Prevalence of Clustering for Current Smoking, Current Drinking and Components of Metabolic Syndrome among Adults of Lanxi, Heilongjiang, China

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Abstract

A total of 2967 participants were surveyed in a poor county of Heilongjiang by a stratified randomized cluster sampling. Information on CVD risk factors was collected with standardized questionnaires and Laboratory Measurements during 2006 to 2007.Overall, 93.65%, 73.71%, 46.29%, 21.55% and 6.99% of rural residents had $\geq 1, \geq 2, \geq 3, \geq 4$ and ≥ 5 modifiable CVD risk factors (serum triglycerides(TG), high density lipoprotein cholesterol(HDL-C), hypertension, diabetes, current smoking, current drinking and overweight. Both hypertension prevalence and diabetes prevalence increased with age, but HDL-C prevalence decreased with age among both men and women (each P for trend, < 0.001). TG, current drinking and current smoking prevalence decreased with age (each P for trend, < 0.05, except for overweight and MS, each P for trend, > 0.05) Among men. While, TG, current drinking, current smoking and MS prevalence increased with age (each P for trend, < 0.001) among women. In a multivariate model including age and sex, the odds ratio (95% confidence interval [CI]) of having $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 CVD risk factors versus none of the studied risk factors were 3.15(95%CI, 1.92-5.16), 3.73(95%CI, 2.27-6.13), 4.31(95%CI, 2.59-7.17), 5.24(95% CI, 3.04-9.03), and 9.29(95% CI, 4.78-18.06), respectively, for Chinese adults 65 to 74 years old versus 35 to 44 years old; 1.77(95%CI, 1.28-2.45), 1.98(95%CI, 1.42-2.74), 2.39(95%CI, 1.70-3.35), 2.40(95% CI, 1.66-3.74), and 2.79(95% CI, 1.77-4.40), respectively, for men compared with women.

Keywords Smoking, Drinking, Metabolic Syndrome, Clustering, Prevalence

1 Introduction

The term "metabolic syndrome"(MS) refers to the clustering of visceral adiposity, hyperglycemia, high blood pressure(BP) and dyslipidemia[1-2] ,associated with increased risk of cardiovascular disease(CVD). Drinking and smoking are considered as risk factors of CVD. CVD accounts for half of noncommunicable diseases deaths worldwide, 16.7 million in 2002[3]. Nowadays, CVD are not exclusive in developed countries. The majority of those deaths ($\approx$ 9.1 million) occurred to economically developing countries, and much of the burden of CVD in developing countries occurs to China[4-5]. Since the reform and opening-up in 1978, infectious diseases has declined, but changes in lifestyle and diet have led to an increase in life expectancy, a greatly increased frequency of CVD and other chronic diseases[6-7] in China. Heilongjiang province located in the northeast of china. Lanxi county is about 60 kilometers in the north of Harbin city, Heilongjiang. Although at the beginning of opening-up and reform in China, Lanxis economy was among poor counties of nation, and its economic is still lagging behind other developed regions, the income and lifestyle of residents have greatly changed during recent decade. Although prevalence and risk factors of CVD in the developed country or developed population were paid much attention to, but little we known about prevalence and risk factors of CVD in the poor population in the rural. In order to provide important information and health education programs to policy makers in economic poverty county of Heilongjiang province, it is important to quantify the proportion of the population at high risk for CVD. Such data provide an understanding of the size of the population in need of targeted interventions to lower the population burden of illness due to CVD. The goal of this study was to quantify the proportion of adult residents in poor economic county who had 1 or more of the following major modifiable CVD risk factors: components of metabolic syndrome(which was defined by the International Diabetes Federation(IDF), including overweight, HDL-C, serum triglycerides(TC), hypertension, diabetes),current smoking and current drinking, to determine the percentage of adults with a clustering of 2 or more, 3 or more, 4 or more and 5 or more of these risk factors. This was completed with the use of data collected from rural residents in Lanxi county of Heilongjiang province during 2006 to 2007.

2 Methods

2.1 Study Population

Multi-stage stratified sampling method was used to select a representative sample of the rural residents of Heilongjiang. In the first stage, Lanxi county was selected as poor county, according to economic condition and residents income of Lanxi during 1978 to 2006. secondly, each town was chosen from Lanxi county if its economy was among middle, and then Pingshan was selected as its economy was in the middle level of Lanxi county. Lastly, 11 villages were chosen by randomized method from 35 villages of Pingshan. Total residents, who aged 35 year and lived in the locate villages more than 5 years were considered as subjects, were 3480 persons. 3012 individuals completed the survey and examination, and others were excluded because of absence or denying to answer questions, as well as exclusion criterion: type diabetes, fever, acute infection disease and other factors which influenced measurement of blood pressure, blood glucose or blood lipids. The response rate is 86.55%. At last, 2967 participants aged 35 to 74 (1324 males and 1643 females) were used for analysis.

2.2 Data Collection

Data collection was conducted in examination centers at local health stations in the participants residential area. In a few instances when participants were unable to go to the examination center, the interview and examination were conducted in their homes. During clinic or home visits, trained research staff administered a standard questionnaire. Information on demographic characteristics include age, gender, education, ethnicity, occupation, household income, cigarette smoking, drinking, a self-reported history of stroke, myocardial infarction and congestive heart failure, and the previous diagnosis and treatment of hypertension, high c-holesterol, and diabetes. Smoking prevalence was calculated using data obtained from the self report questionnaire. Current smoker is defined as a person who has smoked cigarettes continuously or accumulatively for over 6 months during his or her life and smoked at least once during the last month before the investigation[8]. current drinker was defined as a person who has drunk beer or wine or distilled spirits at least once a week, apart from drinking in festivals and holidays[9].

2.3 Blood Pressure Measurement

For each participant, after 15 min of sitting, 3 blood pressure measurements were obtained by a trained nurse using a standard sphygmomanometer, which procedures recommended by the American Heart Association[10]. Before their blood pressure measurement for at least 30 minutes, all subjects were advised to avoid alcohol, cigarette smoking, coffee, tea, and excessive exercise. The mean value of three blood pressure measurements was used for this study. Hypertension was defined as an average systolic blood pressure (SBP) $\geq$ 140mm Hg and/or an average diastolic blood pressure (DBP)$\geq$ 90mm Hg and/or self-reported current treatment for hypertension with antihypertensive medication[11-12].

2.4 Measurements of Weight, Height and Waist Circumstance

Body weight, height and waist circumstance were measured by trained and certified observers according to a standard protocol. Subjects wore light clothing and no shoes. Weight was measured to the nearest 0.1kg by using calibrated balance scales placed on a solid horizontal surface. Height was measured to the nearest 0.1cm with a Frankfort plane positioned at a 90° angle against a wall-mounted metal tape by using calibrated stadiometer.

BMI was calculated as weight divided by height squared (kg/m^2). Waist circumference was taken at the midway point between the inferior margin of the last rib and the crest of the ilium in a horizontal plane and measured to the nearest 0.1 cm. Overweight was defined as having a waist circumference$\geq$ 90 cm (man),$\geq$ 80cm (woman)[13].

2.5 Laboratory Measurements

Participants were asked to fast overnight before their study visit, and blood samples, to measure serum lipids and plasma glucose, were drawn by venipuncture. Blood specimens were processed at the field center and then sent to a central clinical laboratory of First Affiliated Hospital of Harbin Medical University in Harbin by bus, where specimens were stored at -70°C until laboratory assays were performed. HDL-C and serum TC were analyzed enzymatically with commercially available reagents[14]. Lipid measurements were standardized according to the criteria of the Centers for Disease Control and Prevention-National Heart, Lung, and Blood Institute Lipid Standardization Program[15]. Abnormal TC was defined as TC $\geq$ 1.7 mmol/L. Abnormal HDL-C was defined as HDL-C $<$ 0.91 mmol/L or self-reported current treatment with cholesterol-lowering medication. For the glucose measurement, whole blood was collected in evacuated tubes containing NaF. Plasma glucose was measured with a modified hexokinase enzymatic method. Diabetes was defined as having a fasting plasma glucose level$\geq$ 7.0 mmol/L and/or self-reported current treatment with antidiabetes medication (insulin or oral hypoglycemic agents).

2.6 The IDF Consensus Worldwide Definition of The Metabolic Syndrome

According to the new IDF definition[13], for a person defined as having the metabolic syndrome they must have Central obesity (defined as waist circumference $\geq$ 90cm for Chinese men or $\geq$ 80cm for Chinese women) plus any two of the following four factors: raised TG level: $\geq$ 1.7 mmol/L, or specific treatment for this lipid abnormality, reduced HDL cholesterol: $<$ 1.03 mmol/L in males and $<$ 1.29 mmol/L in females, or specific treatment for this lipid abnormality, raised blood pressure: systolic BP $\geq$ 130 or diastolic BP $\geq$ 85 mm Hg, or treatment of previously diagnosed hypertension, raised fasting plasma glucose (FPG) $\geq$ 5.6 mmol/L, or previously diagnosed type 2 diabetes, if above 5.6 mmol/L , OGTT is strongly recommended but is not necessary to define presence of the syndrome. In addition, Ethics committees of harbin medical university in china approved the study. Written, informed consent was obtained from each participant before data collection. Participants with untreated conditions, identified during the study, were referred to their usual primary healthcare provider.

2.7 Statistical Methods

Database was set up by EpiData 3.0, and all analyses were conducted with SAS 9.1.3. Analyses were conducted in these survey participants without a history of myocardial infarction, stroke, or congestive heart failure. Crude rate were standardized according to the age distribution for Chinese adults in the year 2000. Participants missing key variables measurements such as smoking, drinking, height, weight, waist circumstances, HDL-C, TG, glucose, and blood pressure were also excluded from the analyses, leaving a final study population of 2967. The prevalence of each CVD risk factor (HDL-C, TC, hypertension, diabetes, current smoking, current drinking and overweight, MS) was determined for men and women separately, by age group (35 to 44, 45 to 54, 55 to 64, and 65 to 74 years), all from rural residence. The prevalence of 0, 1, 2, 3, 4, and 5 CVD risk factors was determined for the overall study population as well as for men and women separately. Then, the percentage of the population with $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 CVD risk factors was determined by age group and sex separately. The significance of the differences in the prevalence of $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 CVD risk factors across subgroups was compared with the Wald-χ^2 test. The adjusted odds ratios(OR) and 95% confidence intervals (CI) of having $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 major CVD risk factors versus no CVD risk factor were determined from multivariable logistic-regression models that included age group and sex.

3 Results

3.1 Prevalence of CVD Risk Factors in Rural Residents in Heilongjiang

In the 11 villages of Lanxi county, population aged 35 to 74 years, the age standardized prevalence of HDL-C, TG, hypertension, diabetes, current drinking, current smoking, overweight(WC$\geq$ 90(man),$\geq$ 80(woman)) and MS was 31.67%, 13.82 %, 39.26%, 6.49%, 24.65%, 41.81%, 32.86%, 19.84% respectively (Table 1).

Prevalence ± SE

*$HDL-C < 0.91$mmol/L, serum $TG \geq 1.7$ mmol/L, and/or current cholesterol-lowering medication use.

†$SBP \geq 140$mm Hg and/or $DBP \geq 90$mm Hg and/or current antihypertensive medication use. ‡*Fasting* plasma *glucose* $\geq$ 7.0mmol/L and/or current antidiabetes medication use.

§*overweight* was defined as waist circumference (waist circumference $\geq$ 90(man), $\geq$ 80(woman)) SE indicates standard error.

Total SR indicates total standard rate, Standardized on the basis of the year 2000 age distribution of the Chinese population.

The age standardized prevalence of overweight, TG and MS was higher in women than in men (each $P < 0.001$). While hypertension, diabetes, current

Table 1 Age-Standardized Prevalence of CVD Risk Factors among Rural Study Participants in Heilongjiang province

Population Groups	No	TG*	HDL*	Hypertension†	Diabetes‡	Current Drinking	Current Smoking	Overweight§ (90(man)) (80(woman))	MS
Total SR	2967	31.67±0.85	13.82±0.63	39.26±0.90	6.49±0.45	24.65±0.79	41.81±0.91	32.86±0.86	19.84±0.73
Total	2967	32.69±0.86	13.38±0.63	41.32±0.90	6.81±0.46	25.45±0.80	42.67±0.91	33.50±0.87	20.63±0.74
Man									
Overall	1324	31.80±1.28	14.34±0.96	43.96±1.36	6.90±0.70	53.22±1.37	53.59±1.37	21.06±1.12	14.17±0.96
SR Overall	1324	31.34±1.27	13.52±0.94	48.04±1.37	7.48±0.72	53.32±1.37	53.10±1.37	20.77±1.11	14.12±0.96
Age, y									
35-	321	31.78±2.60	17.45±2.11	25.86±2.44	4.67±1.18	52.02±2.79	53.89±2.78	21.81±2.30	14.02±1.94
45-	401	38.90±2.43	14.21±1.74	47.38±2.49	6.23±1.21	59.35±2.45	56.61±2.47	23.19±2.11	15.96±1.83
55-	331	29.31±2.50	10.88±1.71	56.19±2.73	9.37±1.60	56.50±2.72	54.08±2.74	21.15±2.24	14.20±1.92
65-74	271	22.14±2.52	11.07±1.91	65.31±2.89	10.33±1.85	42.07±3.00	45.76±3.03	15.50±2.20	11.44±1.93
Woman									
Overall	1643	33.36±1.16	13.24±0.84	35.39±1.18	6.30±0.60	2.91±0.41	38.03±1.20	43.01±1.22	25.35±1.07
SR overall	1643	33.78±1.17	13.27±0.84	35.91±1.18	6.27±0.60	2.98±0.42	34.27±1.17	43.76±1.22	25.87±1.08
Age, y									
35-	524	20.80±1.77	17.18±1.65	19.47±1.73	2.86±0.73	1.15±0.47	24.05±1.87	34.16±2.07	15.27±1.57
45-	533	36.77±2.09	12.76±1.45	35.65±2.07	6.00±1.03	3.38±0.78	39.77±2.12	48.78±2.17	27.95±1.94
55-	376	40.96±2.54	12.23±1.69	46.81±2.57	7.71±1.38	3.46±0.94	36.44±2.48	48.67±2.58	33.51±2.41
65-74	210	45.71±3.44	6.67±1.72	58.10±3.40	12.86±2.31	5.71±1.60	41.90±3.40	46.19±3.44	35.24±3.30

drinking and current smoking prevalence were higher in men than in women (each $P < 0.001$). There were no significant difference on HDL-C prevalence between woman and man($P > 0.05$). Hypertension and diabetes prevalence increased with age among both men and women (each P for trend, < 0.001). Among men, TG, HDL-C, current drinking and current smoking prevalence decreased with age (each P for trend, < 0.05). Among women, HDL-C prevalence decreased with age ($P < 0.001$). While, TG, current drinking, current smoking and MS prevalence increases with age(each P for trend, < 0.001).

3.2 Prevalence of $\geq 1, \geq 2$, and ≥ 3 CVD Risk Factors in Rural Residents in Heilongjiang

Overall, 4.32% of rural men and 7.98% of rural women, respectively, did not have any of the risk factors investigated(TG, HDL-C, hypertension, diabetes, current drinking, current smoking and, overweight; (Figure 1 and Table 2). CVD risk factors: current smoking, current drinking and component of metabolic syndrome (TG, HDL-C, hypertension, diabetes, overweight)

In contrast, 17.07%, 25.95%, 27.47%, 15.86%, and 9.33% of men and 22.11%, 28.75%, 22.53%, 13.52%, and 5.12% of women had 1, 2, 3, 4 and ≥ 5 of these risk factors, respectively. Overall, 6.35%, 19.86%, 27.50%, 24.73%, 14.56%, and 6.99% of rural adults had 0, 1, 2, 3, 4 and 5 of these risk factors, respectively. In total, 93.65% of the population had 1 or more CVD risk factors (Table 2). The prevalence of $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 major modifiable CVD risk factors was mainly higher at older ages (Table 3; each $P < 0.001$). Also, the age standardized prevalence of $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 risk factors were higher among men compared with women respectively (all $P < 0.05$)(Table 3).

Prevalence±SE; SE indicates standard error; Total SR indicates total standard

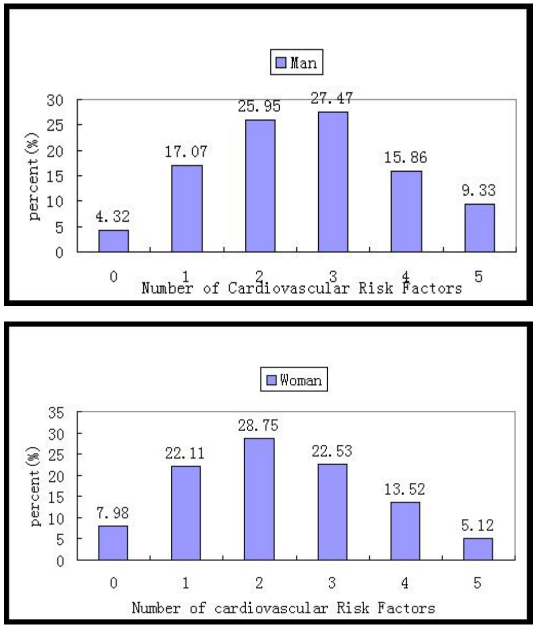

Fig.1 Age-standardized prevalence of CVD risk factors among men and women of poor county in Heilongjiang in China

Table 2 Standardized Prevalence of 0, 1 ,2 ,3 ,4 and $\geq$ 5 Risk Factors among Total and Gender Rural Participants in Heilongjiang Province

	0risk factors N(%SE)	1risk factors N(%SE)	2risk factors N(%SE)	3risk factors N(%SE)	4risk factors N(%SE)	$\geq$ 5risk factors N(%SE)
Age group						
35-	102(12.07±1.12)	227(26.86±1.52)	225(26.63±1.52)	178(21.07±1.40)	85(10.06±1.03)	28(3.31±0.62)
45-	34(3.64±0.61)	172(18.44±1.27)	266(28.51±1.48)	234(25.08±1.42)	151(16.18±1.21)	76(8.15±0.90)
55-	32(4.55±0.78)	107(15.22±1.35)	192(27.31±1.68)	190(27.03±1.67)	130(18.49±1.46)	52(7.40±0.98)
65-74	20(4.18±0.91)	82(17.12±1.72)	131(27.35±2.04)	130(27.14±2.03)	65(13.57±1.56)	51(10.65±1.41)
Woman	137(7.98±0.67)	363(22.11±1.02)	472(28.75±1.11)	370(22.53±1.03)	222(13.52±0.84)	84(5.12±0.54)
Man	57(4.32±0.56)	225(17.07±1.03)	342(25.95±1.20)	362(27.47±1.23)	209(15.86±1.00)	123(9.33±0.80)
Total	188(6.35±0.45)	588(19.86±0.73)	814(27.50±0.82)	732(24.73±0.79)	431(14.56±0.65)	207(6.99±0.47)
Total SR	6.92±0.47	20.80±0.75	27.63±0.82	24.24±0.79	13.83±0.63	6.59±0.46

rate, Standardized on the basis of the year 2000 age distribution of the Chinese population.
Prevalence±SE; N indicates number of participants with risk factors; % indicate prevalence; SE indicates standard error

The adjusted odds ratio of having $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 major modifiable CVD risk factors versus none decreased progressively with increasing age (Table 4). The adjusted odds ratios (95% CI) of $\geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 CVD risk factors for persons 65 to 74 years of age compared with their counterparts 35 to 44 years of age were 2.43 (95% CI, 1.46 to 4.04), 2.96 (95% CI, 1.77 to 4.96), 3.78

Table 3 Prevalence of $0, \geq 1, \geq 2, \geq 3, \geq 4$, and ≥ 5 Risk Factors among Rural Participants in Heilongjiang Province

	0risk factors N(%SE)	≥ 1risk factors N(%SE)	≥ 2risk factors N(%SE)	≥ 3risk factors N(%SE)	≥ 4risk factors N(%SE)	≥ 5risk factors N(%SE)
Age-group						
35-	102(12.07±1.12)	743(87.93±1.12)	516(61.07±1.68)	291(34.44±1.63)	113(13.37±1.17)	28(3.31±0.62)
45-	34(3.64±0.61	899(94.36±0.61)	727(77.92±1.360)	461(49.41±1.64)	227(24.38±1.41)	76(8.15±0.90)
55-	32(4.55±0.78)	671(95.45±0.78)	564(80.23±1.50)	372(52.92±1.88)	182(25.89±1.65)	52(7.40±0.98)
65-74	20(4.18±0.91)	459(95.82±0.91)	377(78.71±1.87)	246(51.36±2.28)	116(24.22±1.96)	51(10.65±1.41)
Woman	131(7.98±0.67)	1511(92.02±0.67)	1148(69.91±1.13)	676(41.17±1.21)	306(18.64±0.96)	84(5.12±0.54)
Man	57(4.32±0.56)	1261(95.68±0.56)	1036(78.60±1.13)	694(52.66±1.37)	332(25.19±3.27)	123(9.33±0.80)
total	188(6.35±0.45)	2772(93.65±0.45)	2184(73.78±0.81)	1370(46.28±0.92)	638(21.55±0.75)	207(6.99±0.47)

(95% CI, 2.24 to 6.40), 4.62(95% CI, 2.62 to 8.15) and 7.39(95% CI,3.68 to 14.84), respectively. In addition, after multivariable adjustment, men were more likely to have $\geq 1, \geq 2$, and ≥ 3 CVD risk factors compared with women, respectively (all $P < 0.001$)(Table 4).

Table 4 Standardized Prevalence of 0, 1 ,2 ,3 ,4 and $\geq$ 5 Risk Factors among Total and Gender Rural Participants in Heilongjiang Province

	≥ 1risk factors	≥ 2risk factors	≥ 3risk factors	≥ 4risk factors	≥ 5risk factors
Age group					
35-	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)	1.00(ref)
45-	3.56(2.38-5.31)	4.19(2.80-6.29)	4.86(3.20-7.39)	5.85(3.71-79.23)	7.28(4.01-13.22)
55-	2.76(1.83-4.17)	3.41(2.25-5.17)	4.07(2.65-6.25)	5.07(3.17-8.10)	5.10(2.73-9.52)
65-74	2.43(1.46-4.04)	2.96(1.77-4.96)	3.78(2.24-6.40)	4.62(2.62-8.15)	7.39(3.68-14.84)
Male-gender	1.77(1.28-2.45)	1.98(1.42-2.74)	2.39(1.70-3.35)	2.40(1.66-3.47)	2.79(1.77-4.40)

*All variables (age group, gender) were included in the same models. For example, the odds ratios for age group were adjusted for gender, the odds ratios for gender were adjusted for age group.
†Risk factors include components of metabolic syndromeoverweight, WC≥90 cm(man) or ≥80 cm(woman), HDL-C ≤0.91 mmol/L, TG≥1.7 mmol/L, or on cholesterol-lowering medication, hypertension(SBP≥140 and/or DBP≥90 or on high blood pressure medication), diabetes (fasting plasma glucose ≥7.0 mmol/L or on antidiabetes medication), current smoking and current drinking.

4 Discussion

The metabolic syndrome is a common risk factor for cardiovascular diseases. Individuals with this syndrome have an increased risk of developing cardiovascular disease(CVD)[16]. Sandra Costa Fuchs et al[17] revealed that hypertension, diabetes mellitus, obesity, low fruit and vegetable intake, and lack of vigorous or moderate physical activity were clustered into a combination of risk factors, which were independently associated with self-reported cardiovascular disease. A populationCbased, cross-sectional national health examination survey(1998) of 8,816 subject aged 15-79 [18] showed that clustering of 3 or more CVD risk factors was 22.7% in man and 21.7% in women. Using $< 21kg/m^2$ as a referent, subjects with BMI of $23kg/m^2$ and $27kg/m^2$ had an odds ratio of 3.5 and 10.2 in men, and 3.1 and 6.7 in women, respectively, for clustering of CVD risk factors. Using <65 cm as a referent, subjects with WC of ≥90 cm in man and ≥80 cm in women had an odds ratio of 13.4 and 13.6, respectively, for clustering of CVD risk factors. A study[19] explored how to influence effect of risk factors on coronary artery disease(CAD) when the age gap between men and women narrows, indicated that hypertension, diabetes, dyslipidemia and family history were independent risk factors for women with stable CAD. Clustering of traditional risk factors may explain the precocity of CAD in women who are near in age to men. A study from Souss, Tunisia[20] for clustering of cardiovascular risk factors among obese urban school children showed that obese children were found to have higher blood pressure, higher TG levels and lower HDL-C than children of normal weight. This results indicated that clustering of cardiovascular risk factors among obese is no longer limited to industrialized countries. Another study from Japan[21] for multiple risk factors clustering and risk of hypertension, which 5275 Japanese male office workers aged 23-59 years were involved, showed that after controlling for potential risk factors of hypertension, the odds ratio of hypertension compared with the absence of risk factors was 1.91, 2.65, 3.88, 6.54, and 8.18 for the presence of 1, 2, 3, 4, and 5 risk factors, respectively (each P for trend < 0.001). The results indicated that the accumulation of risk factors is highly associated with the increased risk of hypertension in Japanese men.

Multicentre collaborative study showed that high levels of CVD risk factors are common in many economically developing countries[22]. In a study of 7 economically developing countries, as many as 78%, 46%, 50%, and 20% of adults in 1 or more countries were current cigarette smokers, had a high cholesterol level, were overweight, and had hypertension, respectively[22]. These risk factors have emerged as important characteristics in predicting CVD morbidity and mortality in economically developing countries, including China[23].

Result from international collaborative study of cardiovascular disease in Asia[24] showed that 80.5%, 45.9%, and 17.2% of Chinese adults had $\geq 1, \geq 2$, and ≥ 3 modifiable CVD risk factors (dyslipidemia, hypertension, diabetes, cigarette smoking, and overweight), respectively. By comparison, 93.1%, 73.0%, and 35.9% of US adults had $\geq 1, \geq 2$, and ≥ 3 of these risk factors, respectively. In a multivariate model including age, sex, and area of residence, the odds ratio (95% confidence interval [CI]) of having $\geq 1, \geq 2$, and ≥ 3 CVD risk factors versus none of the studied risk factors were 2.61 (2.09-3.27), 3.55 (2.77-4.54) and 4.97 (3.67-6.74), respectively, for Chinese adults 65 to 74 years old versus 35 to 44 years old; 3.65 (3.21-4.15), 4.67 (4.06-5.38), and 5.60 (4.70-6.67), respectively, for men compared with women; 1.18 (1.07-1.30), 1.34 (1.21-1.50), and 1.84 (1.60-

2.12), respectively, for urban compared with rural residents; and 1.98 (1.76-2.22), 2.75 (2.42-3.13), and 4.36 (3.68-5.18), for residents of northern compared with southern China, respectively.

The present study indicates that 93.65% rural adults aged 35 to 74 years have at least 1 of the following CVD risk factors: current smoking, current drinking and component of syndrome (TG, HDL, hypertension, diabetes, and overweight). In addition, clustering of 2 or more, 3 or more, 4 or more or 5 or more of these risk factors was noted in 73.78%, 46.28%, 21.55% and 6.99 of rural adults, respectively. The significantly higher prevalence of $\geq 1, \geq 2, \geq 3, \geq 4$ and ≥ 5 risk factors in men compared with women may be due to the fact that 43.96% of rural men versus 35.39% of women were hypertension, 6.90% of rural men versus 6.30% of women were diabetes, 53.22% of rural men versus 2.91% of women were current drinker and 53.59% of rural men versus 38.03% of women were current smokers. Although the prevalence of current smoking and current drinking of men was higher than those of women, the prevalence of current smoking and current drinking decrease with age in man. In contrast, the prevalence of current smoking and current drinking increase with age in woman. The prevalence of MS in woman was higher than that in man.

In this study, we selected components of metabolic syndrome which is defined by IDF, current smoking and current drinking to estimate prevalence of cardiovascular disease. Indexes we selected were different from international collaborative study in Asia[24]. There were some reasons. Firstly, components of MS are considered as risk factors of cardiovascular diseases, and prevalence of MS increase with age. secondly, prevalence of CVD, which involved components of metabolic syndrome, is limited. lastly, drinking should be considered as risk factors of cardiovascular diseases in our clustering analysis.

This study contains the facts that its results are based on findings in 11villages, representative sample of the residents in the poor county, which allows for calculation of rural representative estimates. Otherwise, standard protocols and instruments were used, 86.55% response rate was achieved, and the trained investigators were very careful to collect data.

This is a cross-sectional study, which assesses the prevalence of several CVD risk factors. A limitation of the study was its reliance on estimates derived from a cross-sectional study. Cross-sectional study has demonstrated the importance of these risk factors to the development of CVD, but cross-sectional study do not allow for quantification of the importance of risk factor clustering in the incidence of CVD. Further design and statistics methods are needed[25-27].

In all, 93.65%, 73.78%, 46.28%, 21.55%, 6.99% have $\geq 1, \geq 2, \geq 3, \geq 4, \geq 5$ of the CVD risk factors investigated in the current study, respectively. It was noted that hypertension and diabetes prevalence increased with age among both men and women (each P for trend, <0.001). At the same time, among women, current drinking, current smoking and MS prevalence increases with age(each P for trend, <0.001). Effective interventions for farmers such as improved diet, suitable drinking, smoking cessation and increased physical activity can safely and effectively lower the risk of CVD[28-29]. Local government should take measure to prevent, detect and treat metabolic syndrome, and improve lifestyle in order to decrease the burden of CVD in the rural residents in the poor county.

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