

Letter to the Editor



Prevalence of Major Cardiovascular Risk Factors and Cardiovascular Disease in Women in China: Surveillance Efforts

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In this study, we aimed to assess the relationship of socioeconomic status and acculturation with cardiovascular disease (CVD) risk profiles and CVD and examine the CVD risk factors associated with CVD. We used data from the 2010 China Chronic Disease and Risk Factor Surveillance surveys, which consisted of a nationally representative sample of women. The following prevalence was found: myocardial infarction (MI): 0.4%; stroke: 0.5%; abnormal cholesterolemia: 44.9%; overweight or obesity: 32.2%; hypertension: 31.7%; diabetes: 9.0%; and smoking: 2.5%. In total, 30.9% of Chinese women had no risk factors, but 13.3% had ≥ 3 associated risk factors. In multivariate-adjusted models, hypertension, diabetes, overweight or obese, and smoking were all directly associated with MI; For stroke, associations were positive with hypertension, abnormal cholesterolemia, diabetes, and overweight or obesity. Therefore, it can be concluded that CVD risk factors are common among Chinese women aged ≥ 18 years.

Worldwide, cardiovascular diseases (CVDs), principally ischemic heart disease and stroke, are the leading causes of mortality among women and a major contributor to disability and rising healthcare costs. In China, the leading causes of death among women were cardiovascular and cerebrovascular diseases, accounting for 46.7% of all female deaths in 2012^[1]. Hypertension, diabetes, dyslipidemia, obesity, and smoking are all major risk factors for CVD^[2]. It is critical to fully understand the epidemiological features of CVDs and those risk factors to reduce the increasing burden of CVD.

Powerful evidence has revealed that those with a clustering of CVD risk factors were more likely to develop CVD, as compared with those who had one single CVD risk factor^[3]. It is of interest that the increasing prevalence of multiple CVD risk factors

has been related to an increased risk of all-cause, coronary heart disease and stroke mortality^[3]. Therefore, valid information on the prevalence of cardiovascular risk factors is crucial for implementing effective strategies to prevent CVD. Our study aimed to assess the relationship of socioeconomic status and acculturation with CVD risk profiles and CVD and examine the CVD risk factors associated with CVD.

The samples used in this study were from the 2010 China Chronic Disease and Risk Factor Surveillance (CCDRFS) survey, which was a nationally representative surveillance survey designed to examine the prevalence and distribution of the main noncommunicable diseases (NCDs), and their risk factors, among Chinese adults aged ≥ 18 years. Details of the history, sampling plan, and degree of representativeness of the Disease Surveillance Points (DSP) have already been published^[4]. We extracted data for 52,553 female respondents, aged ≥ 18 years, from the 2010 CCDRFS database. All the participants completed a questionnaire, including anthropometrics (body height, weight, waist circumference, and blood pressure), and blood samples were collected (fasting blood glucose and blood lipids). The statistical analyses values [prevalence and odd ratios (ORs)] were weighted to obtain nationally representative estimates. Confidence intervals (CIs) were estimated using Taylor's series method with a finite population correction, and Rao-Scott χ^2 tests were used to compare the differences with the prevalence of each risk factor. A logistic regression analysis for trend test was used to examine the trends in the prevalence of risk factors and CVD risk factors associated with the prevalence of CVD (including MI and stroke). The study was approved by the ethical committee of the Chinese Center for Disease Control and Prevention.

The results showed that nearly 21.4% of women

studied were 40-49 years old; approximately 79.3% were married or living with a partner; more than one fourth (26.6%) were illiterate or had not completed primary school; almost 70% lived in a rural area; 27.3% lived in western China, and 51.6% had an annual family per capita income of <895 United States dollars (Table S1).

The overall prevalence of risk factors including hypertension, abnormal cholesterolemia, diabetes, overweight or obesity, and current smoking in Chinese women were as follows: 31.7%, 44.9%, 9.0%, 32.2%, and 2.5%, respectively (Table 1), and varied with age. The proportion of unfavorable CVD risk profiles tended to be higher among participants who were older, had lost a life partner, with a low educational level, and in Chinese women living in urban areas and eastern China. In addition, a higher prevalence of CVD was associated with low educational level and family income.

At present, China is undergoing economic transition, with rapid changes in urbanization and industrialization, just as many developed countries have previously experienced. It is obvious that changes in lifestyle, owing to this transition, result in an increased prevalence of CVD and CVD risk factors. In the present study, the prevalence of hypertension was 31.7% in Chinese women in 2010, while in the 2002 China Nutrition Survey, this prevalence was only 17%^[5]. There may be numerous reasons for the

increasing proportion of hypertension; however, an increase in obesity may be the main contributing factor^[5]. Our results showed that there were 44.9% of participants suffering from abnormal cholesterolemia, which was similar to the prevalence found in developed countries. Among the subjects studied, the prevalence of abnormal cholesterolemia, in the descending order, were as follows: low levels of high density lipoprotein (HDL-C), 39.2%; raised total cholesterol (TC), 3.2%; and high levels of low density lipoprotein (LDL-C), 2.1%. As compared with the US population, the prevalence of raised TC and high LDL-C were much lower in Chinese women^[6]. A low serum TC level related to a low habitual dietary intake of fat and cholesterolis considered to be the main underlying reason for the low incidence of coronary heart disease mortality in China. Interestingly, the proportion of current smokers was low (2.5%), among Chinese women in 2010. Data from the Global Adult Tobacco Survey demonstrated that the current prevalence of smoking in Chinese women was the lowest among 16 countries. This maybe because people influenced by the traditional Chinese culture, disapprove of women who smoke. The prevalence of diabetes among Chinese women increased by 2.3 times (9.0% versus 2.7%) according to our data, as compared with that observed in the China National Nutrition and Health Survey of 2002^[7]. Moreover, the prevalence of obesity in China was found

Table 1. Age Specific Prevalence of Main CVD Risk Factors among Women, China, 2010

Characteristic	Age Group, Years						Total
	18-29	30-39	40-49	50-59	60-69	≥70	
Hypertension ^{a,f}	7.7 (6.3-9.1)	15.7 (13.8-17.5)	30.9 (28.8-32.9)	50.8 (47.9-53.8)	64.9 (62.6-67.3)	72.7 (70.1-75.4)	31.7 (29.6-33.8)
Abnormal cholesterolemia ^{b,f}	40.5 (37.2-43.9)	43.7 (40.7-46.7)	44.7 (41.9-47.4)	47.5 (44.9-50.0)	52.8 (49.9-55.6)	46.9 (43.3-50.6)	44.9 (42.3-47.4)
Diabetes ^{c,f}	3.1 (2.4-3.9)	4.2 (3.5-4.8)	7.6 (6.9-8.3)	13.7 (12.7-14.7)	19.6 (18.0-21.1)	21.4 (19.5-23.4)	9.0 (8.3-9.6)
Overweight or obesity ^{d,f}	17.5 (15.8-19.3)	27.8 (25.8-29.9)	39.2 (37.1-41.3)	43.3 (40.6-46.0)	42.5 (39.6-45.3)	35.2 (32.2-38.1)	32.2 (30.4-34.1)
Smoking ^{e,f}	1.1 (0.7-1.5)	1.8 (1.2-2.4)	2.2 (1.5-2.8)	3.1 (2.3-4.0)	4.4 (3.1-5.7)	5.6 (4.2-7.0)	2.5 (1.9-3.0)

Note. ^aSystolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg and/or on medication for decreasing blood pressure. ^bTotal cholesterol ≥240 mg/dL and/or low-density lipoprotein cholesterol ≥160 mg/dL and/or high-density lipoprotein cholesterol ≤40 mg/dL and/or on medication for regulation blood cholesterol. ^cFasting plasma glucose value ≥126 mg/dL and/or 2-hour-post load plasma glucose ≥200 mg/dL, and/or on medication for decreasing plasma glucose. ^dBody mass index ≥25 kg/m². ^eUse of tobacco every day or on some day at the time of the survey. ^f*P*<0.01 significant linear trend for variables across age groups by chi-square test for trend. The values in the columns are all percentages and 95% CIs (CI, confidence interval). All prevalences were weighted with complex weights; the 95% CIs take into account the complex sampling design.

Table 2. Number of Adverse Cardiovascular Disease Risk Factors and Prevalence of Self-reported MI and Stroke Among Women, China, 2010

Characteristic	n % (95% CI)					
	No risk factors ^a	1 risk factor ^b	2 risk factors ^c	≥3 risk factors ^d	MI ^e	Stroke ^f
Total	30.9 (28.6-33.1)	34.1 (32.9-35.2)	21.7 (20.6-22.8)	13.3 (12.3-14.4)	0.4 (0.3-0.5)	0.5 (0.4-0.6)
Age group, years						
18-29	48.0 (44.7-51.3)	37.4 (34.7-40.2)	11.4 (10.1-12.7)	3.1 (2.3-4.0)	0.0 (0.0-0.1)	0.0 (0.0-0.1)
30-39	38.7 (35.9-41.4)	37.2 (35.5-38.9)	17.3 (15.9-18.7)	6.8 (5.9-7.7)	0.2 (0.1-0.3)	0.1 (0.0-0.2)
40-49	28.5 (26.4-30.5)	33.6 (32.4-34.8)	24.8 (23.4-26.2)	13.1 (11.9-14.3)	0.3 (0.2-0.4)	0.3 (0.2-0.4)
50-59	18.6 (16.6-20.6)	30.7 (29.3-32.1)	28.7 (27.4-30.0)	22.0 (20.0-23.9)	0.6 (0.4-0.8)	0.7 (0.5-1.0)
60-69	12.5 (10.8-14.2)	27.4 (25.7-29.0)	30.7 (29.3-32.0)	29.5 (26.9-32.0)	1.0 (0.7-1.3)	1.2 (0.9-1.5)
≥70	9.9 (8.5-11.3)	31.5 (29.2-33.8)	32.5 (30.2-34.8)	26.1 (23.5-28.7)	1.5 (1.0-2.0)	1.7 (1.2-2.3)
P-value for test for trend	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Marital status						
Single	50.9 (46.7-55.0)	37.0 (33.2-40.8)	9.7 (7.9-11.4)	2.5 (1.7-3.2)	0.0 (0.0-0.1)	0.0 (0.0-0.1)
Married or cohabiting	29.8 (27.6-32.1)	33.9 (32.8-35.0)	22.5 (21.4-23.6)	13.8 (12.7-15.0)	0.4 (0.3-0.5)	0.5 (0.4-0.5)
Separated/divorced/Widowed/ others	18.0 (15.6-20.5)	32.4 (30.5-34.3)	28.6 (26.8-30.4)	21.0 (18.3-23.6)	1.1 (0.8-1.5)	1.0 (0.7-1.3)
P-value for test for differences in prevalence	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Education						
Illiterate or some primary school	20.2 (17.9-22.4)	33.7 (32.4-35.0)	27.4 (25.7-29.0)	18.8 (17.0-20.5)	0.8 (0.6-1.0)	0.9 (0.6-1.1)
Primary school graduate or some junior high school	27.8 (24.9-30.6)	32.4 (31.0-33.8)	24.5 (22.9-26.2)	15.3 (13.7-17.0)	0.4 (0.3-0.6)	0.5 (0.3-0.7)
Junior high school graduate or some Senior high school	34.4 (31.7-37.1)	34.9 (33.3-36.6)	19.4 (18.1-20.6)	11.3 (10.0-12.6)	0.2 (0.2-0.3)	0.3 (0.2-0.5)
Senior high school graduate or some college	40.0 (37.0-42.9)	34.6 (32.7-36.6)	16.7 (15.3-18.2)	8.6 (7.6-9.6)	0.2 (0.1-0.3)	0.1 (0.1-0.2)
Characteristic						
College graduate or above	47.8 (42.9-52.7)	34.8 (30.5-39.2)	12.1 (9.6-14.6)	5.3 (3.9-6.6)	0.1 (0.0-0.2)	0.1 (0.0-0.2)
P-value for test for trend	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01

Characteristic	n % (95% CI)					Stroke ^f
	No risk factors ^a	1 risk factor ^b	2 risk factors ^c	≥3 risk factors ^d	MI ^e	
Annual family income ^g , US\$						
<895	28.1 (24.7-31.5)	33.9 (32.3-35.5)	23.6 (21.7-25.4)	14.4 (12.6-16.2)	0.6 (0.4-0.7)	0.6 (0.4-0.8)
895-1791	31.6 (29.4-33.8)	34.0 (32.7-35.3)	21.6 (20.4-22.8)	12.8 (11.7-13.9)	0.4 (0.2-0.5)	0.4 (0.2-0.5)
1792-5373	32.8 (29.8-35.8)	34.2 (32.2-36.2)	20.3 (18.8-21.8)	12.7 (11.2-14.3)	0.2 (0.2-0.3)	0.3 (0.2-0.5)
>5373	36.3 (31.4-41.1)	29.6 (25.1-34.0)	19.7 (16.1-23.3)	14.4 (11.0-17.8)	0.3 (0.0-0.6)	0.1 (0.0-0.2)
Don't know/not sure/refused	32.0 (28.9-35.1)	34.7 (32.5-36.9)	20.6 (18.7-22.4)	12.7 (11.0-14.5)	0.5 (0.3-0.6)	0.5 (0.2-0.7)
P-value for test for trend	0.06	0.3	<0.05	0.13	<0.01	<0.01
Place of residence						
Urban	29.9 (27.5-32.4)	32.6 (31.5-33.7)	22.0 (20.8-23.1)	15.5 (13.9-17.1)	0.4 (0.3-0.6)	0.6 (0.4-0.7)
Rural	31.3 (28.2-34.3)	34.7 (33.2-36.3)	21.6 (20.1-23.1)	12.4 (10.9-13.8)	0.4 (0.3-0.5)	0.4 (0.3-0.5)
P-value for test for differences in prevalence	<0.05	<0.01	0.49	<0.01	0.51	<0.05
Geographic region						
Eastern China	29.8 (26.4-33.2)	33.3 (31.3-35.3)	22.1 (20.4-23.8)	14.8 (12.8-16.7)	0.3 (0.2-0.4)	0.4 (0.3-0.6)
Central China	31.7 (28.0-35.5)	32.9 (31.0-34.7)	21.9 (20.3-23.5)	13.5 (11.8-15.2)	0.5 (0.3-0.8)	0.5 (0.4-0.7)
Western China	31.3 (26.7-36.0)	36.6 (34.8-38.4)	21.0 (18.5-23.5)	11.0 (9.1-13.0)	0.5 (0.3-0.6)	0.4 (0.2-0.6)
P-value for test for differences in prevalence	<0.01	<0.01	0.16	<0.01	<0.01	0.42

Note. CI, confidence interval; US\$, United States dollar; MI, myocardial infarction. ^aBeing free of any following risk factors: hypertension, hypercholesterolemia, diabetes, overweight or obesity, and smoking. ^bHaving any 1 following risk factors: hypertension, hypercholesterolemia, diabetes, overweight or obesity, and smoking. ^cHaving any 2 following risk factors: hypertension, hypercholesterolemia, diabetes, overweight or obesity, and smoking. ^dHaving any 3 or more following risk factors: hypertension, hypercholesterolemia, diabetes, overweight or obesity, and smoking. ^eMI was defined as self-reported history of myocardial infarction. ^fStroke was defined as self-reported history of stroke. ^gBased on the exchange rate of 6.70 renminbi to US\$ 1 that was in effect on 30 September 2010. The values in the columns are all percentages and 95% CIs. All prevalence were weighted with complex weights; the 95% CIs take into account the complex sampling design.

to be much higher (32.2%) than that in 1992-1997 (23.0%). In industrialized countries, the abundance of cheap energy-dense food, widespread mechanization in agriculture and manufacturing, and the preponderance of motorized transport, translates into little physical activity for a large proportion of the population, both inside and outside of work. This may explain why Chinese women still have lower rates of overweight or obesity than those in developed countries.

In our study, 30.9% of women were free of any risk factors for cardiovascular disease analyzed, in contrast to 34.1%, 21.7%, and 13.3% that had only 1, only 2, or ≥ 3 risk factors, respectively. The prevalence of MI and stroke in the women studied was 0.4% and 0.5%, respectively (Table 2). Therefore, approximately 69.1% Chinese women have at least 1 of the following CVD risk factors: hypertension, abnormal cholesterolemia, overweight and obese, diabetes, or smoking. In addition, clustering of any 2 or ≥ 3 of these risk factors was noted in 21.7% and 13.3%, respectively, suggesting that a large number of Chinese women are at a risk of developing CVD. Clustering of CVD risk factors has also been found in other countries. It has been observed that 21.7% of women in South Korea have ≥ 3 risk factors for developing CVD^[8]. Similarly, in Malaysia, 33% of the

population had ≥ 2 risk factors^[9]. In our study, the prevalence of selected risk factors varied greatly by age, socioeconomic status, and place of residence. Overall, the results indicated that older individuals tended to have more risk factors than younger ones. Age, as an unmodifiable risk factor, was an independent risk factor for hypertension, diabetes, and hypercholesterolemia in Chinese women^[7]. Individuals who had lost life partners or had a lower socioeconomic status were more likely to have multiple risk factors of developing CVD in China. This association provides the key basis for the design of targeted public health intervention programs. Furthermore, the prevalence of ≥ 3 risk factors among urban residents was higher than that among their rural counterparts. Accordingly, CVD incidence and mortality rates in Chinese women have been noted to be higher in urban regions, when compared with rural regions. This may be as a result of the poor access to primary care and poor health education in rural areas, where almost 70% of Chinese women live. Therefore, it is particularly important to reinforce public-health interventions in these rural areas.

A leading cause of mortality in Chinese women is CVD and our evidence indicated that CVD incidence and all-cause mortality substantially increased in the

Table 3. Association of Cardiovascular Disease Risk Factors with Cardiovascular Disease Among Women, China, 2010

Characteristic	OR (95% CI)		
	Model 1 ^f	Model 2 ^g	Model 3 ^h
MI ⁱ			
Hypertension ^a	1.762 (1.222-2.542)	1.527 (1.030-2.263)	1.491 (1.014-2.193)
Abnormal cholesterolemia ^b	1.417 (0.995-2.019)	1.251 (0.872-1.793)	1.278 (0.891-1.833)
Diabetes ^c	1.787 (1.351-2.365)	1.539 (1.128-2.099)	1.602 (1.171-2.192)
Overweight or obesity ^d	1.668 (1.255-2.216)	1.429 (1.039-1.966)	1.466 (1.046-2.054)
Smoking ^e	1.905 (1.280-2.836)	2.033 (1.341-3.084)	1.991 (1.335-2.970)
Stroke ^j			
Hypertension ^a	3.527 (2.466-5.045)	2.844 (1.957-4.134)	2.762 (1.909-3.996)
Abnormal cholesterolemia ^b	2.063 (1.500-2.838)	1.713 (1.235-2.375)	1.726 (1.254-2.375)
Diabetes ^c	2.143 (1.595-2.879)	1.603 (1.185-2.169)	1.607 (1.193-2.163)
Overweight or obesity ^d	2.197 (1.715-2.815)	1.595 (1.219-2.086)	1.530 (1.174-1.994)
Smoking ^e	1.205 (0.756-1.918)	1.333 (0.844-2.107)	1.334 (0.848-2.098)

Note. CI, confidence interval; OR, odds ratio; MI, myocardial infarction. ^aSystolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or on medication for decreasing blood pressure. ^bTotal cholesterol ≥ 240 mg/dL and/or low-density lipoprotein cholesterol ≥ 160 mg/dL and/or high-density lipoprotein cholesterol ≤ 40 mg/dL and/or on medication for regulation blood cholesterol. ^cFasting plasma glucose value ≥ 126 mg / dL and/or 2-hour-post load plasma glucose ≥ 200 mg/dL, and/or on medication for decreasing plasma glucose. ^dBody mass index ≥ 25 kg/m². ^eUse of tobacco every day or on some day at the time of the survey. ^fBeing adjusted for age. ^gBeing adjusted for age and all other major biomedical cardiovascular disease risk factors. ^hBeing adjusted for all variables in model 2 plus education, annual family income, marital status, and residence location. ⁱMI was defined as self-reported history of myocardial infarction. ^jStroke was defined as self-reported history of stroke. ORs were estimated with complex weights.

presence of progressively more risk factors. It is assumed that a high prevalence of risk factors may increase the burden of CVD diseases. One study demonstrated that 87% of hypertension heart disease death, 71% of stroke death, 54% ischemic heart disease, and 41% of other CVD deaths were attributed to hypertension^[10]. In the present study, CVD risk factors were strongly associated with self-reported MI, except for abnormal cholesterolemia (OR, 1.466-1.991), and self-reported stroke, except for smoking (OR, 1.530-2.762), respectively (Table 3). Ample evidence has confirmed that effective population-based interventions, such as improving the diet and increased physical activity, can safely and effectively reduce the prevalence of the aforementioned risk factors and thereby lower the risk of CVD.

In summary, the findings of the present study demonstrate the pervasive burden of CVD and CVD risk factors found in Chinese women. It is crucial to implement interventions to reduce the burden of CVD and CVD risk factors among Chinese women overall and especially to target at-risk groups.

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Table S1. Characteristics of the Study Sample of the 2010 China Disease and Risk Factor Surveillance Survey, China, 2010

Characteristic	Women (n=52,553)	
	No.(%)	Weighted ^a (%)
Age group, years		
18-29	7,305 (13.9)	24.7
30-39	9,783 (18.6)	20.4
40-49	1,3787 (26.2)	21.4
50-59	11,437 (21.8)	16.9
60-69	6,602 (12.6)	9.4
≥70	3,639 (6.9)	7.3
Marital status		
Single	3,287 (6.3)	10.6
Married or cohabiting	43,002 (81.8)	79.3
Separated/divorced/Windowed/others	6,264 (11.9)	10.2
Education		
Illiterate or some primary school	16,165 (30.8)	26.6
Primary school graduate or some junior high school	10,002 (19.0)	18.7
Junior high school graduate or some Senior high school	14,862 (28.3)	31.5
Senior high school graduate or some college	10,380 (19.8)	20.8
College graduate or above	1,144 (2.2)	2.4
Annual family income ^b , US\$		
<895	18,253 (34.7)	51.6
895-1,789	12,075 (23.0)	22.0
1,789-5,372	13,202 (25.1)	24.7
>5,372	896 (1.7)	1.7
Don't know/not sure/refused	8,127 (15.5)	17.6
Place of residence		
Urban	21,306 (40.5)	31.4
Rural	31,247 (59.5)	68.6
Geographic region		
Eastern China	17,786 (33.8)	40.3
Central China	16,288 (31.0)	32.4
Western China	18,479 (35.2)	27.3

Note. US\$, United States dollar. ^aComplex weights were used to obtain nationally representative estimates.
^bBased on the exchange rate of 6.70 renminbi to US\$ 1 that was in effect on 30 September 2010.