in lower-income countries are, out of necessity, engaged in a more physically active lifestyle. However, as people with a higher socioeconomic status

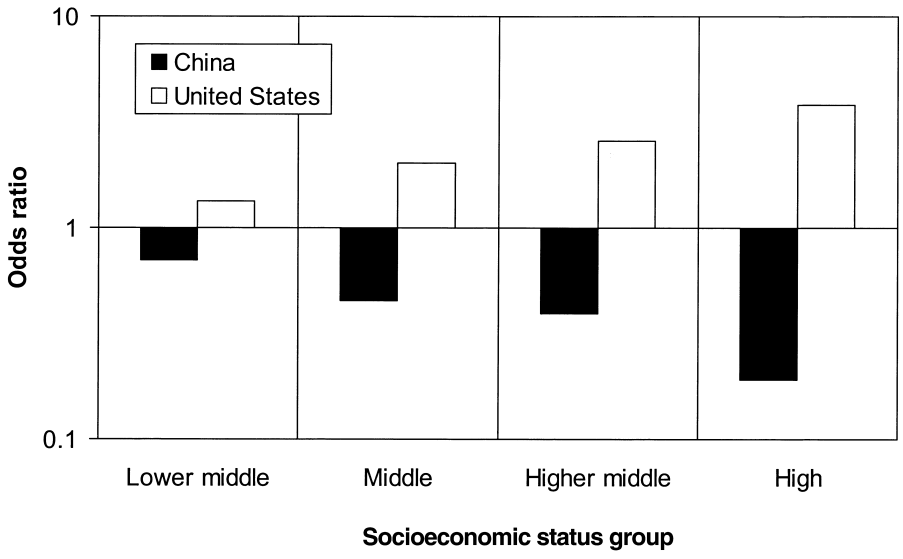

FIGURE 2. Comparison of the likelihood of a healthy lifestyle in China and the United States, by level of socioeconomic status for adults aged 20 years or older, 1993 China Health and Nutrition Survey and 1994–1996 Continuing Survey of Food Intakes by Individuals. For lower middle, middle, and higher middle socioeconomic status groups, an average of the likelihood within the socioeconomic status groups is presented; therefore, 95% confidence intervals for the odds ratios could not be presented. The referent group for the comparison is the lowest socioeconomic status group (low income and low education).

become exposed to a Western lifestyle, they readily adopt some of its unhealthy aspects of lifestyle (including a diet high in fat and sugar and becoming more sedentary), in part because these choices are viewed as privileges of the wealthy. Such behaviors may have become even more apparent in China since the market system was introduced (28). The drastic change that started in the late 1970s from the government-controlled food distribution system to a free market may be continually leading people in the high socioeconomic status groups to change their food-buying habits to select foods that are not only more expensive but also less healthy. In China, the overall level of education does not appear to be high enough to support healthier lifestyle choices.

In the developed societies, people have become accustomed to unhealthy lifestyle behaviors, which evolved almost by default as a result of economic development. This type of lifestyle is characterized by a poor quality diet (low in fruits, vegetables, and grains; low in micronutrients) and lack of physical activity. Processed foods, which in these countries cost less but are poor in quality compared with natural foods, are readily available. People are less active because of increased use of energy-saving devices and motorized transportation. Choosing healthier lifestyle behaviors involves making deliberate choices that people with a higher socioeconomic status can most easily afford (e.g., buying natural rather than processed foods, joining health clubs, investing in sports equipment). Even engaging in walking or running warrants a safer environment that is usually available for those with a higher socioeconomic status.

Smoking and alcohol drinking behaviors themselves, as well as the relation between socioeconomic status and the behaviors, may be less sensitive to the level of development than is diet or physical activity. Smoking and alcohol use seem to reflect more of the cultural practices associated with sociodemographic factors that are also related to socioeconomic status. In China, smoking and alcohol drinking behaviors are found almost exclusively among the males. Higher education is also greatly associated with the male gender in China. Therefore, the relation between socioeconomic status and lifestyle is strongly confounded by gender in China. The relation is also confounded by age, as older people are significantly less educated and engaged more in unhealthy behaviors than the younger generation in China. In the United States, although the proportions of smokers and heavy alcohol drinkers are higher among males than females, the difference between genders is not as great as in China. In addition, gender is not significantly related to education in the United States.

It is interesting to note the similarity of the health behaviors among those in the highest socioeconomic status group in China and the lowest socioeconomic status group in the United States. A vision of a broader development process might potentially suggest a U-shaped relation between the level of development and healthfulness of lifestyles. However, this was not within the analysis of this study.

Of the pathways shown in figure 1, we modeled only pathways *a* through *d*. Our results, in combination with the existing literature, suggest that the contrasting relation between socioeconomic status and healthfulness of lifestyle may affect the link between lifestyle and health outcomes accordingly. However, testing the pathway (pathway *e* in figure 1) was beyond the scope of this study. There are other factors involved in the pathway that could not be examined in this study. The route by which income and education affect health outcomes through other factors, such as health care and environmental, biologic, social, and psychological influences (pathways *f* and *i*), may have different patterns for China and the United States. For example, people with a higher socioeconomic status in China have better access to and quality of health care and more positive social interactions than those with a lower socioeconomic status. These positive elements related to a higher socioeconomic status would offset the negative effect of their unhealthy lifestyles on health status. Therefore, the net result of health outcomes for China may not reflect the differences in healthfulness of lifestyle by socioeconomic status groups as clearly as for the United States. People with a higher socioeconomic status in the United States have both healthier lifestyles and better health care. Therefore, the effect of socioeconomic status on health outcome may be rather amplified by the other factors.

Parameters of socioeconomic status may be intertwined in influencing health behaviors differently, depending on the level of development. In developed countries where people are generally well educated, cultural norms agree with healthy lifestyle choices. In this setting, the higher cost of healthy lifestyles may be a realistic barrier to healthy lifestyle choices. In developing countries, a healthy lifestyle is usually more affordable than an unhealthy one. Because the level of education is not high enough to form healthy cultural norms in these countries, the healthy choices, despite the favorable cost, frequently lose their place to desires for the novel and Westernized that are often unhealthy. In this case, it probably is not the cost that prevents people from engaging in healthy behaviors but the norms related to education.

Applying a market segmentation technique in the health field has been documented in the literature (31). Undoubtedly, public health promotions would be more effective if targeted to subpopulation groups for their specific needs. The findings of this study suggest that global health promotion efforts include developing strategies that take socioeconomic status and level of economic development into account. In developing countries, the focus should be on redirecting the lifestyle transition, especially among the higher socioeconomic status groups, so that they can regain a healthier lifestyle. Developing countries may benefit greatly by establishing healthy cultural norms that encourage healthier lifestyle choices through education. In developed countries, an effective strategy may include tackling the cost barrier by modifying the environment to one that promotes more physical activity and makes healthier foods more available and affordable, especially to the lower socioeconomic status groups. As the world increasingly faces lifestyle transitions toward an unhealthy lifestyle, both in developing and developed countries, these focused interventions would have a particularly effective impact on global public health.

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REFERENCES

1. Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. Ann N Y Acad Sci 1999;896:3–15.
2. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. Circulation 1993;88(4 Pt 1):1973–98.
3. Baquet CR, Commiskey P. Socioeconomic factors and breast carcinoma in multicultural women. Cancer 2000;88(suppl):1256–64.
4. Bell AC, Adair LS, Popkin BM. Ethnic differences in the association between body mass index and hypertension. Am J Epidemiol 2002;155:346–53.
5. Weisburger JH. Worldwide prevention of cancer and other chronic diseases based on knowledge of mechanisms. Mutat Res 1998;402:331–7.
6. Andrulis DP. Access to care is the centerpiece in the elimination of socioeconomic disparities in health. Ann Intern Med 1998;129:412–16.
7. Fiscella K, Franks P, Gold MR, et al. Inequality in quality: addressing socioeconomic, racial, and ethnic disparities in health care. JAMA 2000;283:2579–84.
8. Anderson NB, Armstead CA. Toward understanding the association of socioeconomic status and health: a new challenge for the biopsychosocial approach. Psychosom Med 1995;57:213–25.
9. Feinstein JS. The relationship between socioeconomic status and health: a review of the literature. Milbank Q 1993;71:279–322.
10. Popkin BM. The shift in stages of the nutrition transition in the developing world differs from past experiences. Public Health Nutr 2002;5:205–14.
11. Du S, Lu B, Zhai F, et al. A new stage of the nutrition transition in China. Public Health Nutr 2002;5:169–74.
12. Heath GW, Smith JD. Physical activity patterns among adults in Georgia: results from the 1990 Behavioral Risk Factor Surveillance System. South Med J 1994;87:435–9.
13. Kington RS, Smith JP. Socioeconomic status and racial and ethnic differences in functional status associated with chronic diseases. Am J Public Health 1997;87:805–10.
14. Popkin BM, Paeratakul S, Zhai F, et al. A review of dietary and environmental correlates of obesity with emphasis on developing countries. Obes Res 1995;3(suppl 2):145s–53s.
15. The China Health and Nutrition Survey, August 2001. Chapel Hill, NC: Carolina Population Center, University of North Carolina at Chapel Hill, 2001. (http://www.cpc.unc.edu/projects/china/).
16. Tippett KS, Cypel YS, eds. Design and operation: the Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey, 1994–96. Washington, DC: US Department of Agriculture, 1997. (NFS report no. 96-1).
17. Kim S, Siega-Riz AM, Haines PS, et al. The Lifestyle Index (LI): a comprehensive, cross-national measurement tool of the healthfulness of lifestyles. Prev Med (in press).
18. Paffenbarger RSJ, Hyde RT, Wing AL, et al. The association of changes in physical-activity level and other lifestyle characteristics with mortality among men. N Engl J Med 1993;328:538–45.
19. McGinnis JM, Foege WH. Actual causes of death in the United States. JAMA 1993;270:2207–12.
20. Kant AK, Schatzkin A, Harris T, et al. Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. Am J Clin Nutr 1993;57:434–40.
21. Powell KE, Blair SN. The public health burdens of sedentary living habits: theoretical but realistic estimates. Med Sci Sports Exerc 1994;26:851–6.
22. Greenland S, Rothman K. Introduction to stratified analysis. In: Rothman K, Greenland S, eds. Modern epidemiology. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins, 1998:253–79.
23. Breslow NE, Day NE. Statistical methods in cancer research. Vol I. The analysis of case-control studies. Lyon, France: International Agency for Research on Cancer, 1980. (IARC scientific publication no. 32).
24. Stata Corporation. Stata statistical software: release 7.0. College Station, TX: Stata Corporation, 2001.
25. Popkin BM. The nutrition transition and its health implications in lower-income countries. Public Health Nutr 1998;1:5–21.
26. Popkin BM. An overview on the nutrition transition and its health implications: the Bellagio meeting. Public Health Nutr 2002;5:93–103.
27. Monteiro CA, Conde WL, Popkin BM. Is obesity replacing or adding to undernutrition? Evidence from different social classes in Brazil. Public Health Nutr 2002;5:105–12.
28. Guo X, Mroz TA, Popkin BM, et al. Structural changes in the impact of income on food consumption in China, 1989–93. Econ Dev Cult Change 2000;48:737–60.
29. Popkin BM, Du S. Dynamics of the nutrition transition toward the animal foods sector in China and its implications: a worried perspective. J Nutr 2003;133(suppl):3898S–906S.
30. Drewnowski A, Popkin BM. The nutrition transition: new trends in the global diet. Nutr Rev 1997;55:31–43.
31. Slater M, Flora J. Health lifestyles: audience segmentation analysis for public health interventions. Health Educ Q 1991;18:221–33.