

Body mass index of Chinese adults in the 1980s

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Patterns and trends in the body composition of Chinese adults were studied using data from the 1982 China Nationwide Nutrition Survey (CNS-82) and the 1989 China Health and Nutrition Survey (CHNS-89). The CNS-82 showed rural inhabitants were about 3 kg lighter than urban residents and about 2.2 cm shorter. Males were heavier (55.2 ± 7.4 vs 50.7 ± 8.0) and taller (165.3 ± 7.3 and 153.5 ± 6.3). Using a cut-off for underweight of a body mass index <18.5 and for obesity of >25 , 11.6 % and 12.9 % of the urban and rural sample were underweight and 9.8 % and 6.9 % respectively, were overweight. The CHNS-89 surveyed 5138 adults aged 20-45 in eight selected provinces. The proportion of underweight in both urban and rural samples declined slightly (about 1.3%) but the proportion of obesity increased considerably (4.8 % for the urban sample and 2 % for the rural one). Increased income was significantly associated with reduced low BMI in the urban sample, while in the rural and overall samples the opposite was found. Provincial patterns in energy intake were not associated with the distribution of BMI while occupation was. In particular, government officials and housewives were more likely to be obese as also were subpopulation groups consuming greater proportions of energy from animal sources. Over 80 % of the population fell in the normal BMI range ($18.5 < \text{BMI} < 25$). This may relate to the relatively even distribution of food in China during the past several decades.

Introduction

China is a developing country with more than 1.1 billion people, accounting for about 22 % of the world's total population, but who occupy only 7 % of the world's arable land. The per capita food availability has fluctuated over the past 40 years, since 1949, the founding of the People's Republic of China¹. With the rapid development of the economy from 1978, there was a marked improvement in the per capita income and food consumption of the people. Food patterns changed further in the 1980s^{2,3}. During the 1980s China conquered problems of food scarcity at national level and underwent a remarkable transition in its diet. In order to examine changes in the diet and nutritional status of the people, two large scale surveys were conducted in the 1980s. One was the nation-wide nutrition survey of 1982 (CNS-82), which consisted of a dietary survey, anthropometric measurements, clinical examinations and biochemical assays; the other was the 1989 China Health and Nutrition Survey (CHNS-89), which collected detailed social, economic and ecological information in addition to the biological data.

The International Dietary Energy Consultancy Group proposed the use of body mass index (BMI) for specifying chronic energy deficiency in adults, and cut-off points were identified for its classification⁴. For assessing the nutritional status, the body mass indexes of Chinese adults were examined based on the CNS-82 and CHNS-89 data. The relationship between the distribution of BMI and some dietary and social economic factors was also investigated. The main results and their possible significance are discussed in this paper.

Method

CNS-82

The 1982 China Nationwide Nutrition Survey covered 25 provinces and three municipalities that are all the administrative units directly under the central government, with the exception of Tibet. A two-stage random sampling method was used to select the survey households. Four to 20 survey sites were chosen in each province/municipality depending on the population size, and a cluster of 50 households was then randomly sampled from each selected survey site. A total of 256 survey sites were finally chosen, including about 12 000 households or 71 000 individuals of all ages. In addition, 546 institutional feeding units covering 166 000 individuals were also surveyed, including factories, schools, kindergartens and governmental institutions, etc.

Household dietary data were collected for five consecutive days. The inventory change from the beginning to the end of the five survey days, in combination with the weighing of food stuffs used for preparing meals every day, was adopted to determine the household and institution food consumption. Persons participating in each meal were recorded.

Height, weight, arm circumference and mid-arm skinfold measurements were measured in a portion of the sampled individuals. A clinical examination and blood and urine tests were also carried out in a small subsample of the subjects.

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CHNS-89

The 1989 China Health and Nutrition Survey covered eight provinces (Liaoning, Shandong, Henan, Jiangsu, Hubei, Hunan, Guangxi and Guizhou). A multistage, random cluster process was used to draw the sample. Counties in the eight provinces were stratified by income, and four counties were randomly selected (one low-income, two middle-income, and one high-income) in each province. Within each county, the township capital was selected and three villages were chosen randomly. In addition to the provincial capital, one lower-income city from each province was also chosen. The whole sample consisted of 188 primary survey sites, including 3780 households and covering about 16 000 individuals.

Household food consumption was determined from inventory change each day in combination with a weighing and measurement technique for three days. In addition, individual dietary intakes for three consecutive days were surveyed for all children aged 1-6 years and for all adults aged 20-45 on a 24-hour recall basis.

Weight, height, arm circumference and mid-arm skinfold were measured for adults aged 20-45 (in subsequent rounds anthropometry for all age groups is being collected), and children's weight and stature were measured.

Results

In CNS-82, 13 340 individuals (males 6191, female 7113) aged 20 years or over were measured. The average body weight was 57.2 ± 7.4 kg for males, and 50.7 ± 8.0 kg for females. The average body weight of urban males and females were greater by 3.1 kg and 2.7 kg, respectively than that of the rural men and women (Table 1). The mean weight of various age groups is illustrated in Figure 1. It can be seen to increase with age in urban populations until 50 years of age, and then decrease. In rural populations, however, it decreases with age, particularly for females.

The average height was 165.3 ± 7.3 cm for males and 153.5 ± 6.3 cm for females. The differences between urban and rural averages were 4.4 cm for males and 2.2 cm for females (Table 2). The distribution of the mean height of various population groups by age is shown in Figure 2. All the four groups showed the same trend, ie a decline with age. The differences between the youngest and the oldest groups ranged from 5.1 cm to 8.9 cm. These differences can not be explained by the physiological changes of aging alone, but could possibly be the result of the better environmental conditions of the younger generations.

Table 1. Body weight of Chinese adults (CNS-82).

	Body weight (kg)					
	n	Mean	SD	Percentiles		
				10th	50th	90th
Male						
All	6199	57.2	7.4	48.0	57.0	67.0
Urban	2879	58.9	7.4	50.0	58.4	68.2
Rural	3320	55.8	7.2	47.0	55.0	65.0
Female						
All	7128	50.7	8.0	41.3	50.0	61.0
Urban	2630	52.4	8.3	43.0	51.9	63.0
Rural	4498	49.7	7.7	40.6	49.1	59.0

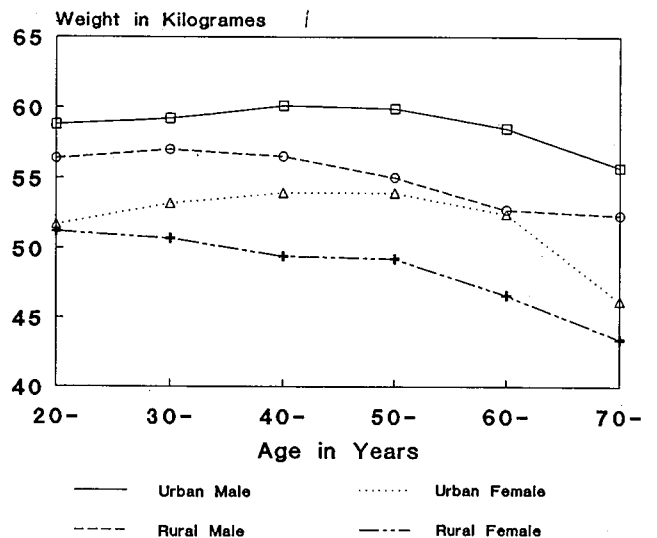


Figure 1. Mean weight of Chinese adults (CNS-82) in kgs.

Table 2. Height of Chinese adults (CNS-82).

	Height (cm)					
	n	Mean	SD	Percentiles		
				10th	50th	90th
Male						
All	6194	165.3	7.3	156.0	165.5	174.0
Urban	2878	167.7	6.9	159.0	168.0	176.0
Rural	3316	163.3	7.0	154.8	164.0	172.0
Female						
All	7119	153.5	6.3	145.6	153.5	161.0
Urban	2629	154.9	6.2	147.0	155.0	162.7
Rural	4490	152.7	6.2	145.0	153.0	160.0

The body mass index (BMI) data of a subsample of the CNS-82 of adults aged 20-45 are presented in Table 3 to allow comparison with the CHNS-89 adults. The percentage

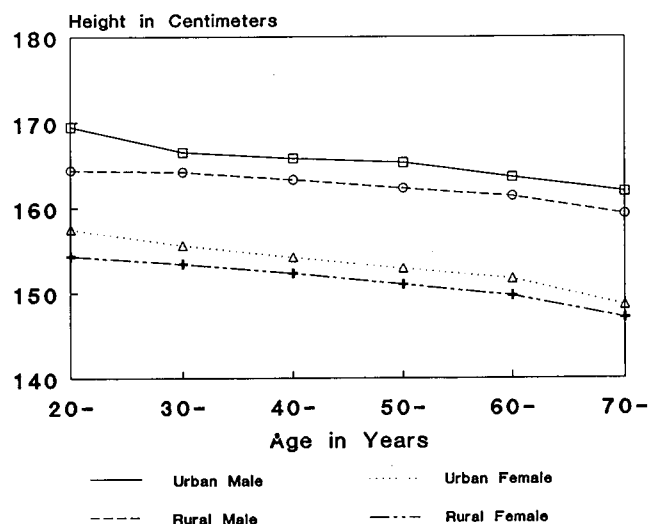


Figure 2. Mean height of Chinese adults (CNS-82).

Table 3. Percentage of individuals with a low or high body mass index.

	n	Percentage of BMI in these categories	
		<18.5	≥25
CHS-82 (All age subjects)			
Urban	5505	11.6	9.8
Rural	7799	12.9	6.9
All		12.3	8.1
CHS-82 (Subjects of 20-45 years)			
Urban	1729	1.5	7.2
Rural	4730	9.0	5.5
All	6459	9.7	6.0
CHS-89 (Subjects of 20-45 years)			
Urban	1609	10.1	12.0
Rural	3356	7.7	7.5
All	4965	8.5	8.9

of individuals with BMI under 18.5 was 11.5 % in urban and 9.0 % in rural areas, and that of those with BMI equal to or over 25 was 7.2 % and 5.5 %, respectively. Figure 3 illustrates the distribution of BMI by age and sex. The BMI value of females is greater than males in all age groups except the oldest one in both urban and rural populations. The urban young adults tend to be thinner than the rural, but urban men and women over 30 years are relatively heavier than the rural inhabitants.

CHNS-89

In the 1989 China Health and Nutrition Survey, height and weight were measured in adults of 20-45 years. The sample size was 5134 (urban 1609, rural 3550) individuals. As shown in Table 3, the proportion of subjects with BMI<18.5 and BMI≥25 were larger in urban populations than in rural. In comparison with the CNS-82 results, there was a smaller percentage of subjects with a low BMI value (1.4 % in the

urban and 1.3 % in the rural sample) whereas that for persons with high BMI value was greater in both samples, 4.8% more in urban and 2% in rural groups.

The distribution of adults' nutritional status by tertile of per capita income, according to BMI classification is shown in Table 4. The percentages of urban adults with BMI<18.5 and >25 were both greater than that of rural adults. More of the underweight individuals (BMI<18.5) were from the urban low income group, whereas overweight individuals (BMI>25) were least in the low income groups in both rural population and in urban and rural combined.

The eight provinces are arranged in order of increasing proportions of individuals with low BMIs in Table 5. Per capita income, energy intake, and energy from fat were not associated with patterns in either underweight or overweight status.

Body composition, as shown in Table 6, is associated with occupation. The highest proportion of obesity was found among government officials while the lowest proportion was found among farmers. Housewives are relatively more at risk for both undernutrition and obesity.

Table 7 shows the distribution of BMI in connection with the dietary energy intake from animal products. The percentage of overweight (BMI≥25) subjects increases as more of the dietary energy comes from animal sources. The proportion of low BMI (<1.85) subjects is the same in the low and medium animal food consumption groups, but marginally higher in the group receiving most energy from animal sources.

Observation of the influence of educational level on BMI revealed no clear trends, but less underweight individuals were seen in the illiterate group and in the highly educated group than in other groups. More overweight cases were seen only in the illiterate group, but no differences were found among other groups.

Table 4. Distribution of body mass index in relation to per capita income (CHNS-89).

	Per capita income	n	Percentage of BMI in these categories	
			<18.5	≥25
Urban				
	Low	251	13.6(a)	12.3
	Middle	601	10.8	11.8
	High	757	8.6(b)	11.5
	Total	1609	10.1	12.0
Rural				
	Low	1453	7.5	6.4(c)
	Middle	1118	7.8	8.1(d)
	High	954	7.9	8.5(d)
	Total	3556	7.7	7.5
Urban + Rural				
	Low	1704	8.4	7.3(e)
	Middle	1719	8.8	9.4(f)
	High	1711	8.2	9.8(f)
	Total	5134	8.5	8.8

(a)/(b), (c)/(d), (e)/(f). P<0.01.

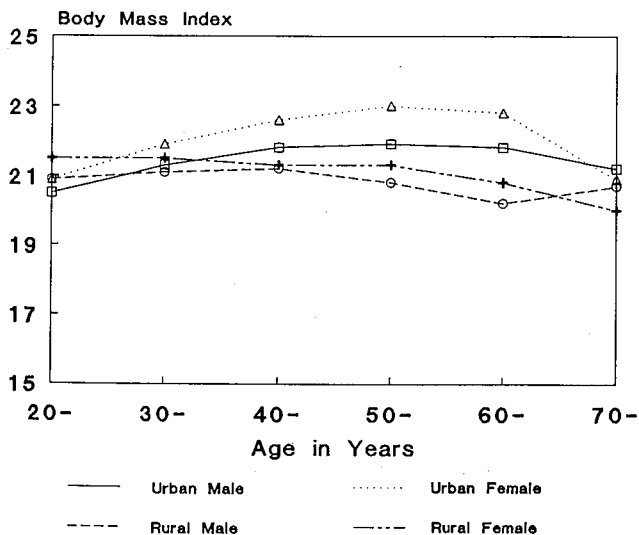


Figure 3. Mean BMI of Chinese adults (CHS-82).

Table 5. Distribution of BMI, per capita energy intake and income by province (CHNS-89).

Province	Percentage with BMI in these categories		Energy intake (kcal/day)	Energy from fat (kcal/day)	Income (yuan/yr)	
	n	<18.5				≥18.5
Shandong	422	2.8	24.2	2364	253	965
Liaoning	749	5.3	9.4	2284	323	1019
Henan	663	7.4	10.7	2771	256	970
Hunan	674	7.1	7.3	2349	432	1617
Hubei	720	9.6	7.1	2494	286	857
Jiangsu	694	10.9	7.9	2342	270	1355
Guizhou	684	11.7	5.1	2780	487	932
Guangxi	559	16.5	3.8	2148	285	1322

Table 6. Distribution of body mass index by occupations (CHNS-89).

Occupation	n	Percentage of BMI in these categories	
		<18.5	≥25
Government official	130	9.2	20.0
Professional	485	9.9	11.3
Worker/Service	1338	9.3	10.9
Farmer	2752	8.2	6.5
Housewife	146	11.6	15.1

Table 7. Distribution of body mass index in association with dietary energy sources (CHNS-89).

Energy from animal food Total dietary energy	n	Percentage of BMI in these categories	
		<18.5	≥25
<20	3638	9.1	8.2
20-40	1039	9.1	9.6
40+	166	10.2	12.1

Discussion

Discussion of the nutritional status of Chinese people have been mostly based on the studies of growth of children^{5,6}. There are a few publications observing adults' height and body weight⁷, but to our knowledge, nothing has been published on the body mass index of Chinese adults.

The distribution of BMI of Chinese adults surveyed in 1982 and 1989 showed that 78-84 % of the sampled subjects were within the defined normal range, ie between 18.5-25 kg/m². There were only 7-13 % underweight, and 6-12 % overweight, individuals, and of them the majority were mild cases. The percentage of chronic energy deficiency cases was quite low in comparison with figures observed in other developing countries, such as 51-70 % in India, and 50-85 % in Ethiopia⁸. The better results in China may well be related to the relatively even distribution of food in the country in past decades. Although the per capita food availability was not high, there are a set of policies in place to secure the basic food needs of the people. The best known policies in this regard are the food quota policy and food price subsidy policy⁹ for urban inhabitants, and the poverty relief policy for the rural population¹⁰.

The percentage of individuals with BMI values below 18.5

Table 8. Dietary intake of energy, protein and fat in China between 1978 and 1989 (per capita per day).

Year	Energy (kcal)		Protein (g)		Fat (g)	
	Urban	Rural	Urban	Rural	Urban	Rural
1981	2088	2418	60	62	61	35
1982	2117	2461	61	63	64	37
1983	2192	2496	63	64	70	39
1984	2186	2587	62	66	70	41
1985	2072	2526	61	64	65	42
1986	2176	2567	64	65	71	43
1987	2146	2589	62	65	72	45
1988	2166	2581	63	65	71	43
1989	-	2603	-	67	-	44

Source: Per Pinstrup-Anderson et al.¹¹.

were lower in 1989 than in 1982. This change is consistent with the increase of average food consumption during this period¹¹. The per capita energy consumption of rural people was 2461 kcal/day in 1982 and 2603 kcal/day in 1989, that of protein 63 g and 67 g respectively, with fat showing the same sort of increase at 36 g and 44 g (Table 8). More overweight subjects were seen in 1989 than in 1982 in both urban and rural populations, but more obviously in urban inhabitants (from 7.2 % to 12.0 % in the comparable groups). The energy intake of the urban population had increased slightly, but there had been a marked shift in the structure of the diet with a marked increase in the proportion of the population consuming more than 30 % of their energy as fat³. Not only has the diet changed but we expect that rapid industrialization has led to reduced energy expenditure at work in the urban population. This combination represents the most likely cause of the increased obesity of urban adults.

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1980 年代中國成人的體質指數

摘要

作者從 1982 年中國營養調查 (CNS-82) 和 1989 年中國健康和營養調查 (CHNS-89) 的數據研究了中國成人身體組成的模式和走向。CNS-82 顯示了農村居民較城市居民輕 3 公斤, 矮 2.2 厘米。男性較女性重些 (平均男女體重分別為 55.2 ± 7.4 和 50.7 ± 8.0) 和高些 (平均男女身高分別為 165.3 ± 7.3 和 153.5 ± 6.3)。如用體質指數 < 18.5 為低體重, > 25 為肥胖這個界定標準, 則城市和農村低體重人數分別為 11.6% 和 12.9%, 超體重人數分別為 9.8% 和 6.9%。

CHNS-89 選擇了 8 個省年齡 20-45 歲的 5138 位成人為對象。結果發現城市和農村低體重的比率稍有下降 (約 1.3%), 但肥胖症的比率明顯增加 (城市為 4.8%, 農村為 2%)。城市居民在收入增加時, 低 BMI 比率明顯減少, 但農村居民在收入增加時, 肥胖症隨之增加。各省居民其能量進食與 BMI 無關, 但公務員和家庭主婦肥胖的比率較大。

超過 80% 人群 BMI 在正常範圍內 ($18.5 < \text{BMI} < 25$), 這也許與中國過去幾十年食物的供應政策有關。

