

RESEARCH ARTICLE

Open Access



Epidemic of chronic diseases and the related healthy lifestyle interventions in rural areas of Shandong Province, China

Juncheng Lyu^{1*}, Wen Zhang², Wei Li^{1*}, Suzhen Wang¹ and Jie Zhang^{3,4}

Abstract

Background: There were amounts of previous studies on chronic diseases, but few studies on the prevalence of chronic disease and the healthy lifestyle intervention in recent years, China. This study aimed to investigate the prevalence of chronic disease and the implementation of healthy lifestyle intervention in rural areas of China, so as to put forward health promotion measures to control the chronic diseases effectively.

Method: A large cross-sectional study ($N = 2168$) on community diagnosis and chronic disease was carried out in Shandong province, China. The chronic disease questionnaire and the healthy lifestyle intervention questionnaires were recruited to survey the chronic diseases and the implementation of healthy lifestyle intervention. Physical examination and biochemical indicators examination were carried out by the medical staffs and clinical laboratory.

Results: The current diagnosed prevalence of hypertension, diabetes, hyperlipidemia for total sample, female, male were 24.97, 24.6, 25.5, 7.60, 8.9, 6.0 and 40.27%, 45.9, 33.3% respectively in rural China. The one-year prevalence of myocardial infarction (MI) and stroke of the total sample, female, male were 1.06, 1.0, 1.1 and 2.09%, 2.2, 2.0% respectively.

Healthy lifestyles interventions were not effective in rural China. The current active smoking rate and passive smoking rate were 25.68 and 42.65%. 27.86% of the population drunk alcohol within a month and 47.01% of them participated in the actions to control salt daily intake. Only 1.07 and 7.89% of the population participated in medium to high intensity physical exercises.

Conclusions: The prevalence of common chronic diseases were still high and the implementation of healthy lifestyle intervention were not optimal in rural area, China. Challenges to prevent chronic diseases were still severe, so medical institutes, government and individuals would put forward effective strategies to reduce the prevalence and public health promotion project should be effectively strengthened.

Keywords: Chronic diseases, Healthy lifestyle intervention, Epidemiology, Health promotion, Rural China

* Correspondence: ljuncheng79@163.com; imliwei@163.com

The study was fund by National Natural Science Foundation of China (71774119, 81872719), Health and Family Planning Commission of Shandong Province (2016WS0676), the Ph.D. Research Fund Project of Weifang Medical University (2017BSQD53) and Social Science Planning and Research Project of Shandong Province (19CJYJ24).

¹Department of Public Health, Weifang Medical University, Weifang 261053, Shandong, China

Full list of author information is available at the end of the article



© The Author(s). 2020 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

Background

Chronic diseases, such as hypertension, heart disease, stroke, cancer, diabetes and chronic respiratory diseases, were the leading cause of mortality in the world, accounting for 63% of all deaths [1]. Meanwhile, mortality of middle-aged Chinese people caused by chronic disease was higher than the developed countries [2]. It was estimated that 80% of deaths and 70% of disability-adjusted life-years (DALYs) lost in China came from chronic disease in 2005, and 160 million adults were hypertensive [3]. As we all know, the aging of population in China increase the harm of chronic diseases. The sixth national population census showed that there were 178 million old people (≥ 60 years old), which was 13.26% of the population in China. The World Bank had projected that more than 400 million Chinese people could be over 60 years old by 2050. With the rapid development of economy, environmental changes [4] and the ageing tendency, unhealthy lifestyle such as tobacco using, unhealthy nutrition, and physical inactivity constantly spring up. Now, China is facing the formidable challenge of chronic diseases.

The National Basic Public Health Service Project is an important part of promoting equalization of health services and deepening reform of the medical and health care system. It is provided and funded by the Chinese government to all the residents free of charge, and focusing on children, pregnant women, the elderly and patients with chronic diseases. At present, the National Basic Public Health Service Project includes 15 basic public health services. Though Chinese government has invested enormous capital resources on the prevention of chronic diseases in recent decades, there is no obvious decrease in the prevalence of common chronic diseases such as hypertension, cardiovascular disease, and stroke.

Previous studies had reported various studies related to chronic diseases in China. Jing, Lou and Zhao etc. assessed the economic burden of chronic hepatitis B (CHB)-related diseases in Beijing and Guangzhou, China [5]. Li, Y., et al. studied the risk factors for non-communicable chronic diseases in women in China [6]. The prevalence and risk factors of chronic obstructive pulmonary diseases in Hainan island of China [7] and risk factors of chronic non-communicable diseases still was studied [8]. Ning, G. and Bloomgarden, Z. reported the prevalence, diagnosis and control of diabetes in China [9]. Hung, K.K. et al., researched the disease pattern and chronic illness in rural China of Sichuan after 2008 earthquake [10]. Tian, M., et al., reported the chronic disease knowledge and its determinants among chronically ill adults in rural areas of Shanxi province in China [11], Kong, L.Z., studied the strategy adjustment and actions of non-communicable chronic diseases in China [12]. The chronic disease prevalence for elders in

Beijing was researched by Liu et al. [13]. Gao reported the study on chronic diseases among middle-aged and elderly population in Shanghai [14]. Cheng et al. researched the chronic disease mortality in rural and urban residents in Hubei province [15].

There were still lot of previous literatures on the relationship between chronic disease and the health lifestyles. Population attributable risks of cigarette smoking for deaths of chronic diseases among adults aged 40–74 years in urban Shanghai [16] and prevalence of tobacco smoking and determinants of success in quitting smoking among patients with chronic diseases in rural western China [17] have been published. The breast cancer risks of Chinese women relationship with active, passive smoking and alcohol drinking was researched [18]. The Physical activity and chronic diseases among older people in a mid-size city in China still was reported in previous literature [19]. The public policy implication of preventing chronic diseases by promoting healthy diet and lifestyle had been introduced [20]. The previous literature [21] emphasized the central role of preventive medicine and healthy lifestyle behaviors to combat chronic diseases in Sri Lanka.

Although many previous studies on chronic diseases had been carried, there were few studies on the prevalence of chronic disease and implementation of healthy lifestyle intervention in recent year in rural China. Meanwhile, little previous literatures simultaneously research chronic diseases and healthy lifestyle intervention. This study aimed to survey the prevalence of chronic disease and the implementation of healthy lifestyle intervention, so as to evaluate the preventive effects and bring forward health promotion measures to control the chronic disease in rural China.

Methods

Study design, setting and participants

Data of the current study ($N = 2168$) were collected from a large cross-sectional study on community diagnosis for chronic disease in rural areas of Shandong province, China. Shandong province located on the east coast of China, and with economic prosperity both in industry and agriculture. The random stratified cluster sampling method was applied to select the survey subjects. Three counties of Shandong province and three villages in each country were chosen randomly according to the development of economy and the geographical location. Then, all the residents in the nine villages were chosen as the survey respondents.

In order to control the information bias and loss to follow-up, the collaboration institutes research meeting had been held several times to discuss the quality control. Representatives of local sanitary bureau, health agency, village administration and researcher designer

were invited to attend the meeting. Pilot investigation was carried out to test the reliability and validity of the questionnaires. The interviewers were trained in order to increase the skill of interviewer. The medical professional experts, university teachers and the postgraduate students majoring in preventive medicine were recruited to carry out the face-to-face questionnaire interview. The village health agencies staffs were responsible for physical examination. The biochemical blood samples were drawn by the local county hospital medical staffs. The biological samples were transported quickly to the local county hospital and analyzed by biochemical equipment.

Questionnaire measurements

The chronic disease questionnaire, designed by Chinese Center for Disease Control and Prevention (China CDC) was recruited to survey the items about chronic diseases. The questionnaire consists of family information part and individual information part. The family interviews part was used to survey the information on family numbers, economic status of family, family disease history etc. The individual interviews part aimed to investigate the demographics variables of individuals (such as gender, age, nationality, occupation, education level, marital status) as well as the status of smoking, drinking, daily diet, history diagnosed, and knowledge of chronic diseases (such as hypertension, diabetes, hyperlipaemia, myocardial infarction and stroke).

The healthy lifestyle intervention questionnaires were designed to survey the implementation situation of healthy lifestyle intervention advocated by the WHO, such as dietary habit, salt intake, active smoking, passive smoking, alcohol drinking, physical exercise, sedentary behavior and sleep time etc.

Face to face interview was used to collect the data. Each individual was interviewed separately by one trained interviewer in a private place of the hospital or the individual's home after signing the informed consent. The average time for each interview was about an hour.

Physical and biochemical indicators examination

The tapeline, weighing-machine, sphygmomanometer and echoscope were used by the village health agencies clinical staffs to measure the physical indicators, such as height, waistline, weight, blood pressure and heart rate.

First the clinical laboratory doctors came from the county hospital asked whether the participant was taking oral hyperglycaemic agents, if not then the doctor drew the blood sample from each individual before the breakfast. The blood tubes samples were spun within an hour and rapidly transported to local county hospital clinical laboratory under the cold chain environment. The blood samples drawn from cubital vein were used to measure

the biological indicators, such as fasting blood glucose (FBG), triglyceride (TG), total cholesterol (TC), high-density lipoprotein (HDL-C), and low-density lipoprotein (LDL-C).

Diagnostic criteria

The diagnostic criteria of hypertension were as follows: if systolic pressure ≥ 160 mmHg or/and diastolic pressure ≥ 95 mmHg then diagnosed with hypertension; if 140 mmHg $<$ systolic pressure < 160 mmHg or/and 90 mmHg $<$ diastolic pressure < 95 mmHg then diagnosed with borderline hypertension.

The diagnostic criteria of diabetes were as follows: if fasting blood-glucose (FBG) ≥ 7.0 mmol/L then diagnosed with diabetes; if fasting blood-glucose (FBG) < 3.9 mmol/L then diagnosed with hypoglycemia.

The diagnostic criteria of hyperlipaemia are as follows: if total cholesterol (TC) > 5.72 mmol/L (220 mg/dL) or/and triglyceride (TG) > 1.70 mmol/L (155 mg/dL) then diagnosed with hyperlipaemia; if 5.2 mmol/L (200 mg/dL) $<$ total cholesterol (TC) < 5.72 mmol/L (220 mg/dL) then diagnosed with borderline hyperlipemia.

Ethics approval and consent for participate statement

This study was approved by the Ethics Committee of Weifang Medical University, and written informed consent was obtained from all participants.

Statistical analysis

The mean and standard deviation ($\bar{x} \pm SD$) and frequency (%) were used to describe the distribution of quantitative and qualitative data respectively. The chi-square test was used to compare the difference of prevalence between male and female groups. All analyses were two tailed and statistical significant probability was determined by $P \leq 0.05$. SPSS (Version 19.0) statistical analysis software was used to analyze data.

Results

Demographics description of the sample

There were 2480 eligible residents recruited in the current study and 2168 residents actually participated in. The participation rate was 87.42%. Demographic variables such as gender, age, occupation, education level, marital status and family annual income were shown in Table 1. The result indicated that gender variable was similar (male 46.6% VS female 53.4%). The age of interviewed residents mainly ranges from 41 to 80 years old. 76.6% of the samples were engaged in agriculture. As to the education level, 56.2% of the samples were under or equal primary school, which showed that the education level of the sample was relatively low in the current study. 88.2% of the samples were married or cohabitation. The mean of the family annual income was about

Table 1 Distribution of the Demographics Variables

Demographic Variables	Frequency	Percent (%)
Gender		
Male (1)	1009	46.6
Female (2)	1158	53.4
Age (year)		
≤ 20 (1)	14	0.6
21–40 (2)	236	10.9
41–60 (3)	1004	46.3
61–80 (4)	779	35.9
≥ 81 (5)	135	6.2
Occupation		
Agriculture (1)	1659	76.6
Non- agriculture (2)	509	23.4
Education level		
No formal education (1)	597	27.5
Primary school (2)	623	28.7
Middle school (3)	915	42.2
Above middle school (4)	32	1.5
Marital Status		
Never married (1)	66	3.0
Married or cohabitation (2)	1912	88.2
Lose spouse, divorced or separation (3)	189	8.7
Family Annual Income (yuan) ($\bar{x} \pm SD$)	28,252.18 ± 27,104.17 ^a	

Note: ^aindicated mean and standard deviation

28,252 *yuan* (China's per capita disposable income of the year was 11,886 *yuan*), which indicated that the income level of sample was lower than the average level of China.

Prevalence of chronic disease

Table 2 showed the prevalence of common chronic disease for the total sample, male and female in rural China. It indicated that there were statistical differences on history diagnosed of hypertension, diabetes between male and female. The current prevalence of diabetes, hyperlipidemia between male and female were still statistical different.

The prevalence of history and current diagnosed hypertension were 29.36 and 24.97% in rural China. The prevalence of history diagnosed hypertension for female was higher than male (female 31.8% VS male 26.5%), but current prevalence of diagnosed hypertension was not statistically different between two groups (female 24.6% VS male 25.5%).

The prevalence of history and current diagnosed diabetes were 15.03 and 7.60% in rural China. And the prevalence of history and current diagnosed of diabetes for female were both higher than male (female 19.7% VS male 9.0%, female 8.9% VS male 6.0%).

The prevalence of history and current diagnosed hyperlipidemia were 5.68 and 40.27% in rural China. The prevalence of history diagnosed of hyperlipidemia for female and male were 6.5 and 4.7% respectively. The prevalence of current diagnosed of hyperlipidemia for female was higher than male (female 45.9% VS male 33.3%).

The one-year prevalence of myocardial infarction (MI) for total sample was 1.06%, for female was 1.0% and for male was 1.1%. The one-year prevalence of stroke for total sample was 2.09%, for female was 2.2% and for male was 2.0% respectively.

Healthy lifestyle intervention related to chronic disease

Table 3 exhibited the major healthy lifestyle intervention variable related to chronic disease. There were significant differences on history smoking, current smoking, alcohol drinking, high physical work, and middle physical work between male and female.

Active smoking and passive smoking

The history active smoking rate of total sample was 29.13% and current active smoking rate was 25.68%. The male was higher than female both on history active smoking rate (male 56.9% VS female 6.8%) and current active smoking rate (male 48.8% VS female 5.6%). The passive smoking rate of total sample was 42.65%, and male 43.9%, female 41.6%.

Alcohol drinking and salt intake

There was 27.86% drunk alcohol within a month and 4.46% a month ago of total sample. 51.9% male and 6.8% female drunk alcohol within a month, which was statistically different between two groups ($P < 0.001$). 47.01% participated in controlling salt daily intakes action (≤ 6 g/day) in total sample. Only 46.1% male and 47.8% female participated in the control salt daily intakes action (≤ 6 g/day).

Physical work and physical exercise

The result indicated that 42.70 and 72.82% persons engaged in high and mild intensity physical work of the total sample. The male engaged more high intensity physical work than female (male 45.2% VS female 40.5%), but the female engaged more mild intensity physical work than male (male 63.3% VS female 81.2%). When it comes to the physical exercise, only 1.07 and 7.89% population attended high and mild intensity physical exercise of total sample. Only 1.2% male and 1.0% female took high intensity physical exercise and 7.7% male and 8.0% female took mild intensity physical exercise. There were no significant differences on high and mild intensity physical exercise between male and female.

Table 2 Prevalence of Common Chronic Disease in Rural China ^a

Chronic Disease	Variables	Total sample	Freq (%)		χ^2	P
			Male	Female		
Hypertension	History Diagnosed				6.008	0.014
	Yes (1)	517 (29.36)	213 (26.5)	304 (31.8)		
	No (2)	1244 (70.64)	592 (73.5)	652 (68.2)		
	Current Diagnosed				0.600	0.741
	Normal or below (1)	1052 (65.02)	470 (65.1)	582 (65.0)		
	Borderline (2)	162 (10.01)	68 (9.4)	94 (10.5)		
Diabetes	Hypertension (3)	404 (24.97)	184 (25.5)	220 (24.6)		
	History Diagnosed				15.457	< 0.001
	Yes (1)	107 (15.03)	28 (9.0)	79 (19.7)		
	No (2)	605 (84.97)	282 (91.0)	323 (80.3)		
	Current Diagnosed				7.811	0.020
	Hypoglycemia (1)	31 (1.87)	19 (2.6)	12 (1.3)		
Hyperlipidemia	Normal (2)	1500 (90.53)	681 (91.4)	819 (89.8)		
	Diabetes (3)	126 (7.60)	45 (6.0)	81 (8.9)		
	History Diagnosed				3.373	0.066
	Yes (1)	122 (5.68)	47 (4.7)	75 (6.5)		
	No (2)	2027 (94.32)	954 (95.3)	1073 (93.5)		
	Current Diagnosed				28.805	< 0.001
Myocardial Infarction	Normal (1)	762 (46.49)	392 (53.1)	370 (41.1)		
	Borderline (2)	217 (13.24)	100 (13.6)	117 (13.0)		
	Hyperlipaemia (3)	660 (40.27)	246 (33.3)	414 (45.9)		
	Suffered in Past one Year					
Stroke	Yes (1)	23 (1.06)	11 (1.1)	12 (1.0)	0.016	0.900
	No (2)	2139 (98.94)	994 (98.9)	1143 (99.0)		
	Suffered in Past one Year					
Stroke	Yes (1)	45 (2.09)	20 (2.0)	25 (2.2)	0.083	0.773
	No (2)	2111 (97.91)	984 (98.0)	1127 (97.8)		

Note: ^aindicated exist missing data

Sedentary behavior and sleep time

The current study indicated that the mean and the SD of sedentary behavior time and sleep time were 3.90 ± 2.50 and 7.72 ± 2.03 of the total sample. There were no statistically significant differences both on sedentary behavior time and sleep time between male and female.

Discussion

Cross-sectional survey was carried out to research the prevalence of chronic diseases and the implementation of healthy lifestyle intervention in current study. Most of the participants were peasants and the middle-aged and elderly, which was the real situation in current rural China, because most of the Youngers flock to work in urban areas with the rapid development of urbanization in China. The education level of retained rural inhabitants was relatively low and the family annual income

was not high enough. The prevalence of chronic diseases and awareness of healthy lifestyle intervention were related to education and income level. Relatively low education and poor residents always have inadequate knowledge on dangers of chronic disease and the awareness of healthy lifestyle intervention.

The prevalence of chronic diseases

The current prevalence of hypertension of total sample, female, male were 24.97, 24.6, and 25.5%. The hypertension prevalence of total sample was lower than the rural area of Northwest China (30.5%) [22] and the 2007–2008 China national diabetes and metabolic disorders study (26.6%) [23]. The female hypertension prevalence was similar to the previous study (24.0%) and male hypertension prevalence was lower than the previous study (29.2%) [23].

Table 3 Healthy Lifestyle Intervention Variables Related to Chronic Disease ^a

Variables	Total sample	Freq (%)		χ^2	P
		Male	Female		
History Active Smoking				592.313	< 0.001
Smoking everyday (1)	501 (25.56)	443 (50.7)	58 (5.3)		
Smoking but not every day (2)	70 (3.57)	54 (6.2)	16 (1.5)		
No smoking (3)	1389 (70.87)	376 (43.1)	1013 (93.2)		
Current Active Smoking				530.170	< 0.001
Smoking everyday (1)	512 (23.65)	457 (45.3)	55 (4.8)		
Smoking but not every day (2)	44 (2.03)	35 (3.5)	9 (0.8)		
No smoking (3)	1609 (74.32)	516 (51.2)	1093 (94.5)		
Passive Smoking				1.170	0.279
Yes (1)	879 (42.65)	413 (43.9)	466 (41.6)		
No (2)	1182 (57.35)	527 (56.1)	655 (58.4)		
Alcohol Drinking				665.228	< 0.001
Drinking within a month (1)	600 (27.86)	522 (51.9)	78 (6.8)		
Drinking but a month ago (2)	96 (4.46)	82 (8.2)	14 (1.2)		
No Drinking within a year (3)	1458 (67.69)	401 (39.9)	1057 (92.0)		
Control Salt Daily Intakes Action				0.668	0.414
Yes (1)	1014 (47.01)	463 (46.1)	551 (47.8)		
No (2)	1143 (52.99)	542 (53.9)	601 (52.2)		
High Intensity Physical Work				4.715	0.030
Yes (1)	921 (42.70)	454 (45.2)	467 (40.5)		
No (2)	1236 (57.30)	551 (54.8)	685 (59.5)		
Mild Intensity Physical Work				87.244	< 0.001
Yes (1)	1573 (72.82)	637 (63.3)	936 (81.2)		
No (2)	587 (27.18)	370 (36.7)	217 (18.8)		
High Intensity Physical Exercise				0.293	0.588
Yes (1)	23 (1.07)	12 (1.2)	11 (1.0)		
No (2)	2122 (98.97)	987 (98.8)	1135 (99.0)		
Mild Intensity Physical Exercise				0.075	0.784
Yes (1)	169 (7.89)	77 (7.7)	92 (8.0)		
No (2)	1974 (92.11)	921 (92.3)	1053 (92.0)		
Sedentary Behavior Time (Hours/per day)	3.90 ± 2.50	3.90 ± 2.53	3.89 ± 2.48	0.114	0.910
Sleep Time (Hours/per day)	7.72 ± 2.03	7.77 ± 1.41	7.68 ± 1.40	1.416	0.157

Note: ^aindicated exist missing data

The current prevalence of diagnosed diabetes for total sample, female, male were 7.60, 8.9, 6.0% respectively, which was lower than the Chinese disease surveillance 2010 (11.6%) [9]. The different results may be derived from different survey samples. The samples of current study came from rural area and the subjects took up physical labor every day, which may be the major reason for lower prevalence of diabetes. Another reason maybe the effect of China's basic public health service project implemented in recent years. Compare the history diagnosed prevalence (15.03%) with the current diagnosed

prevalence (7.60%), the declining trend was obvious. It maybe benefited from the enhancement of diabetes preventive awareness in recent years, in rural areas of China.

Be of great concern, the current prevalence of hyperlipidemia (total sample 40.27%, female 6.5%, male 4.7%) increased greatly than history prevalence (total sample 5.68%, female 45.9%, male 33.3%). There were some possible reasons explaining the obviously rising tendency.

First, with the rapid development of economy in rural areas of China, more and more nutritious foods such as

animal fat and high-protein eggs are easily available in daily life. Second, the syndrome of hyperlipidemia is not obvious and serious enough, so the measurement and supervision of blood lipid is ignored. Third, because the low income and the paid blood lipid monitoring, blood lipid examination is hard to be carried out and popularized in rural China. So, most of the inhabitants had never measured their blood lipid before, and the vast majority of these were newly detected. The rapid increase of hyperlipidemia prevalence maybe profited from the laboratory diagnostic technique and awareness promotion of hyperlipidemia. The newly discovered hyperlipidemia cases may be only the tip of iceberg in rural China. The current research suggests that low fat diet intervention should be strengthened and the epidemiological screening for hyperlipidemia is necessary and urgent.

Healthy lifestyle interventions related to chronic diseases

The effective implementation of healthy lifestyle intervention should be paid more attention to in the future. People who had never measured their blood pressure and blood glucose account for about 20.0% and above 70.0% respectively. Those phenomena manifest that the healthy consciousness is still defective in rural areas of Shandong province, China. Compared with the history smoking, it was easy to find that the active smoking reduced but slightly. Meanwhile, there was 48.8% male active smoking and passive smoking rate of the total sample was 42.65%. The current active smoking prevalence in the sample was higher than the previous literature (26.2%) [17]. So the active smoking and passive smoking were still serious in rural china. Above half of male drunk alcohol within a month and less half of inhabitant took part in control salt daily intakes action. The previous study had indicated that excessive alcohol use was related to the premature deaths involving chronic diseases [24, 25], so excessive alcohol use was the risk factor of chronic diseases and harmful to the health. As is well known that high salt intake results in hypertension and stroke, but there was still over 50% people hesitate to reduce salt intake.

Another phenomenon should be paid close attention to was physical exercises. Only 1.07 and 7.89% attended high and mild intensity physical exercises. In spite of rural residents engage in physical work every day, they spent little time on physical exercises to prevent chronic diseases. Regular and moderate physical exercises would decrease the risks of chronic disease, such as cardiovascular disease, hypertension, diabetes, stroke and cancer etc. [26–30]. But, the implication of physical exercise was not optimal in rural China.

Countermeasures and proposals

The smoking, intemperance, high salt intake and lack of exercise have been validated as the risk factors for

chronic diseases, but the healthy lifestyles interventions advocated by the government, bureau and media to prevent disease have not got desired effective results in rural daily life. It suggests that the basic healthy lifestyle intervention including low fat diet, control cigarettes, quit alcohol, low salt and appropriate amount of exercises should be strengthened and the challenge of chronic diseases prevention is still serious in rural China.

As to the implications, this study would provide theoretical foundation for the near or long-term public health projects basing on China's interests in the future. It is useful to prevent and control chronic diseases in rural areas in China. The government, medical institutes and individuals should adopt effective measurement to reduce the epidemic situation of chronic diseases firmly. Because about 80% of the population is rural residents in China, related health policy should be promulgated leading the health resources such as health funding, advanced technical and professional village doctors flung to rural areas. More perfect and multiple channels financing medical care insurance system should be carried out by the national government to reduce the economic burden of chronic disease in rural areas, China [31]. The epidemiological screen for chronic disease, especially for hyperlipidemia, should be strengthened in rural China. Various aspects of society, such as media, sanitary bureau, health care institution, hospital, medical insurance section, local health village doctors should enhance publicity of healthy lifestyles interventions in order to enhance the healthy awareness of the population. The projects of health education and health promotion still need to be strengthened, four bases of health (rational diet, regular exercises, no smoking and limited amount of liquor, and psychological balance.) initiated by WHO should be propagandized extensively. Regular physical examination, standardized early treatment and long-term health care [15] for high risk population of chronic diseases all still need to be strengthened urgently.

Limitations

Forthcoming studies based on larger scale of sample on different age population needed to be carried out in the future. The inherent inaccuracy of self-report survey may results in research bias. There was no compared area, so standardized prevalence was not calculated in the current study.

Conclusions

The prevalence of chronic diseases was still high, especially hyperlipidemia, and the challenges to prevent chronic diseases was still severe. The implementation of healthy lifestyle intervention for chronic diseases was not optimal in rural areas in China. Challenges to

prevent chronic diseases and the implementation of healthy lifestyle intervention were still severe, so medical institutes, government and individuals should put into effective strategy to reduce the epidemic of chronic diseases and health promotion project should be effectively strengthened. Comprehensive prevention strategies and health promotion project should be effectively strengthened in order to prevent the epidemic of common chronic diseases. The current study has significances for improving public health in China and to guide near or long-term projects of public health in the future.

Abbreviations

CDC: Center for Disease Control and Prevention; TG: Triglyceride; TC: Total cholesterol; HDL-C: High-density lipoprotein; LDL-C: Low-density lipoprotein; FBG: Fasting blood-glucose

Acknowledgments

We certify that no party having a direct interest in the results of the research and no any organization with which we are associated. All authors declare that they do not have any conflict of interest on this research. We thank all collaborators for their contribution in collecting data for current study.

Authors' contributions

JL contributed to data extraction, data analysis and wrote the original manuscript. SW, WL and WZ contributed to the design and reviewed the manuscript. JZ and WZ contributed to polish of the manuscript. WZ made the major contribution to the revision of the manuscript. All authors read and approved the final manuscript.

Funding

The study was fund by National Natural Science Foundation of China (71774119, 81872719), Health and Family Planning Commission of Shandong Province (2016WS0676), the Ph.D. Research Fund Project of Weifang Medical University (2017BSQD53) and Social Science Planning and Research Project of Shandong Province (19CJYJ24). 71774119, 81872719 contributed to the research design and data analysis of this study. 2016WS0676, 2017BSQD53 and 19CJYJ24 provided support for the data collection, interpretation and manuscript writing.

Availability of data and materials

The datasets generated and analyzed of the current study are not publicly available due to the funding regulations but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Weifang Medical University, and written informed consent was obtained from all participants.

Consent for publication

Not Applicable.

Competing interests

We certify that no party having a direct interest in the results of the research. All authors declare that they do not have any conflict of interest on this research.

Author details

¹Department of Public Health, Weifang Medical University, Weifang 261053, Shandong, China. ²Department of Psychiatry, Binzhou People's Hospital, Binzhou, Shandong, China. ³School of Public Health, Shandong University, Jinan 250000, China. ⁴Department of Sociology, State University of New York College at Buffalo, Buffalo, USA.

Received: 1 December 2019 Accepted: 17 April 2020

Published online: 01 May 2020

References

1. Chronic diseases [http://www.who.int/topics/chronic_diseases/en/].

- Strong K, Mathers C, Leeder S, Beaglehole R. Preventing chronic diseases: how many lives can we save? *Lancet*. 2005;366(9496):1578–82.
- Wang L, Kong L, Wu F, Bai Y, Burton R. Preventing chronic diseases in China. *Lancet*. 2005;366(9499):1821–4.
- Yang GH, Ma JM, Liu N, Zhou LN. Smoking and passive smoking in Chinese, 2002. *Chin J Epidemiol*. 2005;26(2):77–83.
- Hu M, Chen W. Assessment of total economic burden of chronic hepatitis B (CHB)-related diseases in Beijing and Guangzhou, China. *Value Health*. 2009;12(Suppl 3):S89–92.
- Li Y, Wang L, Jiang Y, Zhang M. Risk factors for noncommunicable chronic diseases in women in China: surveillance efforts. *Bull World Health Organ*. 2013;91(9):650–60.
- Ding Y, Yang D, He P, Yao J, Sun P, Li Q, Xie P, Lin D, Sun D, Niu H, et al. Prevalence and risk factors of chronic obstructive pulmonary diseases in a Hlai community in Hainan Island of China. *Clin Respir J*. 2018;12(1):126–33.
- Yang F, Qian D, Hu D. Life-course and cohort trajectories of chronic non-communicable diseases risk factors in China. *Iran J Public Health*. 2017;46(5):591–601.
- Ning G, Bloomgarden Z. Diabetes in China: prevalence, diagnosis, and control. *J Diabetes*. 2013;5(4):372.
- Hung KK, Lam EC, Chan EY, Graham CA. Disease pattern and chronic illness in rural China: the Hong Kong red cross basic health clinic after 2008 Sichuan earthquake. *Emerg Med Australas*. 2013;25(3):252–9.
- Tian M, Chen Y, Zhao R, Chen L, Chen X, Feng D, Feng Z. Chronic disease knowledge and its determinants among chronically ill adults in rural areas of Shanxi Province in China: a cross-sectional study. *BMC Public Health*. 2011;11:948.
- Kong LZ. Strategy adjustment and actions of non-communicable chronic diseases control and prevention in China. *Zhonghua Yu Fang Yi Xue Za Zhi*. 2010;44(1):1–3.
- Cai L, Liu A, Zhang L, Li S, Wang P. Prevalence, awareness, treatment, and control of hypertension among adults in Beijing, China. *Clin Exp Hypertens*. 2012;34(1):45–52.
- Ma H, Gao X, Lin HD, Hu Y, Li XM, Gao J, Zhao NQ. Glycated haemoglobin in diagnosis of diabetes mellitus and pre-diabetes among middle-aged and elderly population: Shanghai Changfeng study. *Biomed Environ Sci*. 2013;26(3):155–62.
- Liu Z, Albanese E, Li S, Huang Y, Ferri CP, Yan F, Sousa R, Dang W, Prince M. Chronic disease prevalence and care among the elderly in urban and rural Beijing, China - a 10/66 dementia research group cross-sectional survey. *BMC Public Health*. 2009;9:394.
- Wang YY, Zhang W, Li HL, Gao J, Tan YT, Gao YT, Shu XO, Zheng W, Xiang YB. Population attributable risks of cigarette smoking for deaths of all causes, all cancers and other chronic diseases among adults aged 40–74 years in urban Shanghai, China. *Chin J Cancer Res*. 2015;27(1):59–65.
- Fu H, Feng D, Tang S, He Z, Xiang Y, Wu T, Wang R, Shao T, Liu C, Shao P, et al. Prevalence of Tobacco Smoking and Determinants of Success in Quitting Smoking among Patients with Chronic Diseases: A Cross-Sectional Study in Rural Western China. *Int J Environ Res Public Health*. 2017;14(2):167.
- Gao CM, Ding JH, Li SP, Liu YT, Qian Y, Chang J, Tang JH, Tajima K. Active and passive smoking, and alcohol drinking and breast cancer risk in chinese women. *Asian Pac J Cancer Prev*. 2013;14(2):993–6.
- Zhou P, Hughes AK, Grady SC, Fang L. Physical activity and chronic diseases among older people in a mid-size city in China: a longitudinal investigation of bipolar effects. *BMC Public Health*. 2018;18(1):486.
- Hu FB, Liu Y, Willett WC. Preventing chronic diseases by promoting healthy diet and lifestyle: public policy implications for China. *Obes Rev*. 2011;12(7):552–9.
- Sagner M, Arena R, McNeil A, Brahmam GN, Hills AP, De Silva HJ, Karunapema RP, Wijeyaratne CN, Arambepola C, Puska P. Creating a proactive health care system to combat chronic diseases in Sri Lanka: the central role of preventive medicine and healthy lifestyle behaviors. *Expert Rev Cardiovasc Ther*. 2016;14(10):1107–17.
- Zhao Y, Yan H, Marshall RJ, Dang S, Yang R, Li Q, Qin X. Trends in population blood pressure and prevalence, awareness, treatment, and control of hypertension among middle-aged and older adults in a rural area of Northwest China from 1982 to 2010. *PLoS One*. 2013;8(4):e61779.
- Gao Y, Chen G, Tian H, Lin L, Lu J, Weng J, Jia W, Ji L, Xiao J, Zhou Z, et al. Prevalence of hypertension in China: a cross-sectional study. *PLoS One*. 2013;8(6):e65938.

24. Polednak AP. Surveillance of US death rates from chronic diseases related to excessive alcohol use. *Alcohol Alcohol*. 2016;51(1):54–62.
25. Hsu CC, Kowdley KV. The effects of alcohol on other chronic liver diseases. *Clinics in liver disease*. 2016;20(3):581–94.
26. Stefani L, Galanti G. Physical exercise prescription in metabolic chronic disease. *Adv Exp Med Biol*. 2017;1005:123–41.
27. Turner JE, Lira VA, Brum PC. New insights into the benefits of physical activity and exercise for aging and chronic disease. *Oxidative Med Cell Longev*. 2017;2017:2503767.
28. Bohm CJ, Storsley LJ, Hiebert BM, Nelko S, Tangri N, Cheskin LJ, McAdams-DeMarco MA, Rigatto C. Impact of exercise counseling on physical function in chronic kidney disease: an observational study. *Can J Kidney Health Dis*. 2018;5:2054358117753615.
29. Afsar B, Siriopol D, Aslan G, Eren OC, Dagele T, Kilic U, Kanbay A, Burlacu A, Covic A, Kanbay M. The impact of exercise on physical function, cardiovascular outcomes and quality of life in chronic kidney disease patients: a systematic review. *Int Urol Nephrol*. 2018;50(5):885–904.
30. Aoike DT, Baria F, Kamimura MA, Ammirati A, Cuppari L. Home-based versus center-based aerobic exercise on cardiopulmonary performance, physical function, quality of life and quality of sleep of overweight patients with chronic kidney disease. *Clin Exp Nephrol*. 2018;22(1):87–98.
31. Jing S, Yin A, Shi L, Liu J. Whether new cooperative Mmedical schemes reduce the economic burden of chronic disease in rural China. *PLoS One*. 2013;8(1):e53062.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

