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INCLUSIVITY IN PEOPLE, METHODS, AND OUTCOMES

RESEARCH ARTICLE

Prevalence of Diabetes by BMI: China Nutrition and Health Surveillance (2015–2017) and U.S. National Health and Nutrition Examination Survey (2015–2018)

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Introduction: The risk of diabetes begins at a lower BMI among Asian adults. This study compares the prevalence of diabetes between the U.S. and China by BMI.

Methods: Data from the 2015–2017 China Nutrition and Health Surveillance (*n*=176,223) and the 2015–2018 U.S. National Health and Nutrition Examination Survey (*n*=4,464) were used. Diagnosed diabetes was self-reported. Undiagnosed diabetes was no report of diagnosed diabetes and fasting plasma glucose ≥126 mg/dL or HbA1c ≥6.5%. Predicted age-adjusted prevalence estimates by BMI were produced using sex- and country-specific logistic regression models.

Results: In China, the age-adjusted prevalence of total diabetes was 7.8% (95% CI=7.4%, 8.3%), lower than the 14.6% (95% CI=13.1%, 16.3%) in the U.S. The prevalence of diagnosed diabetes was also lower in China than in the U.S. There were no statistically significant differences in the prevalence of undiagnosed diabetes between China and the U.S. The distribution of BMI in China was lower than in the U.S., and the predicted prevalence of total diabetes was similar between China and the U.S. when comparing adults with the same BMI. The predicted prevalence of undiagnosed diabetes was higher in China than in the U.S. for both men and women, and this disparity increased with BMI. When comparing adults at the same BMI, there was little difference in the prevalence of total diabetes, but diagnosed diabetes was lower in China than in the U.S., and undiagnosed was higher.

Conclusions: Although differences in BMI appear to explain nearly all of the differences in total diabetes prevalence in the 2 countries, not all factors that are associated with diabetes risk have been investigated.

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INTRODUCTION

Type 2 diabetes (T2D) is a public health concern in China and the U.S.[1] In China, T2D is a major cause of morbidity and mortality, with a prevalence of 12.4% in 2018.[2] Compared with trends in Western populations, diabetes trends in China are characterized by a more rapid increase in recent years, with onset at a relatively younger age and lower BMI and with very low rates of awareness and treatments.[3,4] In the U.S., diabetes is also a major cause of morbidity and mortality, with diagnosed diabetes affecting just over 1 in 10 people.[5] Among East Asian U.S. adults, the prevalence of age- and sex-adjusted diagnosed diabetes was 6.6%, whereas the prevalence of total diabetes was 14.0%.[6] At similar BMI categories, the prevalence of diabetes has been shown to be higher in Asian American adults than in White American adults,[7,8] and Asian Americans are the fastest-growing ethnic group in the U.S.[9]

The prevalence of overweight or obesity is higher in the U.S. than in China,[10] and in the U.S., the percentage of total diabetes that is undiagnosed is higher among Asian adults than among White adults.[11,12] Thus, the objectives of this analysis were to describe the prevalence of total diabetes, diagnosed diabetes, and undiagnosed diabetes in adults aged ≥20 years in China in 2015−2017 and in the U.S. in 2015−2018 and to calculate the predicted prevalence of diabetes by BMI for both countries.

METHODS

Study Samples

Data from national surveys in China and the U.S. were used for this study. For China, data were from the 2015−2017 China Nutrition and Health Surveillance (CNHS), a nationally representative and cross-sectional survey in 31 provinces in mainland China. A stratified, multistage probability cluster sampling design was used. There were 571 survey sites covering urban and rural areas. The survey contents included interview, dietary interview, anthropometric measurements, and laboratory tests.[13] All procedures involving sample participants were approved by the Medical Ethics Committee at the Chinese Center for Disease Control and Prevention and National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention (Approval Numbers 201519-A and 201614). All sample participants provided signed informed consent, and the response rate was 100%.

For the U.S., data from the National Health and Nutrition Examination Survey (NHANES) 2015−2018 conducted by the National Center for Health Statistics (NCHS) were used for analyses. NHANES is a cross-sectional survey designed to monitor the health and nutritional status of the U.S. population. NHANES uses a stratified, multistage probability sampling design to produce a nationally representative sample of the U.S. civilian, non-institutionalized population. Participants in NHANES complete interviews in the home and complete standardized physical assessments, including collection of blood samples and measurement of weight and height, in a mobile examination center. NHANES was approved by the NCHS Ethics Review Board, and written informed consent was obtained from adult participants. Interview and examination procedures have been previously described.[14] During 2015−2018, non-Hispanic Asian persons, among other groups, were oversampled. The NHANES final cumulative examination response rate for adults aged ≥20 years was 55.8% in 2015−2016 and 45.3% in 2017−2018.[15]

Measures

Criteria for laboratory diagnosis of diabetes were based on the American Diabetes Association Standards of Medical Care in Diabetes.[16] In both surveys, diagnosed diabetes was defined as a self-reported diagnosis that was determined by healthcare provider. Undiagnosed diabetes was defined as no report of diagnosed diabetes and fasting plasma glucose (FPG) ≥126 mg/dL or HbA1c ≥6.5%. Total diabetes was defined as either diagnosed or undiagnosed diabetes.

In CNHS, blood samples were collected from all participants after an overnight fast ≥10 hours. In NHANES, participants were randomly assigned to a morning, afternoon, or evening examination. FPG from the morning examination was used to define total and undiagnosed diabetes.

In CNHS, FPG was tested using the glucose oxidase method within 3 hours in the survey site laboratories, and serum samples and FPG were shipped to the National Institute for Nutrition and Health (Beijing, China) laboratory. Sample participants had venous HbA1c measured by the same laboratory using quantitative high-performance liquid chromatography and the boronate affinity method (Premier Hb9210 Analyzer). In NHANES, FPG specimens were processed, stored, and shipped to Diagnostics Diabetes Laboratory at the University of Missouri for analysis.[17] HbA1c values, measured in whole blood and obtained on the full examination sample of adults, were analyzed on the Tosoh G8 glycohemoglobin analyzer.[18]

In CNHS, height was measured using a stadiometer after removing shoes, and body weight was measured with light clothes on using a beam scale. The accuracy of height and weight measurements was 0.1 cm and 0.1 kg, respectively. Anthropometric measurements were made according to standard methods[19] with staff training and testing.

In NHANES, height was measured using a stadiometer after removing shoes, and body weight was measured using a digital floor scale while wearing a paper gown or light clothing. Weight was measured to the nearest 0.1 kg, and height was measured to the nearest 0.1 cm. Measurements were transmitted directly from the scale and stadiometer to the database, and staff were trained. BMI was calculated as weight in kilograms divided by height in meters squared.

Demographic variables included sex and age group. For the U.S. analyses, prevalence was estimated for all adults and for non-Hispanic Asian adults. Other race and Hispanic origin groups were not examined separately for purposes of comparability between the 2 countries. Age was categorized as 20−39 years, 40−59 years, and ≥60 years. NHANES participants' race and Hispanic origin were self-reported. The non-Hispanic Asian category includes individuals reporting a single race but is diverse and consists of all persons having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. Although the sample of non-Hispanic Asians of Chinese descent, available through the NCHS Research Data Center, were not selected to be nationally representative of U.S. Chinese Americans,[20] limited analyses of this group are presented in this paper.

Statistical Analysis

To adjust for differences in the age distribution of the 2 countries, all estimates were age adjusted to the U.S. projected population in 2000 using the age groups 20−39 years, 40−59 years, and ≥60 years.[21] Differences in estimates between and within countries were tested using Student's *t*-statistics with the appropriate number of degrees of freedom.

Predicted prevalence estimates were produced using a sex- and country-specific logistic regression model for each outcome (total diabetes, diagnosed diabetes, and undiagnosed diabetes) and are graphically presented. Predicted estimates were age adjusted to the projected U.S. 2000 population using logistic regression,[22] with BMI modeled as a restricted cubic spline with 3 knots; an interaction term (age × BMI) was included if the Wald chi-square test was statistically significant at $p<0.1$ in a given model. Predicted prevalence estimates for BMIs between the 1st and 99th percentile by sex within each country were plotted. Confidence limits for predicted age-adjusted prevalence estimates are shown, but statistical comparisons between countries were not performed.

All CNHS analyses used sample weights to adjust for noncoverage and unequal probability of selection. NHANES analyses used the morning fasting subsample examination weights that adjust for nonresponse, noncoverage, and unequal probabilities of selection to provide estimates representative of the U.S. civilian, noninstitutionalized population reflecting the race/ethnic distribution of the U.S. population in 2015−2018. Prevalence estimates for total and undiagnosed diabetes are not presented for adults of Chinese descent in the U.S. owing to small sample sizes and unstable estimates. Interview sample weights were used to estimate the prevalence of diagnosed diabetes among adults of Chinese descent in the U.S.

All variance estimates from both surveys accounted for stratification and clustering in addition to weighting. The SEs for prevalence estimates for both surveys were calculated using Taylor series linearization. The 95% CIs were constructed using the method by Korn and Graubard for U.S. estimates. The reliability of U.S. prevalence estimates was evaluated on the basis of the NCHS data presentation standards for proportions.[23] A 2-sided $p<0.05$ was used to assess statistical significance. Sex-specific, weighted BMI distributions were calculated by kernel density estimation with the over-smoothing method and age adjusted to the projected 2000 U.S. census population using the age groups of 20−39 years, 40−59 years, and ≥60 years. The area under the density curve within a given BMI range approximates the proportion of the population with a BMI within that range. Analyses were conducted in SAS (SAS Institute), Version 9.4, and SUDAAN (RTI International), Version 11.0.

Analyses included nonpregnant adults aged ≥20 years. For estimates of undiagnosed diabetes, participants missing FPG and HbA1c were excluded, but these individuals could be included in calculation of diagnosed diabetes. Participants missing BMI were excluded only for analyses involving BMI.

RESULTS

Sample sizes and weighted sex and age distributions from each survey are shown in Table 1. The unweighted China CNHS sample size (176,223) was larger than the U.S. NHANES sample (4,464). NHANES included 579 non-Hispanic Asian adults and 306 Americans of Chinese descent in 2015−2018. The weighted distribution by age shows a higher percentage of adults aged 20−39 years in the U.S. (35.3% of the population) than in China (20.1% of the population) and a higher percentage of adults aged 40−59 years in China.

Table 1. Sample Size and Demographics for Adults, China and the U.S.

Demographics	China, 2015−2017			U.S., 2015−2018			U.S. non-Hispanic Asian, 2015−2018		
	n	%	SE	*n*	%	SE	*n*	%	SE
Total	176,223	100		4,464	100		579	100	
Sex									
Male	81,983	46.5	0.3	2,157	48.5	0.7	274	47.2	1.7
Female	94,240	53.5	0.3	2,307	51.5	0.7	305	52.8	1.7
Age, years									
20−39	35,469	20.1	0.8	1,355	35.3	1.0	208	40.7	2.5
40−59	82,661	46.9	0.4	1,485	35.8	1.2	207	36.2	1.7
≥60	58,093	33.0	0.6	1,624	28.8	1.4	164	23.1	1.7

Sources: China, Nutrition and Health Surveillance (2015−2017) and the U.S. National Health and Nutrition Examination Survey (2015−2018). Sample size is unweighted, and percentages are weighted.

In China, the age-adjusted prevalence of total diabetes in 2015−2017 was 7.8% (95% CI=7.4, 8.3), lower than the prevalence (14.6% [95% CI=13.1, 16.3]) in the U.S. in 2015−2018 (p<0.001) (Table 2). The prevalence among men in China (8.2%, 95% CI=7.7, 8.7) was half of that among U.S. men (16.6%, 95% CI=14.5, 18.8) (p<0.001). Among women in China, the prevalence was 7.4% (95% CI=7.0, 7.9), lower than the prevalence among U.S. women (12.9% [95% CI=10.9, 15.2]) (p<0.001). Prevalence among young adults aged 20−39 years (3.1% [95% CI=2.7, 3.4] vs 4.0% [95% CI=2.8, 5.5]) (p=0.165) was similar between the 2 countries; however, among middle-aged adults aged 40−59 years, the prevalence of total diabetes was 8.7% (95% CI=8.2, 9.2) in China compared with 16.9% (95% CI=14.1, 20.0) in the U.S. (p<0.001). Among adults aged ≥60 years, the prevalence was 14.6% (95% CI=13.6, 15.5) in China compared with 29.2% (95% CI=26.2, 32.4) in the U.S. (p<0.001).

Similar patterns were seen with comparisons of diagnosed diabetes in China and the U.S. except that the difference for those aged 20−39 years was significant. There were no differences between China and the U.S. in the prevalence of undiagnosed diabetes for adults aged ≥20 years (4.4% in both countries).

The percentage of total diabetes (based on crude values) that was diagnosed was lower in China than in the U.S. (47.9% vs 71.1%, data not shown in table). The largest difference in percentage of total diabetes that was diagnosed was among young adults aged 20−39 years (16.1% of those in China vs 55.0% of those in the U.S.).

The prevalence of total, diagnosed, and undiagnosed diabetes among non-Hispanic Asian adults in the U.S. was similar to that of the overall U.S. adult population, and differences between China and non-Hispanic Asian adults in the U.S. were similar to the differences seen between China and the overall U.S. adult population. Among the NHANES sample of adults of Chinese descent in the U.S., the age-adjusted prevalence of diagnosed diabetes was 10.4% (95% CI=7.1, 14.5) in 2015−2018 (Table 3), higher than the prevalence of diagnosed diabetes in China (3.4% [95% CI=3.2, 3.6]).

Figure 1 shows the age-standardized distribution of BMI in men (Figure 1A) and women (Figure 1B) in both countries and among non-Hispanic Asian adults in the U.S. The distribution among non-Hispanic Asian men in the U.S. is shifted slightly to the right of the distribution in China, whereas the distribution among all U.S. adult men is shifted further to the right and more skewed than either of the 2 other distributions. The distribution among non-Hispanic Asian women is more skewed than among women in China, whereas the distribution among all U.S. women is shifted to the right and more skewed than the other 2 distributions. These differences reflect the lower average BMI in China than in the U.S. (Appendix Table 1, available online).

Figure 2 shows the sex-specific predicted prevalence of total diabetes (Figure 2A), diagnosed diabetes (Figure 2B), and undiagnosed diabetes (Figure 2C) by BMI, stratified by sex in China and the U.S. In women, there was a significant interaction between BMI and age. Within the range of BMI values observed in both countries (BMI< ~34), the predicted prevalence of total diabetes is generally similar in men in both countries; among women, the estimates are higher in China but within the 95% CIs of the U.S. estimates. Men in China have a generally lower prevalence of diagnosed diabetes that runs in parallel with that of the U.S. men until around BMI of 27 kg/m^2, after which, prevalence between men in the 2 countries diverges. The prevalence of diagnosed diabetes in women in both countries overlapped within the BMI range of 18−23 kg/m^2 but differs at higher BMI values, with prevalence in U.S. women generally higher than in women in China. The predicted prevalence of undiagnosed diabetes was higher in China

Table 2. Age-Adjusted Prevalence of Total Diabetes, Diagnosed Diabetes, and Undiagnosed Diabetes by Sex and Age in China and the U.S. and NHA adults in the U.S.

Outcome and demographics	China		U.S.		China versus U.S.	U.S. NHA		China versus NHA
	%	95% CI	%	95% CI	*p*-value	%	95% CI	*p*-value
Total diabetes								
Total (crude)	9.6	9.4, 9.7	15.9	14.3, 17.6		16.4	13.5, 9.7	
Total	7.8	7.4, 8.3	14.6	13.1, 16.3	<0.001	16.6	13.6, 19.9	<0.001
Sex								
Men	8.2	7.7, 8.7	16.6	14.5, 18.8	<0.001	19.9	14.8, 25.8	<0.001
Women	7.4	7.0, 7.9	12.9	10.9, 15.2	<0.001	13.7	10.1, 18.1	<0.001
Age, years								
20−39	3.1	2.7, 3.4	4.0	2.8, 5.5	0.165	2.8	0.8, 6.7	0.807
40−59	8.7	8.2, 9.2	16.9	14.1, 20.0	<0.001	15.5	9.7, 22.9	0.032
≥60	14.6	13.6, 15.5	29.2	26.2, 32.4	<0.001	41.9	34.3, 49.9	<0.001
Diagnosed diabetes[a]								
Total (crude)	4.6	4.5, 4.7	11.3	9.9, 12.7		11.2	8.7, 14.1	
Total	3.4	3.2, 3.6	10.2	9.0, 11.6	<0.001	11.3	8.8, 14.2	<0.001
Sex								
Men	3.3	3.1, 3.6	11.7	9.6, 14.1	<0.001	13.6	8.8, 19.7	<0.001
Women	3.5	3.3, 3.8	9.0	7.4, 10.7	<0.001	9.4	6.0, 13.7	<0.001
Age, years								
20−39	0.5	0.4, 0.6	2.2	1.4, 3.1	<0.001	0.4	0.0, 2.5	0.810
40−59	3.8	3.5, 4	11.2	9.0, 13.7	<0.001	10.5	6.3, 16.1	0.005
≥60	7.9	7.3, 8.5	22.6	19.6, 25.7	<0.001	31.3	23.5, 39.9	<0.001
Undiagnosed diabetes[b]								
Total (crude)	5	4.9, 5.1	4.6	3.8, 5.6		5.2	3.5, 7.6	
Total	4.4	4.1, 4.7	4.4	3.6, 5.3	1.000	5.3	3.4, 7.7	0.385
Sex								
Men	4.9	4.5, 5.3	4.9	3.4, 6.8	1.000	6.3	3.1, 11.2	0.420
Women	3.9	3.6, 4.2	4.0	3.0, 5.2	0.854	4.4	2.2, 7.7	0.684
Age, years								
20−39	2.5	2.2, 2.9	1.9	1.1, 3.0	0.190	2.4	0.6, 6.3	0.935
40−59	5	4.6, 5.3	5.7	4.1, 7.7	0.403	5	2.1, 10.0	1.000
≥60	6.7	6.1, 7.2	6.7	4.9, 8.8	1.000	10.6	6.3, 16.5	0.103

Sources: China, Nutrition and Health Surveillance (2015−2017) and the U.S. National Health and Nutrition Examination Survey (2015−2018).
Note: All estimates are weighted, and total, men, and women estimates are age adjusted to the projected 2000 U.S. census population using age groups of 20−39 years, 40−59 years, and ≥60 years.
[a]Diagnosed diabetes was defined as a self-reported diagnosis that was determined previously by a healthcare professional.
[b]Undiagnosed diabetes was defined as fasting plasma glucose level of ≥126 mg/dL or HbA1c ≥6.5%.
NHA, non-Hispanic Asian; NHANES, National Health and Nutrition Examination Survey.

than in the U.S., and the difference widened with increasing BMI for both men and women.

The distributions of HbA1c in China and the U.S. are found in Appendix Table 2 (available online). Similarly, Appendix Table 3 (available online) shows the distributions of FPG in China and the U.S. Mean HbA1c was 5.0% (SE=0.02) in China, lower than the mean of 5.7% (SE=0.02) in the U.S. Mean FPG was 96.4 mg/dL (SE=0.38) in China, also lower than the mean of 110 mg/dL (SE=0.61) in the U.S. Similar patterns between countries were seen for men and women and each age group.

DISCUSSION

The prevalence of total diabetes was higher in the U.S. (14.6%) than in China (7.8%), with the difference reflected in diagnosed diabetes (10.2% vs 3.4%) but not in undiagnosed diabetes (4.4% for both). A higher percentage of total diabetes was diagnosed in the U.S. than in China, but differences in diagnostic criteria do exist between the countries. When comparing adults in the 2 countries at the same BMI, total diabetes prevalence was similar, but prevalence of diagnosed diabetes was higher in the U.S. than in China, and undiagnosed diabetes was

Table 3. Age-Adjusted Prevalence of Diagnosed Diabetes in a Sample of Adults of Chinese Descent and in China by Sex and Age, 2015−2018

Demographics	U.S. sample of adults of Chinese descent			China		U.S. Chinese sample versus China
	n	%	95% CI	%	95% CI	*p*-value
Total	306	10.4	7.1, 14.5	3.4	3.2, 3.6	<0.001
Sex						
Male	151	12.7	7.8, 19.1	3.3	3.1, 3.6	<0.001
Female	155	8.7	4.8, 14.4	3.5	3.3, 3.8	0.007
Age, years						
20−39	114	0	0.0, 3.2	0.5	0.4, 0.6	<0.001
40−59	115	10[a]	4.3, 18.9	3.8	3.5, 4	0.055
≥60	77	28.7	17.3, 42.6	7.9	7.2, 8.5	<0.001

Source: National Center for Health Statistics, National Health and Nutrition Examination Survey; Sample of non-Hispanic Asians of Chinese descent was not selected to be nationally representative of U.S. Chinese Americans.
Note: Diagnosed diabetes was defined as a self-reported diagnosis that was determined previously by a healthcare professional. Interview weighted data for diagnosed diabetes were used. Total, male, and female estimates age adjusted to the projected 2000 U.S. census estimates using age groups of 20−39 years, 40−59 years, and ≥60 years.
[a]Estimate potentially unreliable, CI width >5%, and relative CI width >130%.

lower. This is the first study the authors are aware of that compares national estimates of diabetes by BMI between China and the U.S.

Although similar approaches are described in clinical guidelines used in the U.S.[16] and China,[24] an important difference exists. In the U.S., the diagnosis of diabetes is based on FPG ≥126 mg/dL or oral glucose tolerance test (OGTT) of 2-hour plasma glucose ≥200 mg/dL or HbA1c ≥6.5%. In China, diabetes is diagnosed on the basis of the same FPG and OGTT cut points but not of HbA1c. The 2019 standards of medical care for T2D in China[24] states that HbA1c "has not been sufficiently characterized to support routine adoption. Thus, this standard does not recommend the use of HbA1c for diagnosis of diabetes in China." Consequently, estimates of self-reported diagnosed diabetes in China and the U.S. are not equivalent. Although HbA1c is less sensitive than FPG,[25] including HbA1c in the diagnostic criteria improves the ability to diagnosis adults with diabetes. For example, on the basis of analysis of NHANES data from 2005 to 2006, about 5% of people with undiagnosed diabetes were identified by HbA1c only.[26]

BMI cut points to define overweight and obesity in China are lower than the U.S. cut points. The cutoffs suggested by the China Obesity Task Force for adults[27] are BMI ≥24 kg/m^2 and <28 kg/m^2 for overweight and BMI ≥28 kg/m^2 for obesity. The U.S. BMI cut offs were defined using the criterion from the National Obesity Education Initiative of the National Heart, Lung, and Blood Institute.[28] Overweight is defined as a BMI of 25−29.9 kg/m^2, and obesity is defined as a BMI ≥30 kg/m^2. Given that mortality and morbidity risk may increase at lower BMI among some Asian subgroups,[29] one might expect that the curves for the predicted diabetes prevalence versus BMI for China would be higher than for the U.S. at lower BMIs, but this pattern is only apparent for diagnosed diabetes, which is not directly comparable between the 2 countries; for total diabetes, there was no significant difference. In a study using NHANES 2011−2016, BMI-adjusted diabetes prevalence was estimated to be 21.3% among East Asian adults compared with 11.9% among non-Hispanic White adults.[6]

In the U.S., on the basis of other surveys, the prevalence of diagnosed Type 1 diabetes was 0.55%, and that of T2D was 8.6% in 2016.[30] Another survey suggests that 10.5% of adults had diagnosed diabetes in 2016.[31] The 11.3% prevalence of diagnosed diabetes presented from NHANES in this study does not distinguish between Type 1 diabetes and T2D, reflects 2015−2018 estimates, and is higher than both the other estimates.

In China, on the basis of other surveys, the prevalence of total diabetes in China was 12.8% in 2015−2017[32] and 12.4% in 2018.[2] Both of these estimates[2,32] of diabetes prevalence in China included OGTT ≥200 mg/dL in the definition of diabetes. OGTT was not included in the definition of undiagnosed diabetes in this study, which would in part explain the lower total crude prevalence of 9.6%.

Limitations

This study has some strengths and limitations. Strengths of this study include nationally representative samples from both countries, similar assessments of diagnosed and undiagnosed diabetes and laboratory diagnoses to identify undiagnosed diabetes, and adjustment for differences in BMI and age distributions between the 2 countries. This is the first study to compare diabetes

Figure 1

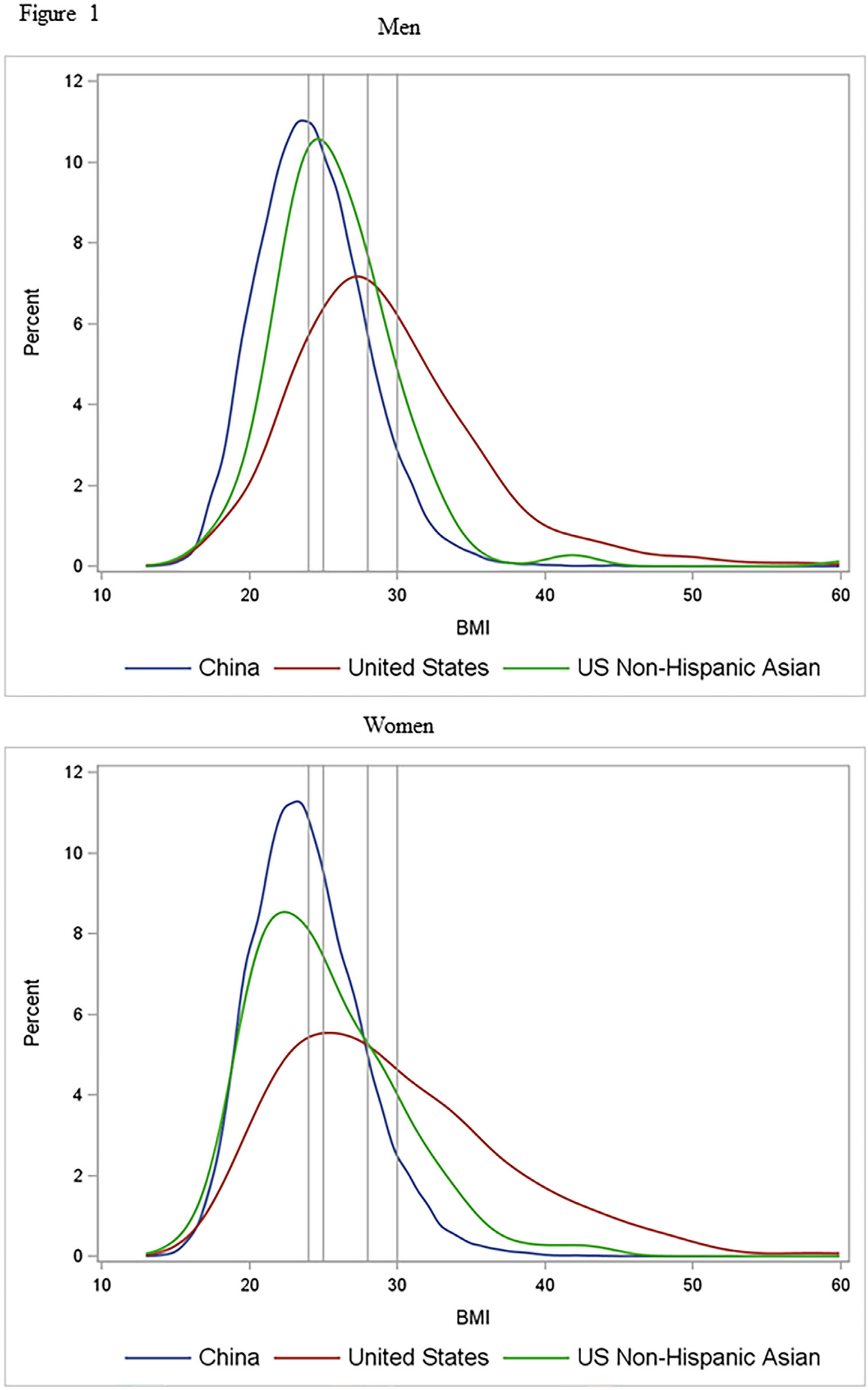

Figure 1. Distribution of BMI among adults aged ≥20 years, by sex, China and the U.S.

Notes: Estimates are weighted and adjusted for age to the projected 2000 U.S. census population using the age groups of 20−39 years, 40−59 years, and ≥60 years. The BMI distributions were calculated using kernel density estimation. The proportion of the population with a BMI within a given range is estimated by the area under the density curve within that range. Vertical reference lines are shown at BMI thresholds for overweight in China (24 kg/m^2) and the U.S. (25 kg/m^2) and for obesity in China (28 kg/m^2) and the U.S. (30 kg/m^2).

Sources: China, Nutrition and Health Surveillance 2015−2017 and U.S. National Health and Nutrition Examination Survey (2015−2018).

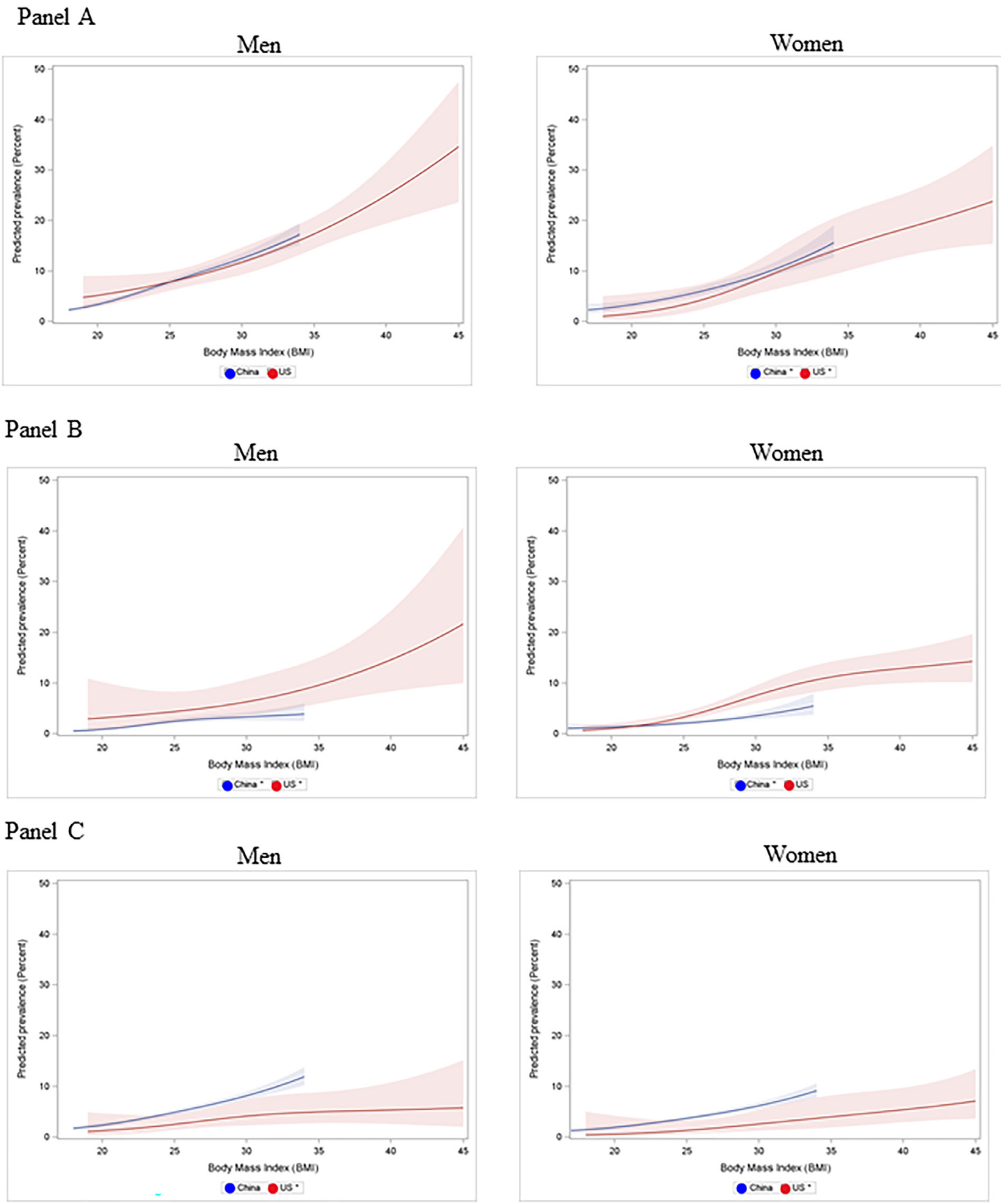

Figure 2. Predicted age-adjusted prevalence of total diabetes, diagnosed diabetes, and undiagnosed diabetes among adults aged ≥20 years by sex and BMI, China and the U.S. (A) Total diabetes, (B) diagnosed diabetes, and (C) undiagnosed diabetes.

Notes: Estimates are age adjusted to the projected 2000 U.S. population using age groups of 20–39 years, 40–59 years, and ≥60 years. Predictions are from sex-stratified logistic regression models on age category and continuous BMI as a restricted cubic spline with 3 knots. Asterisk (*) indicates model including an interaction between age and BMI (interaction $p<0.1$)

Sources: China, Nutrition and Health Surveillance (2015–2017) and the U.S. National Health and Nutrition Examination Survey (2015–2018).

prevalence between China and the U.S. and to include both diagnosed and undiagnosed diabetes. However, the small sample size for adults of Chinese descent in the U. S. limited the ability to compare adults in China with adults of Chinese descent in the U.S. Second, the sample of adults of Chinese descent in NHANES is not nationally representative. Third, the estimates of diagnosed diabetes in China and the U.S. are not directly comparable given the differences in diagnoses in the 2 countries discussed earlier, and a lack of OGTT and HbA1c measures for all participants may have impacted the estimates. Fourth, Type 1 diabetes and T2D could not be differentiated. Fifth, the laboratory assays utilized in the U.S. and Chinese studies were not the same. Finally, these are analyses of cross-sectional studies, and causality cannot be determined.

CONCLUSIONS

When comparing adults in the U.S. with those in China at the same BMI, there was little difference in predicted prevalence of total diabetes; however, undiagnosed diabetes was lower in the U.S., especially at a BMI above about 25 kg/m^2. Whereas differences in BMI appear to explain nearly all of the differences in total diabetes prevalence in the 2 countries, not all factors that are associated with diabetes risk have been investigated.

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CREDIT AUTHOR STATEMENT

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2024.100215.

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