

Body Weight Patterns among the Chinese: Results from the 1989 and 1991 China Health and Nutrition Surveys

ABSTRACT

Objectives. A longitudinal survey assessed the distribution of adult body weight among the Chinese population.

Methods. Data from the 1989 and 1991 China Health and Nutrition Survey were used to study changes in the proportions of adults aged 20–45 years who were classified as underweight, normal weight, overweight, and severely overweight.

Results. There was a slight decline in the proportion of men and women classified as underweight, but among lower-income persons an increase occurred. The proportion of adults with normal body weight decreased, and the proportions of those classified as overweight and severely overweight increased during the same period. The observed increases in proportions of adults classified as overweight and severely overweight were largely confined to the urban residents and to those in the middle- and high-income groups.

Conclusions. Results indicate increases in both obesity and undernutrition. Current efforts in China to develop a preventive health care policy emphasize the prevention of excess nutrient intakes and overnutrition and, hence, address the problem of the increase in obesity among well-to-do, mostly urban residents. However, the increase in undernutrition among low-income Chinese adults should not be overlooked and requires further research and serious policy consideration. (*Am J Public Health*. 1995;85:690–694)

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Introduction

China, like a number of other previously low-income countries, has moved rapidly toward conquering its problems of food scarcity and has begun a rapid epidemiologic and nutrition transition. Social changes and intensive preventive activities have led to major progress in controlling infectious diseases and undernutrition, and the economic and agricultural reform has resulted in widespread food adequacy and increased per capita income.¹ Concurrently, the dietary pattern in China has been moving steadily toward a larger quantity of animal products and a higher fat intake, which are typical of the "affluent" diet in industrialized countries.² The changing dietary pattern, along with a rising life expectancy and increasing urbanization, may have contributed to the emergence of diet-related chronic diseases such as obesity and coronary heart disease in China.^{3,4} Similar patterns have been observed in many low-income countries that are undergoing rapid economic development (e.g., Brazil, Chile, Korea, Taiwan, and Malaysia).^{5,6} Based on the available evidence, it is projected that these diet-related chronic diseases, as opposed to communicable diseases and undernutrition, will present a huge health care burden for these countries in the near future.¹

Obesity is a diet-related chronic disease that is well known for its resistance to treatment.⁷ Moreover, obesity is often associated with conditions such as hypertension, high serum cholesterol, insulin resistance, and other metabolic disturbances that are strong risk factors for other chronic diseases, especially coronary heart disease. These diseases are quickly becoming the leading causes of death in many developing countries.

For example, from 1960 through 1962, cancer, cerebrovascular disease, and heart disease were the sixth, seventh, and eighth most common causes of mortality in Shanghai County, China, but from 1978 through 1980 they had become the three leading causes of death in that area.^{4,8}

National surveys conducted in the United States and other industrialized countries indicate that the prevalence of obesity in these regions is about 25% or higher.^{9,10} Smaller surveys in developing countries have shown that adult obesity is already prevalent in many areas, although the rates are usually much lower and the prevalence varies from country to country.¹ Very high rates have been observed in some places (e.g., Trinidad), and in some countries a high prevalence is already evident in children as well as in adults.¹¹ It must be pointed out, however, that data from the developing countries are still limited.

The purpose of this article is to provide an overview of the problems of underweight and overweight in China, with the data from two large surveys conducted in 1989 and 1991 (two rounds of the China Health and Nutrition Survey). This ongoing survey provides valuable information on the changing body weight distribution pattern in this region.

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Subjects and Methods

Survey Design

The China Health and Nutrition Survey is an ongoing longitudinal survey that covers eight provinces in China (Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong). Although the Survey is not nationally representative, these provinces were selected to provide significant variability in geography, economic development, and health indicators, so that they may be considered to be generally representative of all provinces in the country. A multistage, random-cluster sampling procedure was used to draw the sample from each of the provinces. Counties in the eight provinces were stratified by income (low-, middle-, and high-income tertiles) with per capita income figures from the State Statistical Office, and a weighted sampling scheme was used to randomly select four counties in each province (one low income, two middle income, and one high income). Probability-proportional-to-size sampling was used to select the sample from these units. In addition, urban areas initially not within the county strata were later incorporated by including the provincial capital and a low-income city from each province. Within each county, the township capital was selected and three villages were chosen randomly. Within each city, urban and suburban neighborhoods were randomly selected. The same random selection was used for the selection of neighborhoods from townships and villages. The sample design consisted of 188 primary sampling units and included 3780 households. These households were followed longitudinally in the second and subsequent surveys. The target was the final cluster of 20 randomly selected households from each neighborhood.

The first two rounds of the Survey, conducted in 1989 and 1991, collected a wide range of household, community, health, and health facility data. Data and documentation for the China Health and Nutrition Survey in 1989 and 1991 are available as public-use data sets from the Inter-university Consortium for Political and Social Research, University of Michigan. Both rounds of the Survey were conducted during the same months of the year to provide controls for seasonal influences. Of the 3780 households originally surveyed in 1989, 4.5% households were lost to follow-up in 1991, mostly because of migration from the survey

TABLE 1—Study Population, China Health and Nutrition Survey, 1991

	Mean (SD)		
	Men (n = 1831)	Women (n = 2150)	Total Sample (n = 3981)
Age, y	34.5 (7.3)	34.5 (6.9)	34.5 (7.1)
Weight, kg	59.2 (8.4)	53.0 (7.8)	55.9 (8.6)
Height, cm	166.0 (6.4)	155.6 (5.9)	160.4 (8.0)
Body mass index, kg/m ²	21.4 (2.4)	21.9 (2.8)	21.7 (2.6)

area. Preliminary analysis indicated that the subjects who were lost to follow-up were not statistically different in any major characteristics from those who remained in the 1991 survey. The 1993 China Health and Nutrition Survey has been completed, and successive rounds of the Survey are planned for every 2 years. This article focused on 3981 adults 20 through 45 years of age, for whom the relevant data were available for both the 1989 and 1991 surveys. The selection of this age group was based on the rationale that these adults represent the population at greatest risk of obesity and related chronic diseases in China.³

Survey Data

Anthropometric data. Key anthropometric measurements were obtained from all survey participants. These measurements were carried out by trained health workers who followed standard protocol and techniques. Weight was measured in light indoor clothing without shoes to the nearest tenth of a kilogram with a beam balance scale. Height was measured without shoes to the nearest tenth of a centimeter with a portable stadiometer. Each of these measurements was done by at least two health workers; one worker took the measurements, and another recorded the readings. Specific training in anthropometric measurement techniques was provided at the beginning of each survey, although most workers had had previous experience with other national surveys.

Sociodemographic data. Of the socioeconomic and demographic information collected, the data concerning income and age are especially relevant to this analysis and they deserve special mention. Questions about income were designed to cover all of the income-producing activities that each person might have engaged in during the previous year, in or out of the formal market. This information also includes nonmonetary government subsi-

dies such as food subsidies provided in the form of ration coupons, which have not been included in the past measurements of income in China.¹²

Collection of age data can be quite problematic in China because Western and Chinese calendars are often used interchangeably. In this survey, great care was exercised in obtaining accurate information by placing all dates of birth into the Western calendar, which may differ by as much as 1½ months from the traditional Chinese date.

Statistical Analysis

We defined four distinct weight categories: underweight was defined as a body mass index (weight in kilograms/height in meters squared) less than or equal to 18.5; normal weight as a body mass index between 18.6 and 25.0; overweight as a body mass index greater than 25.0 but less than 27; and severely overweight as a body mass index greater than or equal to 27.0. The percentages of the study population in different weight categories were calculated for the total sample and for the sample stratified by sex, place of residence (urban and rural areas), and income tertiles (low, middle, and high income). We were primarily interested in the changing proportions of underweight and overweight subjects between the 1989 and 1991 surveys. Because the samples from both surveys were not independent, we used the McNemar Test for the significance of changes (with correction for continuity) to determine the significance of changes in proportions of individuals classified as underweight, normal weight, or overweight between 1989 and 1991.¹³ It must be noted that the original study sample was drawn by multistage cluster sampling and that this analysis did not take into account the effect of this sampling procedure. Therefore, caution must be exercised in interpreting the test statistics and their significance because these do not reflect the

TABLE 2—Percentages of Study Population in Different Weight Categories, China Health and Nutrition Survey, 1989 and 1991

Weight Category	Men, %			Women, %			Total Sample, %		
	1989	1991	Change	1989	1991	Change	1989	1991	Change
Underweight	7.8	7.9	+0.1	9.2	8.4	-0.8	8.6	8.2	-0.4
Normal weight	85.8	83.3	-2.5	79.0	78.5	-0.5	82.1	80.6	-1.5
Overweight	4.7	6.0	+1.3**	7.4	8.8	+1.4*	6.2	7.5	+1.3**
Severely overweight	1.7	2.9*	+1.2*	4.3	4.3	0.0	3.1	3.7	+0.6

Note. Weight categories were defined as follows: underweight, BMI less than or equal to 18.5; normal weight, BMI between 18.6 and 25; overweight, BMI greater than 25.0 but less than 27.0; severely overweight, BMI greater than or equal to 27.0. BMI = body mass index (weight in kilograms/height in meters squared).

*Significant change from their corresponding values in 1989; *P* < .05.

**Significant change from their corresponding values in 1989; *P* < .01.

TABLE 3—Percentages of Study Population in Different Weight Categories, by Place of Residence, China Health and Nutrition Survey, 1989 and 1991

	Rural, %			Urban, %		
	1989	1991	Change	1989	1991	Change
Men						
Underweight	7.2	7.8	+0.6	9.1	8.2	-0.9
Normal weight	87.9	85.5	-2.4	81.1	78.0	-3.1
Overweight	4.1	4.8	+0.7*	5.9	8.6	+2.7*
Severely overweight	0.8	1.9	+1.1	3.9	5.2	+1.3
Women						
Underweight	9.2	8.4	-0.8	9.2	8.3	-0.9
Normal weight	80.9	79.9	-1.0	74.8	75.2	+0.4
Overweight	6.3	7.9	+1.6*	10.2	11.0	+0.8
Severely overweight	3.6	3.8	+0.2	5.8	5.6	-0.2
Total sample						
Underweight	8.3	8.1	-0.2	9.2	8.3	-0.9
Normal weight	84.1	82.5	-1.6	77.7	76.5	-1.2
Overweight	5.3	6.5	+1.2**	8.2	9.8	+1.6*
Severely overweight	2.3	2.9	+0.6	4.9	5.4	+0.5

*Significant change from their corresponding values in 1989; *P* < .05.

**Significant change from their corresponding values in 1989; *P* < .01.

design effect of cluster sampling. By not taking into account the design effect or the effect of intracluster correlation, the true sample variance (which would otherwise be obtained by simple random sampling) is underestimated, and a number of significant *P* values reported in this article may be overestimated. All analyses were done with SAS, version 6.08 (SAS Institute Inc, Cary, NC).

Results

During the period from 1989 through 1991, there was a slight decline in the proportion of adults classified as underweight. During the same period, the proportion of adults with normal body weight decreased, and the proportions of those classified as overweight and severely

overweight increased. These changes, however, varied by the income level and by the area of residence. For example, the decline in the proportion of underweight individuals was not observed among men living in the rural area, nor among the low-income men and women. Similarly, the observed increases in proportions of adults classified as overweight and severely overweight were largely confined to the urban residents and to those in the middle- and high-income groups.

Table 1 summarizes the characteristics of the study population at the 1991 survey. Complete weight, height, and sociodemographic data were available from both 1989 and 1991 surveys for 3981 individuals.

The percentages of study population and population subgroups in different

weight categories (underweight, normal weight, and overweight) are presented in Tables 2–4. Overall, during the period from 1989 through 1991, the proportion of adults classified as underweight decreased by 0.4% and the proportion of adults with normal weight decreased by 1.5%, whereas the proportion of individuals classified as overweight increased by 1.3% and the proportion classified as severely overweight increased by 0.6% (Table 2). The decline in underweight was not seen among men, although the increase in overweight was observed in both sexes.

Table 3 shows that during the 2-year period, there was a general decline in the proportion of underweight subjects in both urban and rural populations, excepting rural men, for whom there was a slight increase of 0.6%. Also, there was a general decline in the proportion of adults with normal body weight in both rural and urban areas. The proportions of overweight and severely overweight men increased in both rural and urban areas, with larger increases observed among the urban residents. There was an increase in the proportion of overweight women in rural areas, whereas the changes in proportions of severely overweight women in both rural and urban areas were trivial.

The percentages of the study population in different weight categories according to the levels of household income reported in 1989 are shown in Table 4. During the period from 1989 through 1991, there was a decline in the proportion of underweight men and women in the middle- and high-income groups. However, there was an increase in the proportion of underweight men and women in the low-income group. Overall, there was 1.8% increase in the proportion of underweight adults in the low-income

TABLE 4—Percentages of Study Population in Different Weight Categories, by Tertile of Household Income, China Health and Nutrition Survey, 1989 and 1991

	Low, %			Middle, %			High, %		
	1989	1991	Change	1989	1991	Change	1989	1991	Change
Men									
Underweight	6.9	9.1	+2.2	7.2	6.0	-1.2	9.3	8.7	-0.6
Normal weight	89.2	86.4	-2.8	84.6	83.6	-1.0	83.6	79.6	-4.0**
Overweight	2.6	2.9	+0.3	5.7	7.1	+1.4	5.6	7.9	+2.3*
Severely overweight	1.3	1.6	0.3	2.5	3.3	+0.8	1.5	3.8	+2.3*
Women									
Underweight	9.1	10.5	+1.4	10.7	8.7	-2.0	7.9	5.9	-2.0
Normal weight	80.4	81.0	+0.6	78.3	75.7	-2.6	78.6	78.9	+0.3
Overweight	7.8	5.5	-2.3	7.4	11.1	+3.7*	7.2	9.8	+2.6
Severely overweight	2.8	3.0	+0.2	3.6	4.6	+1.0	6.3	5.5	-0.8
Total sample									
Underweight	8.1	9.9	+1.8	9.1	7.5	-1.6*	8.5	7.2	-1.3
Normal weight	84.4	83.5	-0.9	81.2	79.2	-2.0	80.9	79.2	-1.7
Overweight	5.4	4.3	-1.1	6.6	9.3	+2.7**	6.5	8.9	+2.4*
Severely overweight	2.1	2.3	+0.2	3.1	4.0	+0.9	4.1	4.7	+0.6

*Significant change from their corresponding values in 1989; $P < .05$.

**Significant change from their corresponding values in 1989; $P < .01$.

category. Also, there was a general decline in the proportion of adults with normal body weight, especially among men.

The proportions of men classified as overweight and severely overweight increased across all income categories, with the largest increases observed among high-income men and the smallest increases observed among low-income men. The proportions of overweight women increased in the high- and middle-income categories; there was a decrease of 2.3% for those in the low-income category. The changes in proportions of severely overweight women were negligible, with a very slight decrease seen among those in the high-income group. For the total sample, the middle-income group had the largest increase in the proportion of adults in the combined overweight and severely overweight categories (3.6%), followed by the high-income group (3%), whereas there was a decline (-0.9%) among adults in the low-income group.

Discussion

Because there is no consensus on the body mass index cutoff points to define obesity in the populations of developing countries, our definitions of underweight, overweight, and severely overweight were based on a combination of various body mass index criteria that are currently in use. These criteria are largely based on actuarial analyses or long-term epidemio-

logic studies conducted in North America and Europe that indicate the weight range for each height category that is associated with the lowest mortality rate.¹⁴⁻¹⁶ This produces a U- or J-shaped curve of mortality against weight, suggesting that the mortality progressively increases as the body mass index falls below 20 or rises above 25.^{17,18} Hence, the body mass index range of 20 through 25 is considered by many to be the optimal or healthy weight range.

The body mass index cutoff point of 18.5 has been routinely used to define underweight, and the body mass index cutoff point of 25.0 has been used extensively as a criterion for overweight.¹ In addition, it has been proposed that a body mass index of 27.0 or greater is significantly associated with increased health risks, especially in young adults.^{19,20} In Canada, for example, a body mass index between 25.0 and 27.0 is considered to be a health risk for some people, whereas a body mass index of 27.0 or greater is regarded as a definitive health risk for a majority of the population.²⁰

We consider these body mass index criteria to be appropriate for our study population. Although there have been no long-term studies of body weight and mortality in the developing countries, there is substantial evidence that the obese adults in many cultures develop the same complications; therefore, the definitions derived from affluent communities should be used universally for the pre-

sent.¹ Our classification of obesity bears close resemblance to the classification of obesity recommended by the World Health Organization and to the systems used in the United States and Canada.¹ For example, our definition of severely overweight corresponds closely to the National Center for Health Statistics definition of overweight in the US population (i.e., body mass indexes of 27.8 and 27.3 for men and women, respectively).²¹ We believe that our classification scheme accurately describes the problem of obesity in the developing countries, while preserving the interpopulation comparability of the data.

This article provides valuable information concerning the emerging problem of diet-related chronic diseases in China. It is likely that the similar patterns, characterized by an increase in chronic, degenerative diseases and a decline in infectious diseases and undernutrition, are occurring in many other developing countries as well.⁶ The results presented here support the view that the problems related to nutrient excesses now exist side by side with the problem of undernutrition in these countries.^{1,2} The results also support the findings from an earlier international collaborative study, which showed that over 25% of the adult men and women in an urban area in China have a body mass index above 25.³

Elsewhere, we have shown that there are large urban-rural differences in the intakes of dietary fat and a wide variety of

high-fat foods in China.² Also, we have found differences in the physical-activity patterns of urban and rural residents.²² Therefore, the urban-rural difference in the changing proportions of underweight and obese individuals in this study population is not unexpected. For example, the 1989 through 1991 decline in the proportion of underweight individuals was greater in urban areas, and the increase in obesity was greater in urban areas compared with rural areas. Although such urban-rural differences are rather small, there are reasons to suspect that these differences may be increasing. Moreover, this article used a longitudinal sample, and even though a part of these changes may be attributed to other factors (e.g., measurement error), such changes must still be regarded with serious concern because they occurred over a mere 2-year period between 1989 and 1991.

The relationship between income and obesity in industrialized and developing countries has been well documented: an inverse relationship in the industrialized countries and a positive relationship in the developing countries.^{23,24} The observed increase in underweight among the low-income individuals and the greater increase in obesity in the middle- and high-income groups compared with the low-income group illustrate such a positive relationship between income and body weight in developing countries. Generally speaking, these findings may indicate a bipolarization of the benefits of development in China. It is possible that inequality may be increasing, and the effects of such inequality on the poor should be carefully examined. Extremely rapid economic development has allowed the middle- and high-income groups to change, within one or two decades, from a society where food scarcity abounded to one where most individuals adopt the dietary and physical-activity patterns that predispose them to obesity and other chronic degenerative diseases. At the same time, there is still a problem of undernutrition and underweight among the poor. It is possible that this disparity has been exacerbated during the period of rapid economic change, and this possibility certainly deserves further examination.

Future research may find that the Chinese have effectively reduced both the

problems of undernutrition and overnutrition as part of a new government initiative. The Chinese government has organized the National Commission for Food Reform and Development to address, among other problems, many of the problems noted in this article.²⁵ Such policy represents a model that may be used by other low-income countries to address the problems of undernutrition and overnutrition, which often coexist in many societies. □

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