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The Morbidity Rate of Chronic Disease among Chinese Rural Residents: Results from Liuyang Cohort

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Key Words

Chronic disease · Epidemiology · Risk factors · Prevalence rate · Rural residence · China

Abstract

Objective: To study the health status and explore the putative risk factors of chronic diseases among a Chinese rural population. ***Subjects and Methods:*** Face-to-face interviews were carried out to collect the information of social characteristics, health status and related risk factors of 11,909 families comprised of 49,383 subjects in the rural area of Liuyang, Hunan province during 2007. Chronic disease was diagnosed according to the diagnosis certification from the town clinic or superior level hospital. ***Results:*** The morbidity rate of chronic disease among Liuyang rural residents in 2007 was 19.22%. The prevalence of the top 10 chronic disorders was as follows: hypertension: 3.65%; urolithiasis: 1.03%; chronic obstructive pulmonary disease: 0.92%; ischemic heart disease: 0.92%; chronic gastritis: 0.91%; cerebrovascular disease: 0.71%; lumbar disk disease: 0.61%; chronic viral hepatitis: 0.55%; gallstones: 0.54%, and diabetes: 0.54%. Age, gender, educational level, occupation, marital status, type of housing, source of drinking water, smoking, underweight and overweight were factors associated with chronic disease. We also noticed that 14.2% of the residents were underweight and 29.7% are still using unsafe sources of drinking water. ***Conclusions:*** The prevalence of chronic disease in Liuyang area was severe both in communicable and noncommunicable chronic disease. Unhealthy lifestyles such as tobacco usage and overweight partially contributed to the high prevalence of chronic disease.

Introduction

Chronic diseases are a serious threat to health and longevity in developing countries. In all but the poorest countries, death and disability from chronic diseases now exceeds that of communicable diseases [1]. China has grown more affluent in recent years and its health profile has evolved to more closely resemble that of developed nations [2]. Chronic disease problems in China cannot be neglected as it has been reported that over 80% of deaths in China are due to chronic diseases, even in low income areas, and noncommunicable diseases also contributed to 60% of all deaths [3]. Preventing and controlling this growing burden of illness has become a very important public health problem.

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Previous cohort studies [4, 5] have shown that it is appropriate methodology to investigate risk factors of chronic diseases and to implement intervention for them. One of the most well-known and successful cohort studies is the Framingham Heart Study [5], which has lasted for more than 60 years and has identified the major cardiovascular disease (CVD) risk factors as well as a great deal of valuable information on the effects of related factors. This has led to the development of effective treatment and preventive strategies in clinical practice, thus decreasing the incidence of CVD remarkably in the USA [6].

Cohort studies [7, 8] have also been conducted to illustrate the etiology of noncommunicable diseases among the Chinese population. However, these previous cohort studies were conducted in urban areas or for restricted populations. Rural populations have a different health status and types of diseases from urban populations [9]. Moreover, the risk factors of chronic diseases may vary in different areas and effective intervention strategies would vary as well. Therefore, the findings from urban populations would be unsuitable for rural residents of China. Hence, a prospective cohort study was conducted in the rural area of Liuyang in Hunan Province, China, to investigate the health status, types of diseases and major risk factors and to provide data for prevention and health promotion strategies. Here, only the results of the baseline investigation are reported; the results of the follow-up will be reported in later papers.

Subjects and Methods

Study Design and Setting

Liuyang is a 'county-level city' under the jurisdiction of Changsha located in northeast Hunan Province. Liuyang has jurisdiction over 4 city districts and 33 towns with a total population of 1.38 million and has been honored as one of the 'top 100 national strong counties' for several years. The health status of this area is ranked third among Hunan Province county-level cities [10]. The baseline investigation of the cohort population was carried out in January 2008 in the rural area of Liuyang and completed within a month, using a structured questionnaire in a face-to-face interview. All subjects were followed up every 2 years to collect risk factors and medical information.

Subjects

A multistage sampling method was used to select the study subjects. According to the GDP level in the year 2007, all 37 towns of Liuyang County were stratified into rich, moderate and poor rural areas. One town from each economic stratum was selected randomly. Finally, the towns of Zhentou, Sanxiang and Yanghua were selected to represent a rich, moderate and poor area, respectively). Zhentou is one of the richest towns with a large population approximately 3 times more than the population of the other two selected towns. Therefore, one third of the residents in Zhentou and all of the residents in Sanxiang and Yanghua were recruited. Finally, a total of 12,398 families with 52,071 individuals were included in our sample. Of these, 489 families did not answer the questionnaire and were therefore excluded from the study.

Data Collection and Variable Definition

Selected staff of the local Centers for Disease Control and Prevention (CDC) (35 persons) and Health Center (57 persons) were trained to conduct the interviews. The data obtained in the baseline interview included 3 types: basic information, health status and risk factors. Basic information involving family total income in 2007 and living conditions was answered by the head of the family. Health status, social characteristics and risk factors were obtained by self-report from each family member. Health status information of those less than 16 years of age or incapable of talking was given by the head of the family. Chronic disease was diagnosed according to the diagnosis certification from the town clinic or superior level hospital. Those without diagnosis certification were assumed to be normal population. All chronic diseases were classified according to the International Classification of Diseases (ICD-10) code. Weight status was classified according to body mass index (BMI) or BMI-for-age percentile. According to the 2007 WHO growth standards for children [11], the weight status of 5- to 19-year-olds was evaluated by BMI-for-age percentile (<5th percentile = underweight, 5th percentile to <85th percentile = normal and ≥85th percentile = overweight). For those over 19, the recommended BMI value for the Asian population was considered to classify the population (<18.5 = underweight, 18.5–22.9 = normal and ≥23 = overweight) [12]. Four types of water were used for our study area: closed well water, unrefined mountain spring water, open well water and unrefined water from rivers/ponds. The first three sources of water belong to underground water, but mountain spring and open well water are uncovered and could be easily contaminated. Therefore, we defined closed well water as safe drinking water and the other three source of water were considered as unsafe drinking water.

Data Analysis

A data bank using Epidata 2.0 was compiled and a statistical analysis was conducted using SAS 9.0. The basic analyzed unit was the individual in our research. One person may have had more than one diagnosis of chronic disease. The morbidity rate for chronic diseases presented in our study equals the number of reported cases divided by the total observed population. The comparison of the morbidity rate of chronic diseases in different characteristic groups was done by overall χ^2 test ($\alpha = 0.05$). When comparing more than two groups and the group variant was ordinal, the Cochran-Armitage trend test was adopted to test if the rate was linear variation as the group level changed.

Unconditional logistic regression was used to explore putative risk factors respectively for each of the top 10 prevalent diseases, and resulted in the adjusted odds ratios (ORs). The C statistic of each logistic equation was also estimated to test the effect of explanatory variables on the probability of contracting disease. With or without, the analyzed diseases were used as dependent variables (1 disease was analyzed in one-time regression analysis). Putative risk factor variables that were included in the logistic regression analysis each were as follows: age (<20, 20–34, 35–49, 50–64 and

≥65), gender (male/female), years of schooling (0–6 = 1, 7–9 = 2, 10–12 = 3 and ≥13 = 4), occupation (agricultural labor, factory labor, commercial/service-industry employee, self-employed/private businesses, technical/administrative staff, student, retired or unemployed, agricultural labor as the reference), marital status (never married, married, remarried, divorced, widowed but unmarried, married as reference), housing (concrete/brick structure or adobe/sod/wood house), water (safe or unsafe water), smoking (yes, no), and weight status (underweight, normal or overweight, normal as reference).

Results

Among the 49,383 subjects, 25,541 (51.7%) were male and 23,842 (48.3%) female. The average family size was 4.15. The mean and standard variance of age, years of school of all subjects and BMI value of those over 19 years of age were 36.91 ± 20.43 years, 5.97 ± 3.24 years, and 20.97 ± 3.25, respectively. The number of smokers was 12,673 (25.7% of total subjects) and 99.96% of those were male. In other words, 49.7% of the male residents smoked. The other characteristics of subjects are given in table 1. The morbidity rate of chronic disease for the three areas had significant statistical difference; the morbidity rate also varied according to age, gender, education, occupation, marital status, housing, drinking water, smoking and weight status groups; trend tests also showed that the morbidity of chronic disease increased as age increased (trend test $z = 73.2$, $p < 0.001$) and decreased as the number of years of education increased (trend test $z = -33.2$ $p < 0.001$). Of the 49,383 residents, 14,693 (29.7%) were using unsafe water, and in particular 76 (0.1%) were still using unrefined water from rivers/ponds. The average income per person in 2007 was RMB 3,430.6 (USD 544.5) and the average annual expenditure was RMB 3,134.3 (USD 497.5). Meanwhile, in 2007, the medical cost per person was RMB 628.1 (USD 99.69), which accounted for 20% of total expenditure.

Morbidity Rate of Chronic Disease

Of the 49,383 residents, 9,599 (19.2%) reported that they had chronic diseases. Of these, 8,051 (83.9%) persons presented the diagnosis certification with 9,492 diagnosed cases. Therefore, the morbidity rate of chronic disease in 2007 was 19.22% (9,492/49,383), and the standardized morbidity rate by sex and age was 19.92%, based on National Health Service Survey data [13]. Analyzed by system, the top 5 prevalent diseases were as follows: circulatory system: 5.83%; digestive system: 2.38%; musculoskeletal system and connective tissue: 2.27%; urogenital system: 1.94%, and respiratory system: 1.51%. The number of persons with diseases of these 5 systems accounted for 72.4% of total chronic disease. Analyzed by disease category, the top 10 prevalent diseases and relevant morbidity rate were: hypertension: I10–I15 (3.65%); urolithiasis: N20–N23 (1.03%); chronic obstructive pulmonary disease (COPD): J40–J44 (0.92%); ischemic heart disease: I20–I25 (0.92%); chronic gastritis: K29.301–K29.707 (0.91%); CVD: I60–I69 (0.71%); lumbar disk disease: M50–M51 (0.61%), chronic viral hepatitis: B15–B19 (0.55%), gallstones: K80 (0.54%), and diabetes: E10–E14 (0.54%).

Only the risk factors with a statistically significant association with 1 of the top 10 diseases in multivariate analysis are listed in table 2. The results of multivariate analysis showed that males were more likely to have chronic gastritis ($OR_{adj} = 1.13$) and lumber disk disease ($OR_{adj} = 1.04$), but less likely to have COPD ($OR_{adj} = 0.95$), gallstones ($OR_{adj} = 0.73$) and diabetes ($OR_{adj} = 0.33$). Age was related to all of the top 10 diseases; the specific associations are listed in table 2. People with a higher educational level had a lower risk of suffering from hypertension ($OR_{adj} = 0.66$). Compared to agricultural labor, unemployment was a risk factor for CVD ($OR_{adj} = 1.42$) and a protective factor for viral hepatitis ($OR_{adj} = 0.31$). Marital status was associated with hypertension, COPD, chronic gastritis and lumbar disk disease. Smoking was related to COPD ($OR_{adj} = 1.88$), ischemic heart disease ($OR_{adj} = 1.21$), chronic gastritis ($OR_{adj} = 1.34$), lumbar disk disease ($OR_{adj} = 1.87$) and gallstone ($OR_{adj} = 2.10$). The relationships between underweight and hypertension ($OR_{adj} = 0.67$), COPD ($OR_{adj} = 1.24$) and lumber disk disease ($OR_{adj} = 0.28$) were statistically significant. Overweight was a risk factor for hypertension ($OR_{adj} = 1.73$) and diabetes ($OR_{adj} = 3.80$) but a protective factor for chronic gastritis ($OR_{adj} = 0.49$; table 2). The C statistics of the logistic equations which manifest the effect of explanatory variables on the probability of contracting each disease were as follows: hypertension: 0.693; urolithiasis: 0.579; COPD: 0.615; ischemic heart disease: 0.622; chronic gastritis: 0.606; CVD: 0.613; lumbar disk disease: 0.599; chronic viral hepatitis: 0.595; gallstones: 0.605; and diabetes: 0.680.

Discussion

In general, the morbidity rate of chronic disease among Liuyang rural residents in 2007 was 19.22%, which was higher than the nationwide rate of 17.10% in

Table 1. Characteristics and morbidity rate of chronic diseases of study population in year 2007

Characteristics	Enrolled subjects		Chronic disease	Morbidity rate, %	p
	n = 49,383	proportion, %			
Age group[a]					<0.001
<5	2,234	4.5	84	3.76	
5–14	4,418	8.9	136	3.08	
15–34	16,483	33.4	1,039	6.30	
36–64	20,752	42.0	5,617	27.07	
≥65	5,496	11.1	2,616	47.60	
Gender					<0.001
Female	23,842	48.3	4,886	20.49	
Male	25,541	51.7	4,606	18.03	
Years of school[b]					<0.001
≤6 years	26,200	53.1	6,531	24.93	
7–9 years	16,983	34.3	2,327	13.70	
10–12 years	4,981	10.1	572	11.48	
≥13 years	1,219	2.5	62	5.09	
Occupation					<0.001
Agricultural labor	26,569	53.8	5,675	21.36	
Factory labor	9,417	19.1	1,110	11.79	
C/S employee[e]	2,048	4.1	231	11.28	
S/P businesses[f]	1,773	3.6	264	14.89	
T/A staff[g]	1,143	2.3	162	14.17	
Student	3,911	7.9	154	3.94	
Retired	255	0.5	170	66.67	
Unemployed	4,267	8.6	1,726	40.45	
Marital status					
Unmarried	16,379	33.2	920	5.62	<0.001
Married	29,739	60.2	7,304	24.56	
Remarried	300	0.6	242	80.67	
Divorced	719	1.5	66	9.18	
Widowed	2,246	4.5	960	42.74	
Type of housing					<0.001
Concrete/brick	42,800	86.6	7,860	18.36	
Adobe/sod/wood	6,583	13.4	1,632	24.79	
Source of water					<0.001
Closed well water	34,690	70.3	6,573	18.95	
Unrefined spring	9,904	20.1	1,904	19.22	
Open well water	4,713	9.5	998	21.18	
Unrefined river/pond	76	0.1	17	22.37	
Smoking					<0.001
No	36,710	74.3	6,648	18.11	
Yes	12,673	25.7	2,844	22.44	
Weight status[d] (n = 47,194)					<0.001
Underweight	6,681	14.2	1,423	21.30	
Normal	36,297	76.9	6,859	18.90	
Overweight	4,216	8.9	1,126	26.71	
Area[c]					<0.001
Zhentou (rich)	17,984	36.4	3,669	20.40	
Sanxiang (moderate)	17,441	35.3	3,369	19.32	
Yanghua (poor)	13,958	28.3	2,454	17.58	

[a] Trends test z = 84.5, p < 0.001. [b] Trends test z = –33.2, p < 0.001. [c] Trends test z = 39.6, p < 0.001. [d] Population over 5 years of age (n = 47,194). [e] Commercial/service-industry employee. [f] Self-employed/private businesses. [g] Technical/administrative.

Table 2. Risk factors with statistical significant association with top 10 diseases in the multivariate conditional logistic analysis, Liuyang rural area, 2007

Disease (ICD-10 code)	Risk factors with statistical significance	OR_{adj} (95% CI)[a]
Hypertension (I10–I15)	year of school	0.66 (0.45, 0.98)
	widowed vs. married	1.20 (1.02, 1.73)
	underweight vs. normal	0.67 (0.46, 0.78)
	overweight vs. normal	1.73 (1.42, 2.61)
	50–64 vs. 20–34 age group	1.63 (1.22, 2.91)
	≥65 vs. 20–34 age group	1.93 (1.64, 3.51)
Renal lithiasis (N20)	50–64 vs. 20–34 age group	1.13 (1.02, 1.82)
	≥65 vs. 20–34 age group	1.21 (1.14, 3.42)
COPD (J40–J44)	unmarried vs. married	2.26 (1.02, 6.39)
	smoking vs. no smoking	1.88 (1.24, 2.90)
	underweight vs. normal	1.24 (1.04, 2.45)
	male vs. female	0.95 (0.70, 0.99)
	≥65 vs. 20–34 age group	1.53 (1.32, 2.45)
Ischemic heart disease (I20–I25)	smoking vs. no smoking	1.21 (1.13, 4.16)
	50–64 vs. 20–34 age group	1.22 (1.12, 2.91)
Chronic gastritis (K29.301–K29.707)	smoking vs. no smoking	1.34 (1.13, 3.77)
	overweight vs. normal	0.49 (0.28, 0.84)
	male vs. female	1.13 (1.02, 3.32)
	35–49 vs. 20–34 age group	1.73 (1.32, 5.32)
Cerebrovascular disease (I60–I69)	unemployed vs. agricultural labor	1.42 (1.09, 3.70)
	≥65 vs. 20–34 age group	1.23 (1.12, 6.01)
Lumbar disk disease (M50–M51)	unmarried vs. married	0.57 (0.29, 0.89)
	smoking vs. no smoking	1.87 (1.20, 6.43)
	underweight vs. normal	0.28 (0.20, 0.62)
	male vs. female	1.04 (1.01, 2.82)
	35–49 vs. 20–34 age group	1.03 (1.02, 1.92)
	50–64 vs. 20–34 age group	1.30 (1.32, 2.01)
	≥65 vs. 20–34 age group	1.41 (1.27, 5.21)
Viral hepatitis (B15–B19)	unemployed vs. agricultural labor	0.31 (0.13, 0.70)
	<20 vs. 20–34 age group	0.57 (0.46, 0.69)
	50–64 vs. 20–34 age group	0.75 (0.42, 0.94)
	≥65 vs. 20–34 age group	0.43 (0.32, 0.90)
Gallstones (K80)	smoking vs. no smoking	2.10 (1.14, 6.76)
	male vs. female	0.73 (0.42, 0.85)
Diabetes (E10–E14)	overweight vs. normal	3.80 (1.28, 7.39)
	male vs. female	0.33 (0.12, 0.76)
	50–64 vs. 20–34 age group	1.23 (1.08, 5.22)
	≥65 vs. 20–34 age group	1.25 (1.12, 6.01)

[a] Variables in regression were years of schooling, occupation, marital status, housing, water, smoking, weight status, gender and age.

2008 for rural residents even after standardization by sex and age (the standardized rate was 19.92%) [13]. Unlike developed countries, chronic hepatitis is one of the top 10 prevalent chronic disorders in the rural area of Liuyang, which indicates that Liuyang is experiencing both communicable and noncommunicable chronic disease burdens. However, while the morbidity of renal urolithiasis is lower than in rural areas of some developed countries [14], it is higher than that of other places in China [2, 13]; the reason is not quite clear and further study is needed.

Our study showed that the prevalence rate of most of the top 10 diseases increased along with aging, but the rate of hepatitis was higher in the 20- to 49-year-old group than in other age groups. Males were more prone to having chronic gastritis and lumbar disk disease than females, but less likely to suffer from COPD, gallstones and diabetes. Such differences between genders have been observed previously [15].

Evidence indicates that socioeconomic status is strongly associated with health [16], and education is always associated with greater health care and awareness [17]. Well-educated individuals suffer less anxiety and depression, endure fewer functional limitations, and face decreased probabilities of being diagnosed with heart conditions, stroke and hypertension [16, 17]. Our study confirmed this observation. Compared to agricultural labor, the unemployed have a higher risk for CVD and lower risk for viral hepatitis. The unemployed person may have had less occupational physical activity and more anxiety than the agricultural laborer, which resulted in higher risk of CVD. Hepatitis virus infection is more likely to be associated with health habits [18]. However, information on personal health habits in the baseline survey was not obtained. The detail mechanism may need further investigation.

The National Health Service Survey [13] showed that the richer the rural area, the higher the morbidity rate. Our study also confirmed this observation. The average income in the Liuyang area per person of RMB 3,430 (USD 544.40) is slightly higher than the national rural area average level [19] of RMB 3,255 (USD 516.70), which may be the major reason for the higher morbidity of chronic disease in the Liuyang area.

Negative dimensions of marital functioning have indirect influences on health outcomes through depression and health habits, and direct influences on cardiovascular, endocrine, immune, neurosensory and other physiological mechanisms [20]. It has been observed that the widowed have a higher risk for hypertension and the unmarried have a risk factor for COPD but a protective factor for chronic gastritis and lumbar disk disease.

The prevalence rate of smoking in our study was 25.7%, consistent with the national average [21], and confirmed the previous observation of the relationship between smoking and chronic disease [5, 6] including most of the top 10 diseases. Previous research [22, 23] observed that underweight is associated with chronic respiratory disorders and overweight is associated with gastritis [24]. Our study also confirmed these observations. However, our study did not confirm the previous relationship between underweight and hypertension [25] and further studies may be needed to elucidate this difference.

Our study has several strengths. First, it was a rural population-based study conducted with stable estimations and reduced selection bias. Second, the data were collected by trained members from the CDC and Health Center, which may have reduced the information bias. A limitation of this study was that it dealt only with diagnosed chronic diseases and, therefore, underestimated the prevalence of chronic diseases, which would attenuate the observed association between risk factors and chronic disease.

Conclusion

The prevalence of chronic disease in the Liuyang area was high both in communicable and noncommunicable chronic disease. Unhealthy life styles such as tobacco usage and overweight partially contributed to the high prevalence rate of chronic disease.

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