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Prevalence and Secular Trends in Obesity Among Chinese Adults, 1991–2011

Ying-Jun Mi, MD¹, Bing Zhang, PhD², Hui-Jun Wang, MD², Jing Yan, PhD³, Wei Han, MS¹, Jing Zhao, MS¹, Dian-Wu Liu, PhD¹, and Qing-Bao Tian, PhD¹

¹Department of Epidemiology and Statistics, School of Public Health, Hebei Medical University, Shijiazhuang, China

²National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention, Xicheng District, Beijing, China

³Electron Microscopy Research Center, Hebei Medical University, Shijiazhuang, China

Abstract

Introduction—The prevalence of obesity in Chinese adults increased from 1991 to 2000; however, recent changes in this trend are unclear. This study aims to estimate the current prevalence of obesity and to assess trends in obesity and BMI distribution in Chinese adults from 1991 through 2011.

Methods—Height and weight measurements of 12,249 Chinese adults from the 2011 China Health and Nutrition Survey were analyzed (in 2013) together with China Health and Nutrition Survey data for 1991–2009. Obesity was defined as BMI ≥ 28.0 based on the Working Group on Obesity in China criteria.

Results—In the 2011 survey, the age-adjusted mean BMI was 23.8 (95% CI=23.7, 23.9) for men and 23.4 (95% CI=23.2, 23.5) for women. The age-adjusted prevalence of obesity was 11.3% (95% CI=10.8%, 11.9%) overall, 11.8% (95% CI=10.8%, 12.6%) among men, and 11.0% (95% CI=10.3%, 11.8%) among women. Estimates of age-adjusted obesity prevalence among the Chinese population were significantly lower than those of the U.S. population (all $p < 0.05$). Over the 20-year period, the prevalence of obesity increased from 2.88% to 11.8% among men (age-adjusted annual change in OR=1.08, 95% CI=1.07, 1.09, $p < 0.001$) and from 4.55% to 11.0% among women (OR=1.05, 95% CI=1.05, 1.06, $p < 0.001$). Similar significant findings were observed for both men and women based on WHO recommendations.

Conclusions—The prevalence of obesity among both Chinese men and women increased significantly from 1991 through 2011, particularly among men.

Address correspondence to: Qing-Bao Tian, PhD, Department of Epidemiology and Statistics, School of Public Health, Hebei Medical University, 361 East Zhongshan Road, Shijiazhuang, Hebei Province, China. tianqingbao1980@aliyun.com.

The first two authors should be regarded as joint first authors.

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Introduction

Obesity is a major risk factor for hypertension, diabetes, coronary heart disease, and certain types of cancer.^{1–6} Ongoing monitoring of trends in obesity is important for assessing interventions aimed at preventing or reducing the burden of obesity. With the increasing global pandemic of obesity, there has also been a dramatic rise in the number of obese adults in China.^{7,8} For example, during 1989–2000, the prevalence of obesity combined with overweight increased by 50% in adults aged 20–45 years.⁹ Additionally, Gu et al.¹⁰ found that the risk of cardiovascular disease increased with increasing BMI. However, most previous estimates of obesity and overweight were either based on limited survey data that only reflected a relatively short period of changes in obesity^{9,11,12} or on clinical data. Recent prevalence and trends in the distribution of BMI among Chinese adults remain unknown. In this study, we provide new estimates of the prevalence of obesity and overweight in adults aged 20 years or older based on measurements of weight and height in 2011; we also provide the long-term trend to determine if it is continuing. We further compare the prevalence of obesity in adults between the Chinese and U.S. populations. In addition, we provide the BMI distribution from 1991 to 2011 of the China Health and Nutrition Survey (CHNS) both for the overall adult population and by sex and age group.

Methods

Study Design

The CHNS is an international collaborative project between the National Institute for Nutrition and Food Safety, Chinese Center for Disease Control and Prevention, and University of North Carolina at Chapel Hill, and is also the only large-scale, longitudinal, household-based survey in China to date.¹³ The first round of the CHNS was conducted in 1989, and subsequently in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011.¹⁴ The CHNS began with eight provinces and added a ninth, Heilongjiang in 1997, and the three largest municipalities including Beijing, Shanghai, and Chongqing in 2011, accounting for approximately 56% of China's population and varying substantially in geography, economic development, public resources, and health indicators.¹¹ In each of the surveyed provinces, a multistage, random-cluster process was used to select the sample. A detailed description of the survey design and procedures has been published elsewhere.^{13,15} The study was approved by the IRB of the National Institute for Nutrition and Food Safety, China Center for Disease Control and Prevention, and University of North Carolina at Chapel Hill.

Study Population

Analysis was based on data from eight waves of the CHNS conducted from 1991–2011 previously noted, as data were not collected for all age groups in the 1989 survey. This study focused on adults aged ≥20 years in each survey year and data provided information on age, sex, urban–rural status, and detailed physical examinations including weight and height. To limit biases caused by pre-existing factors, this analysis excluded participants who had been diagnosed with pregnancy or were lactating. In addition, participants with missing information on height or weight or extreme or implausible height (<120.0 cm) or BMI (<15.0 or >40.0) values were excluded.

Anthropometric Methods and Definitions of Overweight and Obesity

Weight and height were measured by trained health workers following standardized protocols from WHO.^{16,17} The body weight of participants dressed in light clothing was measured without shoes to the nearest 0.1 kg with a calibrated beam scale (Seca North America, Chino, CA). The height of barefoot subjects was measured to the nearest 0.1 cm using a portable stadiometer (Seca North America). BMI was calculated as weight in kilograms divided by the height in meters squared, rounded to one decimal place.

According to the criteria of the Working Group on Obesity in China (WGOC),¹⁸ general obesity was defined as BMI ≥ 28.0 and normal weight was defined as BMI < 24.0 . Based on WHO recommendations,¹⁶ normal weight was defined as BMI < 25.0 , and general obesity was defined as BMI ≥ 30.0 for adults aged ≥ 20 years.

Statistical Analysis

All statistical analyses were conducted using SPSS, version 13.0, in 2013. The sample sizes were sufficient to detect an annual increase of 0.05 percentage points with $>90\%$ power. Analyses were stratified by sex, age group, and degree of urbanization (urban versus rural). Based on the age at the interview, age was grouped into 20–39 years, 40–59 years, and ≥ 60 years. Taking into account unequal probabilities of selection, the values of overweight and obesity were adjusted by direct method for the 2010 census of the Chinese adult population using the corresponding age groups.

Trends in the prevalence of obesity (BMI ≥ 28.0 or BMI ≥ 30.0) and of overweight and obesity combined (BMI ≥ 24.0 or BMI ≥ 25.0) among participants from 1991 to 2011 were assessed by linear-by-linear trend testing. Logistic regression was utilized to further assess the changes in obesity throughout the eight waves of the CHNS, as well as the differential increase rate by sex with an interaction term (sex $\times$ survey time). The age-adjusted prevalence obesity estimate from the most recent data (2011 CHNS) was compared between men and women using the chi-square test. A two-tailed p -value < 0.05 was considered statistically significant. In addition, comparisons of the prevalence estimates between Chinese adults in the 2011 survey and the U.S. population from the 2011–2012 National Health and Nutrition Examination Survey (NHANES) were conducted. Linear regression was applied to assess the trends in log-transformed BMI. To further examine trends in BMI, selected percentiles were graphed by sex and degree of urbanization.

Sensitivity analyses included analyzing the secular trend of obesity among Chinese adults from 1991 through 2011 based on the inclusion criteria.

Results

Pregnant ($n=452$) or lactating ($n=440$) women were excluded from data analysis. Additionally, participants with missing data ($n=4,027$), extreme height ($n=75$), or extreme BMI values of < 15.0 or > 40.0 ($n=234$) were also excluded. The remaining participants aged ≥ 20 years were 8,142 for 1991; 7,776 for 1993; 8,282 for 1997; 9,184 for 2000; 8,966 for 2004; 8,982 for 2006; 9,297 for 2009; and 12,249 for 2011. Sample sizes for analyses of the eight waves of the CHNS for 1991–2011 are presented in Appendix Table 1 (available

online). Detailed information on the age-adjusted prevalence of obesity and of overweight and obesity combined for the overall sample and by age and sex from the 1991–2011 CHNS is shown in Table 1 according to the WGOC criteria and in Appendix Table 2 (available online) based on WHO recommendations.

According to WGOC criteria, the age-adjusted overall prevalence of obesity (BMI ≥28.0) approximately tripled from 3.75% (95% CI=3.44%, 4.16%) in 1991 to 11.3% (95% CI=10.8%, 11.9%) in 2011 (Table 1). In the analysis stratified by sex, the change in the age-adjusted prevalence of obesity was more striking among men than that among women ($p<0.001$), with an increase from 2.88% (95% CI=2.36%, 3.40%) to 11.8% (95% CI=10.8%, 12.6%) among men and from 4.55% (95% CI=3.92%, 5.18%) to 11.0% (95% CI=10.3%, 11.8%) among women. Although the prevalence among women was higher than that among men in the first six rounds of the CHNS, this trend began to reverse in the latest two rounds of the survey. In addition, the overall age-adjusted prevalence of overweight and obesity combined (BMI ≥24.0) doubled from 20.5% (95% CI=19.7%, 21.4%) in 1991 to 42.3% (95% CI=41.3%, 43.4%) in 2011. In the stratified analysis, the change in age-adjusted prevalence of overweight and obesity combined was also more pronounced among men ($p<0.001$), with an increase from 16.5% (95% CI=15.4%, 17.6%) to 46.1% (95% CI=44.5%, 47.7%) compared with an increase from 24.3% (95% CI=23.0%, 25.6%) to 39.3% (95% CI=37.9%, 40.6%) among women. There were constant increases in the age-adjusted prevalence of obesity overall and by sex, as well as that of overweight and obesity combined ($p<0.001$ for all trends) (Table 1). Similar trends for changes with a relatively lower prevalence of overweight and obesity were also observed based on WHO recommendations ($p<0.001$ for all trends) (Appendix Table 2, available online).

Results of the tests for trends in obesity (BMI ≥28.0) over the eight waves of the CHNS from 1991 through 2011, shown in Table 2, are expressed as age-adjusted annual change in OR, indicating the estimated increase per year in the odds of obesity prevalence. There were significant increases overall (OR=1.06, 95% CI=1.06, 1.07) and for both men (AOR=1.08, 95% CI=1.07, 1.09) and women (AOR=1.05, 95% CI=1.05, 1.06) during the 1991–2011 period. The trends of an estimated increase in OR were similar under the condition of WHO recommendations for obesity (BMI ≥30.0).

In order to further disaggregate the period (1991–2011) effect, the age-specific (20 years, 30 years, and 40 years) prevalence of overweight and obesity in different periods (1991–2000, 2000–2011, and 1991–2011) were analyzed according to WGOC criteria (Figure 1). The combined prevalence of overweight and obesity increased at all three ages investigated during the three corresponding periods, with the highest increase (from 12.4% to 59.9%) in the men aged 40 years in 1991–2011 (Figure 1A). An equivalent effect was observed in women aged 30 years (from 12.9% to 32.6%, Figure 1B). When WHO recommendations were used for analysis, similar results were obtained (Appendix Figure 1, available online).

The most recent data from the 2011 CHNS showed further increases in overweight and obesity prevalence for both men and women in all age groups. In order to explore the difference in obesity between Chinese and American adults, estimates of the prevalence of obesity between Chinese adults (2011 CHNS) and the U.S. population (NHANES 2011–

2012) aged 20 years were compared according to WGOc criteria (Figure 2A and B). Both the estimates of the age-adjusted prevalence of obesity and overweight and obesity combined among Chinese adults (BMI 28.0 and BMI 24.0) were significantly lower than those of the U.S. population (BMI 30.0 and BMI 25.0) (all $p<0.05$) (Figure 2A). In addition, the ORs for obesity for the Chinese (BMI 28.0) versus U.S. population (BMI 30.0) were analyzed, with an OR of 0.32 (95% CI=0.30, 0.35) overall, 0.33 (95% CI=0.29, 0.37) in men, and 0.32 (95% CI=0.29, 0.36) in women (Figure 2B). The OR of overweight and obesity combined (BMI 24.0 and BMI 25.0) was 0.45 (95% CI=0.42, 0.48) overall, 0.42 (95% CI=0.31, 0.47) in men, and 0.48 (95% CI=0.44, 0.52) in women (Figure 2B). Findings based on WHO recommendations were consistent with these results (all $p<0.05$) (Figure 2C and D).

In the 2011 survey, the age-adjusted mean and median BMI values were 23.8 (95% CI=23.7, 23.9) and 23.7 (interquartile range, 21.4–26.0) for men, and 23.4 (95% CI=23.2, 23.5) and 23.4 (interquartile range, 21.2–26.0) for women, respectively. Tests for trends in log-transformed mean BMI over the 20-year period from 1991 through 2011 showed significant increases in both men ($p<0.01$) and women ($p<0.01$). Trends in BMI were similar to obesity trends. Notably, the increase in the estimated median BMI was much higher in men (2.6) than in women (1.9) ($p<0.05$). To further describe changes in the distribution of BMI by sex and region (urban and rural), we calculated selected percentiles, with results shown graphically in Appendix Figures 2–4 (available online). For both men and women, the estimated median BMI (50th percentile) was much higher in 2011 than in 1991 within both regions. In each survey, the median BMI in urban areas was higher than that in rural areas in both men and women from 1991 through 2011; however, the increases in the median BMI in rural areas were relatively higher. The changes in the BMI distribution by age group and region (urban and rural) are shown in Appendix Figures 5–7 (available online).

We conducted sensitivity analyses for the secular trend of obesity among Chinese adults from 1991 through 2011 based on the inclusion criteria. No significant differences were observed (data not shown). These analyses suggested that the prevalence of obesity among both men and women increased significantly from 1991 through 2011.

Discussion

The present data show striking increases in the prevalence of BMI-defined obesity and overweight in adults in China over the 20-year period from 1991 through 2011 for both men and women. Remarkably, both the prevalence of obesity and the combined prevalence of overweight and obesity increased more rapidly among men than women. Meanwhile, there was a significant rising tendency in log-transformed mean BMI from 1991 through 2011 both for men and women. Notably, the changes of BMI in men were particularly pronounced compared with those in women.

Because of differences in sampling, study design, and cut off points for obesity and overweight status, it is challenging to make international comparisons of obesity and BMI. However, for estimates based on measured data, the prevalence of obesity among the Chinese population is significantly lower compared with the U.S. population, but the

prevalence of overweight among the Chinese population is much closer to that among the U.S. population.¹⁹ Although the obesity prevalence does not seem to be outstanding compared with that of the U.S., the net population of obesity among the Chinese is nearly the highest in the world.²⁰ NHANES data for the U.S. population showed that it took almost 40 years for the obesity prevalence to reach a stable state, covering the 1960–2000 period.^{19,21} If the prevalence of obesity among the Chinese population reaches a stable status as in the U.S. population, it will continue to increase over the next few years. In other words, if the increase in obesity continues without any effective interventions, China will follow in the footsteps of the U.S. into an obesity crisis.^{19,22}

This study indicates that increases in body weight are continuing, especially among men, which is in accordance with previous studies.^{9,10,23–25} However, Wang and colleagues⁹ only focused on analyzing participants aged 20–45 years from 1989 to 2000. As the population in our analysis was aged 20 years data from 1991 through 2011, our study is more representative of the current population. Additionally, Wang et al. mainly reported trends in the distribution of BMI, but our study is more comprehensive as it includes both the prevalence of obesity and trends in the BMI distribution. Further, people in China, as well as several other Asian Pacific populations, have a higher risk for obesity-related diseases at a lower BMI than Caucasians,^{18,26–29} thus our analysis provides estimates of prevalence based on the lower BMI cut off points.¹⁸ The findings of an elevated prevalence of obesity and overweight are consistent with those from previous studies on obesity defined by BMI with a more rigorous cut off point.^{9,24,25,30}

In this study, a dramatic increase in the prevalence of overweight and obesity was observed among Chinese adults from 1991 through 2011. This increase occurred among men and women in all studied age groups. The presented estimates offer a realistic picture of overweight and obesity prevalence in China, which is helpful for predicting trends in their changes. In past three decades, peoples' lifestyles have changed greatly in China. The increased use of motorized transportation,³¹ consumption of high-fat food, and greater TV viewing time³² have been considered contributors to the increased obesity prevalence. Given the current prevalence of overweight, the large population, and other chronic diseases,^{33–36} China is facing the consequences of obesity-related health problems.^{37–41} The magnitude of the increases in the prevalence of overweight and obesity foretell a substantial increase in chronic diseases in the next several decades. These data call for immediate measures of weight control and prevention programs for overweight and obesity among Chinese adults to prevent chronic disease epidemics and deleterious obesity-related health outcomes.

Limitations and Strengths

In past three decades, increasingly more people have moved from rural areas to cities in China. We included data from participants from three large cities to mirror the changes in urbanization. More than 20 years of coverage enables us to study the impact of time on the prevalence of overweight and obesity. The analysis comparing the prevalence of overweight and obesity in China and the U.S. will help us understand the differences between developing and developed countries. There are limitations in this study. The studied population was from only a portion of China, thus caution should be taken when

generalizing the results and conclusion as a reflection the national condition. Risk factors and their impact on the increase of overweight and obesity should be analyzed in a future study.

Conclusions

The prevalence of overweight and obesity among both Chinese men and women increased significantly from 1991 through 2011. These estimates suggest that the increases in body weight are continuing, particularly among men.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1.

Age-adjusted prevalence of obesity and overweight in men and women in 20-, 30- and 40-year old age groups over the period of 1991–2000, 2000–2011, and 1991–2011 according to the criteria suggested by the Working Group on Obesity in China.

Figure 2.

Comparison of the age-adjusted prevalence of obesity and overweight between Chinese (The China Health and Nutrition Survey in 2011) and the U.S. population (The National Health and Nutrition Examination Survey during 2011–2012), as well as the OR of obesity and overweight status of Chinese to the U.S. * $p < 0.05$.

Table 1

Prevalence of Obesity (BMI ≥ 28 kg/m²) and of Overweight and Obesity Combined (BMI ≥ 24 kg/m²): CHNS 1991–2011

Sex	Age/ORs	% (95% CI)								p for Trend ^b
		1991	1993	1997	2000	2004	2006	2009	2011	
		BMI 28 ^a								
All	20 y	3.51 (3.11, 3.91)	3.50 (3.09, 3.91)	5.54 (5.05, 6.04)	7.44 (6.90, 7.97)	8.59 (8.01, 9.17)	8.87 (8.29, 9.46)	10.2 (9.62, 10.9)	11.8 (11.2, 12.4)	
	Age adjusted 20 y ^c	3.75 (3.34, 4.16)	3.56 (3.15, 3.97)	5.43 (4.94, 5.92)	7.24 (6.71, 7.77)	7.98 (7.42, 8.54)	8.28 (7.45, 9.11)	9.82 (9.22, 10.4)	11.3 (10.8, 11.9)	<0.001
	ORs ^d	—	0.950 (0.800, 1.12)	1.56 (1.33, 1.81)	1.36 (1.20, 1.54)	1.11 (0.990, 1.24)	1.04 (0.940, 1.16)	1.21 (1.09, 1.34)	1.17 (1.07, 1.28)	
	ORs ^e	—	0.950 (0.800, 1.12)	1.48 (1.27, 1.71)	2.01 (1.75, 2.30)	2.23 (1.94, 2.56)	2.32 (2.02, 2.66)	2.81 (2.46, 3.21)	3.27 (2.88, 3.72)	
Men	20 y	2.72 (2.21, 3.22)	2.47 (1.98, 2.97)	4.91 (4.25, 5.58)	6.56 (5.83, 7.29)	7.56 (6.76, 8.35)	7.75 (6.95, 8.56)	9.52 (8.66, 10.39)	11.1 (10.3, 11.9)	
	Age adjusted 20 y ^c	2.88 (2.36, 3.40)	2.50 (2.00, 3.00)	4.85 (4.19, 5.51)	6.49 (5.74, 7.20)	7.40 (6.62, 8.18)	7.88 (7.07, 8.69)	9.87 (8.99, 10.75)	11.8 (10.8, 12.6)	0.001
	20–39 y	1.17 (0.69, 1.64)	1.26 (0.74, 1.78)	3.53 (2.66, 4.4)	5.85 (4.74, 6.96)	6.77 (5.38, 8.15)	8.15 (6.54, 9.75)	10.3 (8.53, 12.1)	13.0 (11.2, 14.9)	
	40–59 y	3.49 (2.51, 4.47)	2.95 (2.05, 3.85)	5.11 (4.02, 6.20)	6.63 (5.49, 7.78)	8.02 (6.83, 9.21)	7.97 (6.78, 9.15)	10.5 (9.20, 11.9)	11.9 (10.7, 13.1)	
	60 y	5.94 (4.08, 7.80)	4.68 (3.07, 6.3)	7.69 (5.79, 9.60)	7.82 (6.02, 9.62)	7.64 (6.00, 9.28)	6.97 (5.47, 8.48)	7.21 (5.79, 8.63)	8.38 (7.07, 9.68)	
	ORs ^d	—	0.860 (0.65, 1.13)	1.98 (1.55, 2.55)	1.36 (1.13, 1.64)	1.15 (0.970, 1.36)	1.07 (0.910, 1.26)	1.28 (1.10, 1.49)	1.22 (1.08, 1.39)	
	ORs ^e	—	0.860 (0.65, 1.13)	1.71 (1.35, 2.16)	2.33 (1.87, 2.91)	2.68 (2.15, 3.34)	2.87 (2.31, 3.57)	3.67 (2.97, 4.53)	4.49 (3.67, 5.50)	
Women	20 y	4.26 (3.65, 4.87)	4.46 (3.82, 5.1)	6.14 (5.42, 6.87)	8.25 (7.47, 9.03)	9.53 (8.69, 10.37)	9.86 (9.02, 10.7)	10.9 (10.0, 11.8)	12.4 (11.6, 13.2)	
	Age adjusted 20 y ^c	4.55 (3.92, 5.18)	4.50 (4.17, 4.83)	5.96 (5.25, 6.67)	7.91 (7.14, 8.68)	8.52 (7.72, 9.32)	8.64 (7.84, 9.44)	9.73 (8.90, 10.6)	11.0 (10.3, 11.8)	<0.001
	20–39 y	1.41 (0.90, 1.92)	2.09 (0.430, 2.74)	3.50 (2.62, 4.37)	5.00 (3.99, 6.01)	4.72 (3.62, 5.87)	4.91 (3.71, 6.11)	6.43 (5.00, 7.86)	7.12 (5.83, 8.41)	
	40–59 y	7.03 (5.71, 8.35)	6.37 (5.13, 7.61)	7.11 (5.89, 8.34)	9.71 (8.41, 11.0)	10.6 (9.29, 11.9)	10.8 (9.50, 12.0)	12.4 (11.1, 13.8)	14.0 (12.8, 15.3)	
	60 y	6.92 (5.02, 8.81)	6.55 (4.72, 8.39)	9.48 (7.5, 11.5)	11.1 (9.17, 13.1)	13.3 (11.3, 15.2)	13.1 (11.3, 15.0)	12.0 (10.3, 13.7)	14.1 (12.5, 15.7)	

Sex	Age/ORs	% (95% CI)								p for Trend ^b
		1991	1993	1997	2000	2004	2006	2009	2011	
	OR _s ^d	—	0.990 (0.810, 1.22)	1.34 (1.10, 1.63)	1.36 (1.15, 1.60)	1.08 (0.940, 1.26)	1.02 (0.880, 1.17)	1.14 (0.990, 1.31)	1.15 (1.02, 1.30)	
	OR _s ^e	—	0.990 (0.810, 1.22)	1.33 (1.10, 1.61)	1.80 (1.51, 2.16)	1.96 (1.64, 2.34)	1.99 (1.66, 2.37)	2.26 (1.90, 2.69)	2.59 (2.20, 3.06)	
	BMI 24									
	All	20 y	19.9 (19.1, 20.8)	21.9 (21.0, 22.78)	26.9 (26.0, 27.9)	33.1 (32.2, 34.1)	36.5 (35.6, 37.6)	37.8 (36.8, 38.8)	40.3 (39.3, 41.3)	45.0 (44.1, 45.8)
	Age adjusted	20.5 (19.7, 21.4)	22.1 (21.2, 23.0)	26.7 (25.7, 27.6)	32.5 (31.4, 33.5)	34.8 (33.8, 35.8)	35.8 (34.8, 36.8)	38.2 (37.1, 39.3)	42.3 (41.3, 43.4)	<0.001
	OR _s ^d	—	1.10 (1.02, 1.19)	1.28 (1.19, 1.38)	1.32 (1.24, 1.41)	1.11 (1.04, 1.18)	1.05 (0.980, 1.11)	1.11 (1.04, 1.18)	1.19 (1.12, 1.25)	
	OR _s ^e	—	1.10 (1.02, 1.19)	1.41 (1.31, 1.52)	1.87 (1.74, 2.00)	2.07 (1.93, 2.22)	2.16 (2.02, 2.32)	2.40 (2.24, 2.57)	2.84 (2.66, 3.03)	
Men	20 y	16.0 (14.9, 17.2)	18.4 (17.1, 19.6)	24.3 (23.0, 25.6)	31.5 (30.1, 32.9)	35.8 (34.4, 37.2)	37.3 (35.9, 38.8)	41.1 (39.7, 42.6)	46.4 (45.1, 47.6)	
	Age adjusted	16.5 (15.4, 17.6)	18.9 (17.3, 19.8)	24.2 (22.9, 25.5)	31.2 (29.7, 32.7)	34.9 (33.5, 36.3)	36.8 (35.3, 38.2)	40.5 (38.8, 42.1)	46.1 (44.5, 47.7)	<0.001
	20–39 y	12.3 (10.8, 13.7)	13.6 (12.0, 15.3)	19.8 (18.0, 21.7)	27.4 (25.3, 29.5)	31.0 (28.5, 33.6)	34.1 (31.3, 36.9)	37.1 (34.3, 40.0)	44.1 (41.4, 46.8)	
	40–59 y	19.5 (17.4, 21.6)	22.6 (20.4, 24.8)	27.7 (25.5, 29.9)	34.9 (32.7, 37.1)	39.6 (37.5, 41.8)	41.2 (39.0, 43.3)	45.6 (43.5, 47.8)	50.1 (48.3, 52.0)	
	60 y	20.4 (17.2, 23.6)	22.2 (19.0, 25.4)	27.3 (24.1, 30.5)	32.4 (29.3, 35.6)	34.3 (31.4, 37.3)	33.6 (30.8, 36.4)	37.2 (34.6, 39.9)	42.1 (39.7, 44.4)	
	OR _s ^d	—	1.18 (1.05, 1.33)	1.37 (1.23, 1.53)	1.42 (1.29, 1.56)	1.18 (1.08, 1.29)	1.09 (0.990, 1.19)	1.17 (1.07, 1.27)	1.26 (1.16, 1.36)	
	OR _s ^e	—	1.18 (1.05, 1.33)	1.62 (1.45, 1.81)	2.30 (2.07, 2.55)	2.72 (2.44, 3.02)	2.95 (2.66, 3.27)	3.45 (3.11, 3.82)	4.33 (3.92, 4.78)	
Women	20 y	23.6 (22.3, 24.9)	25.2 (23.8, 26.5)	29.4 (28.1, 30.8)	35.5 (34.2, 36.9)	37.3 (35.9, 38.7)	38.1 (36.8, 39.5)	39.6 (38.3, 41.0)	43.7 (42.5, 44.9)	
	Age adjusted	24.3 (23.0, 25.6)	25.4 (24.0, 26.7)	29.0 (27.6, 30.4)	34.5 (33.0, 36.0)	34.6 (33.3, 36.0)	34.9 (33.6, 36.3)	36.0 (34.5, 37.5)	39.3 (37.9, 40.6)	<0.001
	20–39 y	16.9 (15.3, 18.5)	17.7 (15.9, 19.4)	22.1 (20.1, 24.1)	25.2 (23.2, 27.2)	24.1 (21.8, 26.4)	24.5 (22.1, 26.9)	25.5 (22.9, 28.0)	26.3 (24.1, 28.6)	
	40–59 y	31.6 (28.8, 33.5)	31.9 (29.5, 34.2)	35.4 (33.1, 37.7)	43.8 (41.7, 46.0)	44.4 (42.3, 46.5)	43.7 (41.7, 45.8)	45.3 (43.2, 47.3)	50.6 (48.9, 52.4)	

Sex	Age/ORs	% (95% CI)								<i>p</i> for Trend ^b
		1991	1993	1997	2000	2004	2006	2009	2011	
	60 y	27.7 (24.3, 31.0)	30.3 (26.9, 33.8)	32.1 (29.0, 35.3)	37.2 (34.1, 40.2)	39.5 (36.7, 42.4)	41.5 (38.8, 44.3)	41.8 (39.2, 44.4)	46.5 (44.3, 48.8)	
	ORs ^d	—	1.06 (0.960, 1.17)	1.20 (1.09, 1.32)	1.29 (1.18, 1.41)	1.00 (0.920, 1.09)	1.01 (0.930, 1.10)	1.05 (0.970, 1.14)	1.15 (1.07, 1.24)	
	ORs ^e	—	1.06 (0.960, 1.17)	1.27 (1.15, 1.40)	1.64 (1.50, 1.80)	1.65 (1.50, 1.81)	1.67 (1.52, 1.83)	1.75 (1.60, 1.92)	2.02 (1.85, 2.20)	

Note: Boldface indicates statistical significance ($p < 0.001$).

^a Calculated as weight in kilograms divided by height in meters squared.

^b Trends in the prevalence of obesity from 1991 to 2011 were assessed by linear-by-linear trend test.

^c Adjusted by the direct method to the year 2010 Census population using the age groups 20–39 years, 40–59 years, and 60 years or older.

^d Age-adjusted ORs based on previous year.

^e Age-adjusted ORs based on 1991 samples.

CHNS, China Health and Nutrition Survey.

Table 2

Estimated Annual Increase in the Odds of Obesity Prevalence by Sex: CHNS, 1991–2011

Sex	AOR (95% CI)	p-Value
	BMI 28 ^a	
All ^b	1.06 (1.06, 1.07)	<0.001
Men ^b	1.08 (1.07, 1.09)	<0.001
Women ^b	1.05 (1.05, 1.06)	<0.001
Sex	BMI 30	
All ^b	1.07 (1.06, 1.08)	<0.001
Men ^b	1.09 (1.08, 1.10)	<0.001
Women ^b	1.05 (1.04, 1.06)	<0.001

Note: Boldface indicates statistical significance ($p < 0.001$).

^a Calculated as weight in kilograms divided by height in meters squared.

^b Age adjusted by the direct method to the year 2010 Census population using the age groups of 20–39 years, 40–59 years, and 60 years or older.

AOR, annual change in OR; CHNS, China Health and Nutrition Survey.