Risk factors for noncommunicable chronic diseases in women in China: surveillance efforts

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Objective To investigate risk factors for chronic noncommunicable diseases (NCDs) and their determinants in Chinese women.
Methods Data from the 2010 China Chronic Disease and Risk Factor Surveillance survey, comprising a nationally representative sample of women, were obtained to determine the prevalence of eight risk factors for chronic NCDs: current smoking, harmful use of alcohol, insufficient intake of fruit and vegetables, physical inactivity, overweight and obesity, raised blood pressure, raised fasting blood glucose and raised total serum cholesterol. The mean number of risk factors per woman was estimated. Their independent demographic and socioeconomic covariates were also examined with ordinal logistic regression.
Findings The following prevalences were found: insufficient intake of fruit and vegetables, 51.7%; overweight and obesity, 32.3%; raised blood pressure, 29.7%; physical inactivity, 18.3%; raised total serum cholesterol, 18.1%; raised blood glucose, 7.0%; current smoking, 2.4%; and harmful use of alcohol, 1.3%. The mean number of risk factors per woman was 1.61; 48.0% of the women had at least two risk factors. Women who were older, poorer, from rural areas or from eastern or central China had more risk factors, but only being more than 35 years old, poorly educated and a resident of eastern or central China independently increased the likelihood of having multiple risk factors.
Conclusion Risk factors for chronic NCDs are common among Chinese women aged 18 or older. Interventions to reduce these factors are needed and should target women who are older, who live in eastern or central China or who are poorly educated.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Chronic non-communicable diseases (NCDs) have become the leading causes of death among women in China owing to the substantial decrease in deaths from infectious diseases brought about by decades of economic development and improvements in health care, living conditions and nutrition.[1,2] In 2010, the leading causes of death among Chinese women were cardiovascular and cerebrovascular diseases and cancer, which together accounted for nearly 70% of all deaths.[3] According to the World Bank, the burden of NCDs in both sexes is expected to increase substantially between 2010 and 2030 and the social and economic impact of NCDs will be greatly amplified by the rapid growth of the elderly population and the relative reduction in the workforce if China does not mount an effective response.[4] A small number of modifiable behavioural risk factors are the main contributors to the development of NCDs.[5–7] These behavioural factors – tobacco use, the harmful use of alcohol, physical inactivity and an unhealthy diet – are causes of overweight and obesity, raised blood pressure, raised blood glucose and dyslipidemia, all important biological risk factors for NCDs. A better understanding of the epidemiological distribution of these biological risk factors is necessary to improve preventive measures and design public health interventions for reducing NCDs and the social burden they represent. An important way to gain a better understanding of these risk factors is to monitor their prevalence through surveillance systems and to analyse their social and economic determinants. Accordingly, the global monitoring framework for NCDs of the World Health Organization (WHO) has recommended a set of indicators, to be adopted in national NCD surveillance, for measuring the behavioural and biological risk factors for NCDs.[8] The behavioural risk factors include current tobacco use, harmful use of alcohol, low fruit and vegetable intake, physical inactivity, overweight and obesity; the biological risk factors comprise raised blood pressure, raised blood glucose, raised total serum cholesterol, fat intake and salt intake.

Many studies have examined the prevalence of risk factors for NCDs among Chinese women. The most recent studies have shown that smoking and harmful use of alcohol are found in 2.4% and 15.0% of Chinese women, respectively.[9–11] According to the 2002–2003 World Health Survey, 96.8% of Chinese women consumed insufficient fruit and vegetables, in comparison with 59.3% in Brazil and 74.0% in India.[12] On the other hand, a study of physical activity in 20 countries and regions based on surveys conducted between 2002 and 2004 showed that the rate of physical inactivity among women in mainland China was 6.4%, a figure much lower than in Japan (45.6%); Taiwan, China, (43.3%) and Hong Kong Special Administrative Region of China (16.8%).[13] Longitudinal studies conducted in recent decades have demonstrated an increase in obesity and overweight among Chinese women of all ages.[14–16] China's 2002 Health and Nutrition Survey showed that 18.8% of women in China were either overweight or obese, according to WHO definitions.[17]

Recent national surveys have examined the prevalence of some NCDs. For example, the China National Diabetes and Metabolic Disorders Study, conducted from June 2007 to May 2008, revealed that 8.8% of all women aged 20 years or older had diabetes, 0.51% had coronary heart disease, 0.60% had had a stroke and 1.10% had cardiovascular disease.[18,19] The 2002 China National Nutrition and Health Survey found that 17% of women aged 18 years or older had hypertension.[20] However, the prevalence in China of biological risk factors such as raised blood pressure, raised blood glucose and raised total

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serum cholesterol is still poorly known. The studies conducted in the country so far have generally focused on a single risk factor and have used different target populations, sampling techniques and statistical methods, and they have employed different definitions for the various risk factors examined. As a result, their findings lack comparability and are not amenable to comprehensive analysis. This study was conducted to get a comprehensive picture of the epidemiologic distribution of risk factors for NCDs among women in China. Its specific objective was to investigate the prevalence and determinants of selected behavioural and biological risk factors for NCDs, as defined by WHO, among women in China by using nationally-representative data from China's 2010 Chronic Disease and Risk Factor Surveillance (CCDRFS) survey.

Methods

Surveillance and study sample

The CCDRFS is an ongoing, nationally representative surveillance survey administered by China's National Center for Chronic and Noncommunicable Disease Control and Prevention. The 2010 CCDRFS was carried out from August to November 2010 using the national disease surveillance points system, which encompassed 162 districts/counties and all 31 provinces, autonomous regions and municipalities in mainland China. The establishment, history and degree of representativeness of the national disease surveillance points system are explained elsewhere.[21,22] The ethics committee of the Chinese Center for Disease Control and Prevention approved the 2010 CCDRFS and written informed consent was obtained from each participant before data collection.

The 2010 CCDRFS was conducted by gathering participants in certain central locations. Face-to-face interviews were conducted to collect data on behavioural risk factors for NCDs. For each respondent, height, weight, hip circumference and blood pressure were measured, and the following laboratory tests were conducted: fasting blood glucose and 2-hour oral glucose tolerance tests, blood lipids (total serum cholesterol, triglycerides and high and low density lipoprotein) and glycated haemoglobin (HbA1c). Blood glucose was tested daily at local laboratories; blood lipids and HbA1c were tested in the national laboratory located in Shanghai. More than 2000 investigators – from 10 to 30 per surveillance site – participated in national or provincial training courses and were qualified to engage in field activities after passing standard exams. Standard operational procedures were developed for all physical measurements and laboratory examinations. Detailed information on quality control, laboratory testing procedures, transport of blood samples and the data analysed in the 2010 CCDRFS has been published elsewhere.[23]

Multistage stratified cluster sampling was used to select participants for the 2010 CCDRFS. In the first stage of sampling, four townships were randomly selected from each surveillance district/county using the method of probability proportional to size. Three villages or residential areas were then selected from each chosen township by using the same method as in the previous stage. Subsequently a residential group (at least 50 families) was selected from each chosen village or residential area by simple random sampling. Finally, an individual at least 18 years old was selected in each family by means of a Kish grid. About 9.4% of the sampled families could not be located on three attempts and these households were replaced by others having a similar family structure. A total of 98 712 interviews were conducted and fully completed.

We retrieved data for 53 515 female respondents 18 years of age or older from the 2010 CCDRFS database. After excluding 914 observations with missing values for the risk factors of interest, we were left with data from 52 601 respondents for the final analyses.

Measures

We obtained data on demographic characteristics (age group and marital status), socioeconomic status (educational level and annual per capita household income) and place of residence (rural/urban and geographic region of China). The corresponding subcategories are shown in Table 1. We assessed eight risk factors – five behavioural and three biological – for NCDs as defined by WHO's global monitoring framework for NCDs[8] and by the Chinese standard for harmful use of alcohol.[24] These risk factors were: current smoking status; harmful use of alcohol; insufficient intake of fruit and vegetables; physical inactivity; overweight and obesity; raised blood pressure; raised fasting blood glucose; and raised total serum cholesterol.

All relevant indicators were dichotomized (yes/no). Current smoking was defined as self-reported use of tobacco products (use of cigarettes, pipes, chewing tobacco or snuff) every day or on some days at the time the survey was conducted. Individuals who said they did not smoke during the survey period were classified as non-smokers. In accordance with Chinese dietary standards, harmful use of alcohol was defined as a daily consumption of pure alcohol of 15 g or more.[24] The computation for determining the daily consumption of pure alcohol from various kinds of alcoholic beverages has been described elsewhere.[10] Food frequency questionnaires were used to assess fruit and vegetable intake. A daily intake of less than 400 g of fruit and vegetables combined was considered insufficient. The Global Physical Activity Questionnaire was used to evaluate each respondent's level of physical activity. Physical inactivity was defined on the basis of: (i) the total time engaged in some form of physical activity and the frequency and intensity of the activity in a typical week; (ii) the impact of the activity in terms of metabolic equivalents.[25] Women with less than 150 minutes of moderate activity per week or its metabolic equivalent were defined as insufficiently active. The height and weight of all respondents were used to compute their body mass index (BMI, or weight in kg divided by height in metres squared). Women with a BMI ≥ 25 were classified as overweight or obese. All respondents had their blood pressure measured three times in succession with an electronic upper arm blood pressure monitor (HEM-7071, Omron Healthcare, Inc., Kyoto, Japan), with one-minute intervals between measurements. The average of the last two measurements was used for the analyses. Raised blood pressure was defined as a systolic blood pressure ≥ 140 mmHg and/or a diastolic blood pressure ≥ 90 mmHg. To measure fasting blood glucose, venous blood was drawn with a vacuum tube containing sodium fluoride after study participants had fasted for at least 10 hours. The specimen was centrifuged on site within 2 hours of collection. Plasma glucose was measured in a local hospital laboratory with a glucose metre employing hexokinase or glucose-oxidase. Raised blood glucose

Table 1. **Characteristics of the study sample of the 2010 China Chronic Disease and Risk Factor Surveillance survey, China, 2010**

Characteristic	Women ($n = 52\,601$)	
	No. (%)	Weighted[a] %
Age group (years)		
18–24	4072 (7.7)	15.5
25–34	7159 (13.6)	18.1
35–44	12 774 (24.3)	23.4
45–54	12 587 (23.9)	18.2
55–64	9730 (18.5)	13.6
65–74	4520 (8.6)	7.2
75+	1759 (3.3)	4.1
Marital status		
Single	3276 (6.2)	10.5
Married or cohabiting	43 047 (81.8)	79.3
Separated/divorced/widowed/others	6278 (11.9)	10.2
Education		
Illiterate or some primary school	16 204 (30.8)	26.7
Primary school graduate or some junior high school	10 035 (19.1)	18.8
Junior high school graduate or some senior high school	14 849 (28.2)	31.4
Senior high school graduate or some college	7659 (14.6)	14.9
College graduate or above	3854 (7.3)	8.2
Annual per capita household income[b] (US$)		
< 895	15 853 (30.1)	30.1
895–1789	11 196 (21.3)	20.0
1790–5372	12 142 (23.1)	22.4
> 5372	1224 (2.3)	2.3
Don't know/not sure/refused	12 186 (23.2)	25.2
Place of residence		
Urban	24 686 (46.9)	44.1
Rural	27 915 (53.1)	55.9
Geographic location		
Eastern China	17 750 (33.7)	40.3
Central China	16 353 (31.1)	32.4
Western China	18 498 (35.2)	27.3

US$, United States dollar.
[a] Complex weights were used to obtain nationally representative estimates.
[b] Based on the exchange rate of 6.70 renminbi to US$ 1 that was in effect on 30 September 2010.

was defined as a fasting plasma glucose ≥ 7.0 mmol/L or as being on medication for raised blood glucose. To measure total serum cholesterol, sera were extracted within 2 hours of collection and transported in dry ice by air to the national laboratory in Shanghai Ruijin Hospital, which was certificated by the College of American Pathologists. The sera were stored at −80 °C before being tested in an automatic analyser (Abbott Laboratories, Chicago, United States of America). Raised total serum cholesterol was defined as a total serum cholesterol level ≥ 5.0 mmol/L.

Statistical analysis

In the present study, weighting was conducted in all statistical analyses to obtain nationally representative estimates. The weights were the product of sampling selection weight, which was the reciprocal of the probability of a particular individual being selected, and a post-stratification factor that adjusted for age, rural/urban residence and geographic location in accordance with the 2009 Chinese population estimates obtained from the National Bureau of Statistics of China.

We first determined the characteristics of the study sample and subsequently estimated the prevalences of the eight selected risk factors by demographic characteristics, socioeconomic status, rural/urban residence and geographic location. We conducted Rao-Scott χ^2 tests for each risk factor to test for differences in prevalence by marital status, rural/urban residence and geographic location. We tested for trend in age, education and income by including these ordered categorical variables as a continuous variable in a logistic regression model.[26] We then determined the number of risk factors that each woman had at the time of the survey (from 0 to 8). To reflect clustering within individuals, we examined the mean number of risk factors by covariates. We employed linear regression to test for trend in the number of risk factors by age, education and income. We used analysis of variance to test for differences in the number of risk factors by marital status, rural/urban residency and geographic location. We examined the independent effects of covariates on risk factor clustering within individuals by modelling a multiple ordered logistic regression, with the number of risk factors as the dependent variable.

We carried out all statistical analysis with SAS version 9.3 (SAS Institute Inc., Cary, USA) and estimated confidence intervals (CIs) while accounting for complex sample design by using Taylor's series method with finite population correction.

Results

The characteristics of the study sample are shown in Table 1. Almost one fourth (24.3%) of the women sampled were 35 to 44 years old; nearly one third (30.8%) were illiterate or had not completed primary school; 81.8% were married or cohabiting; 30.1% lived in a family with an annual household per capita income of less than 895 United States dollars, 53.1% resided in a rural area; 35.2% lived in western China. The table also shows the distributions of the various characteristics after weighting to obtain nationally representative estimates.

Risk factor prevalences are shown in Table 2. Of the eight risk factors studied, insufficient intake of fruit and vegetables had the highest prevalence. More than half (51.7%) of the women reported consuming less than 400 g of fruit and

Table 2. **Prevalence (%) of behavioural and biological risk factors for selected noncommunicable diseases among women, China, 2010**

Characteristic	Current smoking[a]	Harmful use of alcohol[b]	Insufficient fruit and vegetable intake[c]	Physical inactivity[d]	Overweight or obesity[e]	Raised blood presssure[f]	Raised blood glucose[g]	Raised total cholesterol[h]
Total	2.4 (1.9–3.0)	1.3 (1.0–1.5)	51.7 (48.7–54.8)	18.3 (16.2–20.4)	32.3 (30.4–34.2)	29.7 (27.6–31.7)	7.0 (6.5–7.6)	18.1 (16.3–19.9)
Age (years)								
18–24	1.0 (0.5–1.4)	0.7 (0.4–1.0)	55.7 (52.3–59.2)	24.5 (21.5–27.5)	15.2 (13.2–17.3)	6.7 (5.1–8.3)	1.9 (1.3–2.6)	9.3 (7.1–11.5)
25–34	1.5 (1.0–2.0)	0.7 (0.5–1.0)	47.9 (44.1–51.7)	17.4 (15.1–19.6)	23.1 (21.0–25.2)	9.8 (8.5–11.1)	2.8 (2.2–3.4)	9.4 (8.2–10.5)
35–44	1.9 (1.4–2.5)	1.2 (0.9–1.5)	49.6 (45.7–53.4)	14.1 (12.0–16.3)	33.3 (31.4–35.3)	20.9 (19.1–22.7)	4.4 (3.7–5.1)	12.9 (11.1–14.7)
45–54	2.5 (1.8–3.3)	1.7 (1.2–2.1)	49.3 (45.6–52.9)	14.1 (12.0–16.2)	43.3 (40.8–45.7)	38.6 (36.2–40.9)	8.6 (7.9–9.4)	23.9 (21.1–26.8)
55–64	3.7 (2.6–4.8)	1.6 (1.1–2.0)	51.4 (47.7–55.1)	15.6 (12.9–18.4)	43.6 (40.8–46.4)	54.5 (51.7–57.3)	13.6 (12.5–14.7)	30.5 (27.6–33.4)
65–74	5.5 (4.1–6.9)	1.8 (1.1–2.4)	58.6 (55.5–61.7)	25.2 (21.4–28.9)	40.5 (37.4–43.6)	65.5 (63.3–67.7)	16.1 (14.7–17.4)	30.4 (27.2–33.5)
>75	5.1 (3.7–6.6)	2.3 (1.2–3.4)	66.1 (62.0–70.3)	38.2 (33.4–43.0)	31.2 (27.5–4.8)	69.8 (66.7–73.0)	15.1 (12.6–17.6)	29.8 (26.7–32.9)
P-value for test for trend	<0.01	<0.01	<0.01	0.10[i]	<0.01	<0.01	<0.01	<0.01
Marital status								
Single	1.3 (0.8–1.7)	0.7 (0.4–1.0)	54.9 (51.5–58.4)	26.9 (23.4–30.4)	12.5 (10.4–14.6)	7.1 (5.7–8.5)	1.8 (1.1–2.5)	8.9 (7.0–10.8)
Married or cohabiting	2.3 (1.7–2.9)	1.3 (1.0–1.6)	50.8 (47.4–54.2)	16.7 (14.5–18.8)	34.4 (32.3–36.4)	30.1 (28.0–32.1)	7.1 (6.6–7.7)	18.3 (16.4–20.2)
Separated/divorced/widowed/others	4.5 (3.5–5.5)	1.8 (1.2–2.3)	55.6 (52.5–58.7)	22.1 (18.7–25.5)	36.6 (33.9–39.2)	50.2 (46.4–53.9)	11.9 (10.3–13.5)	25.5 (22.4–28.6)
P-value for test for differences in means	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Education								
Illiterate or some primary school	3.7 (2.7–4.6)	2.0 (1.5–2.6)	58.6 (54.6–62.5)	19.7 (16.5–22.9)	36.1 (33.7–38.5)	48.4 (44.9–51.9)	10.1 (9.1–11.1)	23.1 (20.8–25.3)
Primary school graduate or some junior high school	3.2 (2.2–4.2)	1.1 (0.7–1.4)	53.8 (49.7–57.9)	16.0 (13.4–18.6)	37.4 (34.7–40.2)	32.2 (29.5–35.0)	7.7 (6.9–8.5)	18.8 (16.5–21.1)
Junior high school graduate or some senior high school	1.9 (1.4–2.3)	0.8 (0.6–1.1)	49.8 (46.5–53.1)	17.2 (15.1–19.3)	31.3 (29.2–33.4)	22.7 (20.5–24.8)	5.5 (5.0–6.1)	15.0 (13.3–16.6)
Senior high school graduate or some college	1.3 (1.0–1.7)	1.0 (0.7–.2)	47.0 (43.4–50.6)	18.6 (16.3–20.9)	27.4 (25.2–29.6)	18.2 (16.5–19.9)	5.4 (4.5–6.2)	17.2 (13.5–20.9)
College graduate or above	0.9 (0.5–1.3)	1.5 (1.1–1.9)	40.9 (36.8–44.9)	22.4 (18.5–26.3)	21.0 (18.5–23.5)	10.6 (9.1–12.1)	4.2 (3.1–5.4)	13.5 (10.5–16.4)
P-value for test for trend	<0.01	<0.01	<0.01	0.62	<0.01	<0.01	<0.01	<0.01
Annual per capita household income[j] (US$)								
<895	2.6 (1.9–3.3)	1.3 (0.9–1.8)	54.0 (49.5–58.5)	18.6 (15.4–21.9)	34.4 (31.7–37.2)	34.3 (30.7–38.0)	6.9 (6.0–7.8)	18.7 (16.6–20.8)
895–1789	2.8 (1.9–3.8)	1.1 (0.8–1.5)	51.2 (47.0–55.5)	17.1 (15.0–19.2)	33.8 (31.6–36.0)	28.4 (26.3–30.6)	6.7 (6.0–7.4)	17.0 (15.3–18.7)
1790–5372	2.2 (1.7–2.7)	1.4 (1.0–1.7)	46.5 (42.2–50.8)	16.2 (13.7–18.8)	31.7 (29.2–34.3)	24.1 (21.9–26.4)	7.4 (6.3–8.6)	19.0 (15.3–22.8)
>5372	1.5 (0.7–2.3)	1.6 (0.8–2.4)	44.1 (37.7–50.5)	19.2 (14.9–23.5)	32.2 (26.9–37.4)	22.6 (19.1–26.1)	6.3 (5.0–7.6)	20.9 (15.5–26.3)
Don't know/not sure/refused	2.3 (1.5–3.0)	1.2 (0.8–1.5)	54.8 (50.5–59.1)	20.6 (17.8–23.4)	29.1 (26.5–31.8)	30.7 (27.6–33.8)	7.2 (6.4–8.0)	17.1 (14.9–19.2)
P-value for test for trend	0.08	0.79	<0.01	0.30	0.14[i]	<0.01	0.62	0.75

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Characteristic	Current smoking[a]	Harmful use of alcohol[b]	Insufficient fruit and vegetable intake[c]	Physical inactivity[d]	Overweight or obesity[e]	Raised blood presssure[f]	Raised blood glucose[g]	Raised total cholesterol[h]
Place of residence								
Urban	2.1 (1.7–2.5)	1.2 (0.9–1.4)	47.7 (44.3–51.0)	17.2 (14.8–19.5)	33.3 (31.2–35.3)	27.5 (25.4–29.5)	8.0 (7.2–8.8)	19.2 (16.3–22.1)
Rural	2.7 (1.9–3.5)	1.3 (1.0–1.7)	54.9 (51.0–58.9)	19.2 (16.7–21.7)	31.5 (29.1–34.0)	31.4 (28.8–34.1)	6.3 (5.6–6.9)	17.2 (15.3–19.1)
P-value for test for differences in prevalence	0.06	0.36	0.00	0.12	0.20	< 0.01	< 0.01	0.20
Geographic location								
Eastern China	2.2 (1.5–2.9)	1.4 (1.0–1.8)	50.8 (46.0–55.6)	18.1 (14.6–21.6)	34.8 (31.2–38.5)	30.5 (27.4–33.6)	8.2 (7.2–9.2)	21.4 (17.8–25.1)
Central China	3.1 (1.8–4.3)	1.1 (0.6–1.6)	53.6 (47.2–60.1)	19.7 (15.7–23.7)	32.2 (29.3–35.0)	31.1 (27.9–34.4)	7.0 (6.2–7.8)	16.6 (14.4–18.9)
Western China	2.1 (1.3–2.8)	1.3 (0.8–1.8)	50.9 (46.6–55.1)	17.0 (13.7–20.3)	28.7 (25.5–31.8)	26.8 (22.3–31.3)	5.3 (4.6–6.1)	14.8 (12.3–17.3)
P-value for test for differences in prevalence	0.27	0.66	0.71	0.62	0.04	0.26	< 0.01	< 0.01

CI, confidence interval; US$, United States dollar.

[a] Use of tobacco every day or on some days at the time of the survey.

[b] Consumption of ≥ 15 g of pure alcohol per day.

[c] Consumption of < 400 g of fruit and vegetables per day.

[d] < 150 minutes of moderate activity or their metabolic equivalent per week.

[e] Body mass index ≥ 25 kg/m^2.

[f] Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

[g] Fasting plasma glucose value ≥ 7.0 mmol/L and/or on medication for raised blood glucose.

[h] Total cholesterol ≥ 5.0 mmol/L.

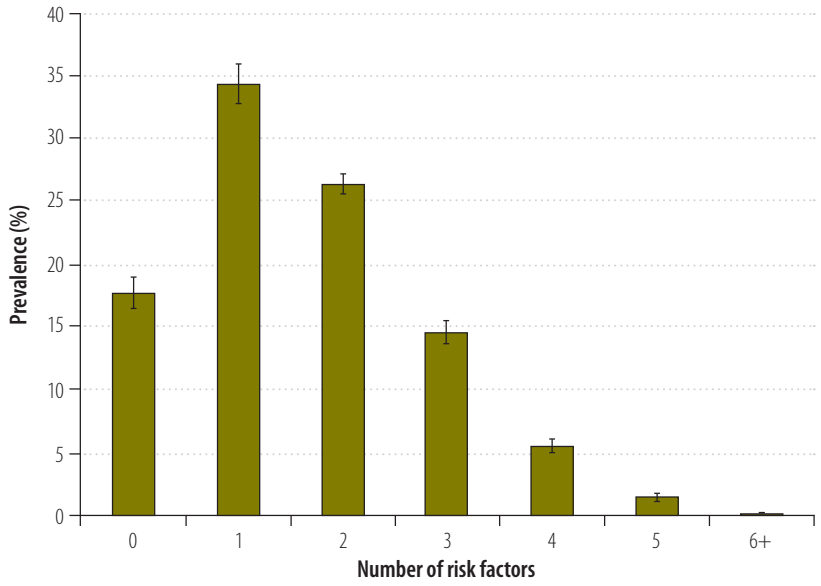
[i] *P*-value for test for differences in prevalence < 0.01.

[j] Based on the exchange rate of 6.70 renminbi to US$ 1 that was in effect on 30 September 2010.

Note: The values in the columns are all percentages and 95% CIs unless otherwise indicated. All prevalences were weighted with complex weights; the 95% CIs take into account the complex sampling design.

Source: Data from the 2010 China Chronic Disease and Risk Factor Surveillance survey.

Fig. 1. **Prevalence of multiple risk factors for noncommunicable diseases in women 18 years of age or older, China, 2010**



Note: All prevalences were weighted with complex weights. 95% confidence intervals take into account the complex sampling design.
Source: Data from the 2010 China Chronic Disease and Risk Factor Surveillance survey.

vegetables per day. The prevalences of other risk factors, in descending order, were as follows: overweight and obesity, 32.3%; raised blood pressure, 29.7%; physical inactivity, 18.3%; raised total serum cholesterol, 18.1%; raised blood glucose, 7.0%; current smoking, 2.4%; and harmful use of alcohol, 1.3%. All risk factors except for physical inactivity showed a similar association with age, marital status and education: all of them increased significantly with age, showed the highest prevalence among women who were separated, divorced or widowed, and declined with higher educational level. Although we observed no trend for physical inactivity by age and education, women between the ages of 45 and 54 years and those who had finished primary school, or who had attended junior high school without completing, showed the highest levels of physical activity (P for difference in means < 0.01). We observed a negative association between annual per capita household income and fruit and vegetable consumption on the one hand, and raised blood pressure on the other. No other factor showed an association with income. Women who lived in a rural area consumed fewer fruits and vegetables than women from an urban area (54.9% versus 47.4%, respectively) and they also had higher mean blood pressure than those from urban areas (31.4% versus 27.5%, respectively). On the other hand, the prevalence of raised blood glucose was higher among women from urban areas than among those from rural areas (8.0% versus 6.3%, respectively). The prevalence of some risk factors varied by geographic location. For example, higher prevalences of overweight and obesity, raised blood glucose and raised total serum cholesterol were found in women from eastern China than in those from central and western China.

As for the number of risk factors per woman (Fig. 1), only 17.7% of the women had none; 34% had one risk factor; 26.4% had two risk factors; and 21.6% had three or more risk factors.

The average number of risk factors per woman in different subpopulations of women based on demographic characteristics, socioeconomic status and place of residence are shown in Table 3. Overall, the mean number of risk factors per woman was 1.61 and increased significantly with age (P for trend < 0.01). Women between the ages of 18 and 24 years had a mean of 1.15 risk factors and those who were 75 years of age or older had a mean of 2.58 risk factors. The mean number of risk factors was inversely associated with educational level and income. As for place of residence, women from rural areas had a higher mean number of risk factors than women from urban areas (1.65 versus 1.56, respectively); women from eastern China had more risk factors, on average, than women from central or western China (1.67 versus 1.64 and 1.47, respectively).

Table 3 shows the independent effect of various covariates on the clustering of risk factors at the individual level as revealed by ordinal logistic regression. Age, education and geographic location were independently associated with the number of risk factors a woman had. For instance, in women aged 75 years or older, the cumulative odds of having x number of risk factors or more versus having fewer were 8.29 times higher than among women between the ages of 18 and 24 years. The cumulative odds increased steadily with age and decreased with educational level. Women living in eastern and central China were 1.39 and 1.35 times more likely to have x or more risk factors, respectively, than women from western China.

Discussion

In the present study, the prevalence of selected risk factors for NCDs varied greatly. Many risk factors were quite common among Chinese women aged 18 years or older. Age and socioeconomic status exerted a substantial influence on the prevalence of risk factors for NCDs. A large difference in prevalence was found between women from urban and rural areas and those from different parts of China.

The prevalence of each risk factor varied considerably. The prevalence of insufficient intake of fruit and vegetables (51.7%) found in this study was much lower than the estimate for China from the 2003 World Health Survey (96.8%).[12] This large improvement may have been caused primarily by the rise in household disposable income and the increased availability of fruit and vegetables owing to China's booming market economy. Current smoking (2.4%) and harmful use of alcohol (1.3%) were the least frequent risk factors, perhaps because in China people disapprove of women who smoke or drink. In this study the rate of current smoking was similar to the rate in some other Asian countries where social values are similar to those in China, such as India (2.9%), Thailand (3.1%) and

Table 3. **Mean number of behavioural or biological risk factors for noncommunicable diseases per woman and independent effects of covariates on risk factor clustering in individuals, China, 2010**

Characteristic	Mean number of risk factors (95% CI)[a]	Cumulative OR[b] (95% CI)[a]
Total	1.61 (1.55–1.66)	–
Age group (years)[c]		
18–24	1.15 (1.09–1.21)	Reference
25–34	1.13 (1.07–1.18)	0.91 (0.82–1.02)
35–44	1.38 (1.33–1.44)	1.36 (1.20–1.55)
45–54	1.82 (1.76–1.88)	2.80 (2.45–3.21)
55–64	2.14 (2.06–2.23)	4.45 (3.80–5.21)
65–74	2.43 (2.36–2.51)	6.79 (5.70–8.08)
75+	2.58 (2.46–2.70)	8.29 (6.74–10.20)
Marital status[d]		
Single	1.14 (1.09–1.19)	Reference
Married or cohabiting	1.61 (1.55–1.66)	0.96 (0.87–1.06)
Separated/divorced/widowed/others	2.08 (1.96–2.20)	0.95 (0.83–1.09)
Education[c]		
Illiterate or some primary school	2.02 (1.93–2.10)	Reference
Primary school graduate or some junior high school	1.70 (1.62–1.78)	1.05 (0.96–1.16)
Junior high school graduate or some senior high school	1.44 (1.38–1.51)	0.92 (0.83–1.03)
Senior high school graduate or some college	1.36 (1.31–1.41)	0.80 (0.70–0.92)
College graduate or above	1.15 (1.08–1.22)	0.74 (0.62–0.88)
Annual per capita household income[e] **(US$)**		
< 895	1.71 (1.62–1.80)	Reference
895–1789	1.58 (1.51–1.65)	0.95 (0.85–1.05)
1790–5372	1.49 (1.41–1.56)	0.86 (0.75–0.98)
> 5372	1.48 (1.38–1.59)	0.89 (0.72–1.09)
Don't know/not sure/refused	1.63 (1.55–1.71)	0.95 (0.81–1.12)
Place of residence[f]		
Rural	1.65 (1.58–1.71)	Reference
Urban	1.56 (1.50–1.62)	0.91 (0.77–1.06)
Geographic location[d]		
Western China	1.47 (1.38–1.56)	Reference
Central China	1.64 (1.56–1.73)	1.35 (1.12–1.63)
Eastern China	1.67 (1.58–1.77)	1.39 (1.14–1.69)

CI, confidence interval; OR, odds ratio; US$, United States dollar.

[a] The 95% CIs take into account the complex sampling design.

[b] Cumulative OR from an ordinal logistic regression model with adjustment for all covariates. The number of risk factors was the dependent variable. Each OR reflects the cumulative odds of having *x* or more risk factors versus having fewer against the cumulative odds in the reference group. Hence, the cumulative OR represents the average effect of the covariate on the cumulative odds of having *x* number of risk factors or more.

[c] *P*-value for test for trend < 0.01.

[d] *P*-value for test for differences in means < 0.01.

[e] Based on the exchange rate of 6.70 renminbi to US$ 1 that was in effect on 30 September 2010.

[f] *P*-value for test for differences in means = 0.03.

Note: Means and ORs were estimated with complex weights.

Source: Data from the 2010 China Chronic Disease and Risk Factor Surveillance survey.

Viet Nam (1.4%). It was much lower than in many industrialized countries, such as the Russian Federation (21.7%), the United Kingdom of Great Britain and Northern Ireland (20.6%) and the United States (16.2%).[11] Since what is considered harmful drinking differs from country to country, the findings of the present study do not bear comparison with those of other studies. Only 18.3% of the women did not engage in sufficient physical activity; this corresponds to the lowest prevalence of physical inactivity of any country in the world.[13,27] The explanation for such a low prevalence may be that a large proportion of Chinese women live in rural and undeveloped areas where they work in non-mechanized agriculture and have to transport the products themselves on foot. The prevalence of overweight and obesity in China is much higher today (32.3%) than in 2002 (18.8%).[17] Although it is still much lower than in developed countries such as Australia (56.2% in 2011), England (58% in 2010) and the United States (63.7% in 2010),[28–30] the unprecedentedly high prevalence of overweight and obesity in China calls for urgent public health action. In industrialized countries, the abundance of cheap energy-dense food, widespread mechanization in agriculture and manufacturing and the preponderance of motorized transport translate into little physical activity for a

large fraction of the population both in and outside work. This may explain why China still has lower rates of overweight and obesity than those countries. However, this gap is narrowing as a result of the rapid modernization and urbanization that have taken place in China in recent decades.[31] After accounting for the age differences of study populations in the present study, the prevalence of raised blood glucose and of raised total serum cholesterol in Chinese women was lower than the global estimate for women 25 years of age or older published by WHO in 2008 (8.0% versus 9.2% for raised blood glucose; 19.7% versus 40.0% for raised total serum cholesterol, respectively).[32–34] In China, the prevalence of raised blood pressure among women 25 years of age or older in this study was 33.9%, about halfway between two different global estimates published in 2011 by WHO (24.8% and around 40%).[34,35]

Caution should be exercised when comparing the findings of this study with those of other researchers. We have avoided such comparisons because of the use of different questionnaires and laboratory procedures, different statistical methods and different definitions. Australia, England, the United States and WHO employed different standards for defining harmful drinking and low intake of fruit and vegetables. Comparisons are further complicated by the seasonal variability of some risk factors, such as physical activity and diet. We have therefore compared our findings only with those of studies in which the same definitions, a similar time period and a study population comparable in age to ours were used.

Individual clustering of multiple risk factors, evidenced by the presence of at least two risk factors in almost half of the women in our study, suggests that a large number of Chinese women are at risk for developing chronic diseases. The evidence indicates that healthy behaviours are associated with lower mortality and a lower risk of chronic disease.[36,37] Having two risk factors as opposed to only one increases the risk of death substantially.[38] Risky behaviours related to lifestyle, always hard to change without suitable interventions, are usually established in childhood and often persist in adulthood.[39–41] Appropriate public health interventions should be implemented in China to reduce these risky behaviours and thereby lower the prevalence of the biological NCD risk factors to which they can lead, such as hypertension, raised blood glucose and hypercholesterolemia.

In our study the prevalence of the various risk factors varied by age, socioeconomic status, place of residence and geographic location. Older women had more risk factors than younger ones. There are several possible reasons for this. First, age was an independent risk factor for hypertension, diabetes and hypercholesterolemia in Chinese women.[19,20,42] Second, preventive education on the importance of a healthy lifestyle began only a few decades ago; women who already had certain habits acquired at an early age might be prone to develop risk factors in later life. Third, on average older women have lower educational attainment than younger women and their compliance with public health interventions may be lower as well. Furthermore, the present study corroborates the findings of a previous study that, in China, higher socioeconomic status decreases the likelihood of having multiple behavioural risk factors.[43] This association has been pivotal for the design of targeted public health intervention programmes. In our study, women from rural areas had a higher number of risk factors, on average, than those from urban areas. This is perhaps the result of poor access to primary care and poor health education in rural areas. As 55.9% of China's female population live in a rural area, it is crucially important to reinforce health-care and public-health interventions in rural areas to reduce the risk factors for NCDs.

The present study has several limitations. First, the cross-sectional design does not allow for any inferences on causality. Second, all the data collected except for laboratory test results are susceptible to recall bias. Third, a substantial proportion (23.2%) of women did not provide information on household income. As a result, all estimations related to income may be biased. Nonetheless, the CCDRFS is the largest nationwide Chinese survey and is a useful source of data for understanding the risk factors related to NCDs and for informing public health interventions.

In conclusion, several risk factors for NCDs were prevalent among Chinese women 18 years old or older and many women had two or more risk factors. It is imperative that immediate public health policies and interventions be implemented to reduce these risk factors. Such policies and interventions should target in particular older women, those from eastern and central China and those with low educational level. ■

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ملخص

عوامل الاختطار الخاصة بالأمراض المزمنة غير السارية لدى النساء في الصين: جهود الترصد

الغرض تحري عوامل الاختطار الخاصة بالأمراض المزمنة غير السارية ومحدداتها لدى النساء في الصين.

الطريقة تم الحصول على البيانات من استقصاء ترصد الأمراض المزمنة وعوامل الاختطار في الصين لعام 2010، الذي يضم عينة تمثيلية للنساء على الصعيد الوطني، لتحديد مدى انتشار عوامل الاختطار الثمانية للأمراض المزمنة غير السارية، وهي: التدخين في الوقت الراهن، وتعاطي الكحول على نحو ضار، وعدم كفاية المدخول إلى الجسم من الفواكه والخضروات، والخمول البدني وفرط الوزن والسمنة، وارتفاع ضغط الدم، وارتفاع نسبة الغلوكوز في الدم قبل الإفطار، وارتفاع إجمالي مستوى الكولسترول في مصل الدم. وتم تقدير متوسط عدد عوامل الاختطار لكل امرأة. وتم كذلك دراسة متغيراتها المستقلة الديمغرافية والاجتماعية والاقتصادية باستخدام الارتداد اللوجيستي الترتيبي.

النتائج تم اكتشاف معدلات الانتشار التالية: كان معدل الانتشار

الخاص بعدم كفاية المدخول إلى الجسم من الفواكه والخضروات 51.7 ٪؛ وبفرط الوزن والسمنة 32.3 ٪؛ وبارتفاع ضغط الدم 29.7 ٪؛ وبالخمول البدني 18.3 ٪؛ وبالارتفاع الإجمالي في مستوى الكولسترول في مصل الدم 18.1 ٪؛ وبارتفاع نسبة الغلوكوز في الدم 7.0 ٪؛ وبالتدخين في الوقت الراهن 2.4 ٪؛ وبتعاطي الكحول على نحو ضار 1.3 ٪. وكان متوسط عدد عوامل الاختطار لكل سيدة 1.61؛ وكان لدى 48.0 ٪ من السيدات عاملا اختطار على الأقل. وكان لدى السيدات الأكبر سناً أو الأفقر أو اللاتي يعشن في مناطق ريفية أو من شرق أو وسط الصين عدد أكثر من عوامل الاختطار، غير أنه زادت، على نحو مستقل/ احتمالية الإصابة بالعديد من عوامل الاختطار لدى النساء اللاتي تزيد أعمارهن عن 35 عاماً وينخفض لديهن مستوى التعليم ويعشن في شرق أو وسط الصين.

الاستنتاج عوامل الاختطار للأمراض المزمنة غير السارية شائعة بين النساء الصينيات اللاتي تبلغ أعمارهن 18 عاماً أو أكثر. ويجب إجراء تدخلات لتقليل هذه العوامل وينبغي استهداف السيدات الأكبر سناً، اللاتي يعشن في شرق أو وسط الصين أو اللاتي ينخفض لديهن مستوى التعليم.

摘要

中国女性非传染性慢性疾病危险因素：监控工作

目的 调查中国女性慢性非传染性疾病（NCD）的风险因素及其决定因素。

方法 从 2010 年中国慢性疾病和风险因素检测调查结果中获取包含全国女性具有代表性的样本数据，来确定慢性 NCD 的八个普遍风险因素：当前吸烟、酗酒、水果和蔬菜摄入量不足、身体缺乏运动、超重和肥胖、血压高、空腹血糖和血清总胆固醇高。估计每个女性风险因素的平均数。还使用有序逻辑回归调查独立人口统计和社会经济变量。

结果 发现以下的因素普遍率：水果和蔬菜摄入量不足，51.7%；超重和肥胖，32.3%；血压高，29.7%；身体缺乏运动，18.3%；血清总胆固醇高，18.1%；血糖高，7.0%；当前吸烟，2.4%；酗酒，1.3%。每个女性的风险因素平均数是 1.61；48.0% 女性至少有两个风险因素。年老、贫穷、来自农村或者中国东部或中部的女性风险因素更多，但是只有超过 35 岁、教育程度不高并且居住在中国东部或中部的女性面临更高的独立多风险因素可能性。

结论 中国 18 岁及以上女性的慢性 NCD 风险因素很普遍。有必要进行减少这些因素的干预，并且应针对老年、居住在中国东部或中部以及教育程度不高的女性。

Résumé

Facteurs à risque pour les maladies non transmissibles chroniques chez les femmes en Chine: efforts de surveillance

Objectif Analyser les facteurs à risque pour les maladies non transmissibles (MNT) chroniques et leurs déterminants chez les femmes chinoises.

Méthodes Des données de l'enquête de surveillance des maladies chroniques et des facteurs à risque de 2010 en Chine couvrant un échantillon de femmes représentatif à l'échelle nationale ont été collectées pour déterminer la prévalence de huit facteurs à risque pour les MNT chroniques: tabagisme, consommation nocive d'alcool, consommation insuffisante de fruits et légumes, sédentarité, surpoids et obésité, hypertension artérielle, hyperglycémie et hypercholestérolémie. Le nombre moyen de facteurs à risque par femme a été estimé. Les covariables démographiques et socioéconomiques indépendantes ont également été analysées au moyen d'une régression logistique ordinaire.

Résultats Les prévalences suivantes ont été constatées: consommation insuffisante de fruits et légumes, 51,7%; surpoids et obésité, 32,3%; hypertension artérielle, 29,7%; sédentarité, 18,3%; hypercholestérolémie, 18,1%; hyperglycémie, 7,0%; tabagisme, 2,4%; consommation nocive d'alcool, 1,3%. Le nombre moyen de facteurs à risque par femme était de 1,61; on a constaté au moins deux facteurs à risque chez 48,0% des femmes. Les femmes plus âgées, plus pauvres, provenant de régions rurales ou de Chine centrale ou orientale présentaient plus de facteurs à risque mais le fait d'être âgée de plus de 35 ans, peu éduquée ou d'habiter en Chine centrale ou orientale augmentait indépendamment la probabilité de présenter des facteurs à risque multiples.

Conclusion Les facteurs à risque pour les MNT chroniques sont courants parmi les femmes chinoises âgées de 18 ans ou plus. Les interventions visant à réduire ces facteurs sont nécessaires et devraient s'adresser à des femmes plus âgées, vivant en Chine centrale ou orientale, ou peu éduquées.

Резюме

Факторы риска неинфекционных хронических заболеваний у женщин в Китае: попытки изучения

Цель Изучение факторов риска хронических неинфекционных заболеваний (НИЗ) и их детерминант у китаянок.

Методы Были собраны данные исследования эпиднадзора за хроническими заболеваниями факторами риска в Китае в 2010 году, включившего национально репрезентативную выборку женщин, с целью определения распространенности восьми факторов риска развития хронических неинфекционных заболеваний: активное курение, вредное употребление алкоголя, недостаточное потребление фруктов и овощей, недостаток физической активности, избыточный вес и ожирение, повышенное кровяное давление, повышенное содержание глюкозы в крови натощак и повышенное содержание общего сывороточного холестерина. Было рассчитано среднее число факторов риска на одну женщину. Также с применением порядковой логистической регрессии были рассмотрены независимые демографические и социально-экономические ковариативные факторы.

Результаты Были обнаружены следующие показатели распространенности: недостаточное потребление фруктов и овощей — 51,7%; избыточный вес и ожирение — 32,3%; повышенное кровяное давление — 29,7%; недостаток физической активности — 18,3%; повышенное содержание общего

сывороточного холестерина — 18,1%; повышенное содержание глюкозы в крови — 7,0%; активное курение — 2,4%; вредное употребление алкоголя — 1,3%. Среднее число факторов риска на одну женщину составляло 1,61; 48,0% женщин имели по крайней мере два фактора риска. Больше факторов риска было у женщин старшего возраста, более бедных, из сельской местности или из восточной или центральной части Китая, но присутствие хотя бы одного из этих факторов — возраст старше 35 лет, малообразованность и проживание в восточной или центральной части Китая, независимо увеличивало вероятность наличия нескольких факторов риска.

Вывод Факторы риска развития хронических неинфекционных заболеваний являются общими для китаянок в возрасте от 18 лет и старше. Мероприятия по снижению этих факторов необходимы. Они должны быть нацелены на женщин старшего возраста, проживающих в восточной или центральной части Китае или имеющих низкий уровень образования.

Resumen

Los factores de riesgo de las enfermedades crónicas no transmisibles en las mujeres chinas: los esfuerzos de vigilancia

Objetivo Investigar los factores de riesgo de las enfermedades crónicas no transmisibles (ENT) y sus factores decisivos entre las mujeres chinas.

Métodos Se extrajeron los datos del Estudio sobre enfermedades crónicas y control de los factores de riesgo en China realizado en 2010, que incluye una muestra representativa a nivel nacional de las mujeres, a fin de determinar la prevalencia de ocho factores de riesgo causantes de enfermedades no transmisibles crónicas: tabaquismo, consumo nocivo de alcohol, ingesta insuficiente de frutas y verduras, inactividad física, sobrepeso y obesidad, presión arterial elevada, nivel elevado de la glucemia en ayunas y nivel elevado del colesterol de lipoproteínas de baja densidad. Se calculó el promedio de factores de riesgo por mujer. Asimismo, se analizaron las covariables demográficas y socioeconómicas independientes mediante una regresión logística ordinal.

Resultados Se hallaron las siguientes prevalencias: ingesta insuficiente de frutas y verduras en el 51,7 %, sobrepeso y obesidad en el 32,3 %, presión arterial elevada en el 29,7 %, inactividad física en el 18,3 %, nivel elevado del colesterol de lipoproteínas de baja densidad en el 18,1 %; nivel elevado de glucosa en sangre en el 7,0 %, tabaquismo en el 2,4 % y consumo nocivo de alcohol en el 1,3 %. El promedio de factores de riesgo por mujer fue de 1,61. El 48,0 % de las mujeres presentaban al menos dos factores de riesgo. Los factores de riesgo eran más elevados entre las mujeres más pobres y de edad más avanzada de las zonas rurales, o del este o centro de China. Sin embargo, las probabilidades de presentar factores de riesgo múltiples aumentaban independientemente por el único hecho de ser mayor de 35 años, tener una educación deficiente y residir en el este o el centro de China.

Conclusión Los factores de riesgo de las enfermedades no transmisibles crónicas son comunes entre las mujeres chinas a partir de los 18 años. Para reducir estos factores, son necesarias intervenciones dirigidas a mujeres mayores, con una educación deficiente o residentes en el este o el centro de China.

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