ORIGINAL ARTICLE

The positive effect of an intervention program on the hypertension knowledge and lifestyles of rural residents over the age of 35 years in an area of China

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Hypertension (HTN) is a leading cause of cardiovascular and cerebrovascular diseases. Lifestyle modification may be the preferential approach to prevent and control HTN. The purpose of this study was to evaluate the effects of a community intervention program, which focused on improving the HTN knowledge, diets and lifestyles in a rural Chinese area. The study was carried out in a rural area of the Hubei Province from May 2003 to April 2006. A total of 1632 participants were recruited. Of the participants, 826 from the town of Xiaoxita and 806 from the town of Fenxiang were assigned to the intervention group (group I) and to the control group (group C), respectively. Group I participants underwent an intervention that included HTN education and dietary and lifestyle guidance. Group C participants were not subjected to an intervention. The outcome measures included HTN knowledge, dietary and lifestyle behaviors, and prevalence, awareness, treatment and control rates of HTN. Along with the changes in HTN education ($P < 0.05$), the participants in group I exhibited a significantly greater improvement in dietary habits and lifestyle behaviors, including reducing salty food intake (13.6%), fat intake (22.9%) and alcohol consumption (9.6%), after 3 years in comparison with those in group C (21.7, 31.9 and 18%, respectively). The prevalence of HTN was significantly lower in group I (22.5%) than in group C (36%) after the intervention strategies. The study showed that the implementation of a community intervention program involving HTN education and lifestyle modifications for rural residents is a powerful approach to reduce HTN prevalence and improve long-term health outcomes.

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INTRODUCTION

Hypertension (HTN) is one of the leading causes of cardiovascular and cerebrovascular diseases in the aging population.¹ Cerebrovascular disease became the second leading cause of death in urban residents and the top cause of death in rural areas of China in 1998 (see ref. 2). The awareness (30.2%), treatment (24.7%) and control (6%) rates of HTN among residents are very low.³ Data from an investigation that was organized by the Ministry of Health of the People's Republic of China (MOH) in 2002 indicate that 27.2% of Chinese adults between the ages of 35 and 74 years have HTN.

Because of the morbidity and the cost to society, HTN is a public health concern.⁴ The onset of HTN involves a slow, evolving process. Therefore, healthcare staff should not only identify hypertensive patients, but also promote preventive measures to decrease the prevalence of HTN.^{5–7}

In the past few decades, there has been a growing interest in improving the awareness, treatment and control rates of HTN in

adults in the United States and other countries.^{8–12} Current recommendations for preventing and controlling HTN emphasize lifestyle modifications.⁸ Lifestyle modifications, which include measures such as reducing sodium intake, increasing physical activity and restricting alcohol consumption, can effectively decrease blood pressure. Although well-defined preventative measures concerning lifestyle and dietary modifications are available for reducing blood pressure, it is not clear whether the rural residents have access to these services and information. Furthermore, although people may easily understand the advantages of lifestyle modifications, inter-related consistent behavioral changes are difficult to achieve.⁸ It is essential to implement and then evaluate the effects of intervention measures that promote HTN education and lifestyle improvements for rural residents.

Residents who live in rural areas often have limited access to contemporary HTN information and exhibit some dietary and lifestyle behaviors that are not conducive to good health. To reduce the prevalence rate of HTN and to improve the knowledge of it, the pilot

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study, attitudes and practices (KAP) on HTN for Chinese rural residents, was developed and supported by the Hubei Province Health Administration Institution. The study was designed and carried out by the Tongji Medical College in a Chinese rural area.

The goals of the intervention program were to provide HTN information and guidance and to eliminate the common misconceptions about the traditional diets and lifestyles of rural residents. This study aimed at testing the effects of the intervention program in a Chinese rural area.

METHODS

Study sites and participants

The study was carried out from May 2003 to April 2006 in the Yichang Three Gorge Dam area in the Hubei Province in the central part of China. Approximately 200 000 residents dwell in the area. Two towns (Xiaoxita and Fenxiang) were selected; the towns have similar geographical characteristics (rural area, highlands), agriculture resources (oranges and tea) and populations (8000 residents). The selection of the intervention towns was based on the feasibility of an intervention. The two towns are separated by a town that was not involved in the study. The residents from Xiaoxita and Fenxiang were assigned to the intervention group (group I) and the control group (group C), respectively. The participants of the study were selected from the population of rural residents in a three-step process. First, individuals under the age of 35 years were excluded. Second, those who could not fulfill the requirements of the investigation because of an extended absence or illness were excluded. Third, we excluded those suffering from established coronary heart disease, diabetes mellitus or chronic renal disease. Ultimately, a total of 1632 participants were originally enrolled in the study, which included 826 from Xiaoxita assigned to Group I and 806 from Fenxiang assigned to Group C. Informed consent was obtained from all participants. The research was approved by the Tongji Medical College Ethics Committee.

Intervention study design

This study design consisted of an intervention trial. Group I was exposed to the comprehensive intervention measures, which included HTN education and behavior and lifestyle guidance. The education and guidance were provided by the local healthcare staff, which was intensively trained by our research team. The healthcare staff was trained twice, once before the first visit and once before the last visit.

The intervention activities included the following:

Training local healthcare staff. It was essential to train the local healthcare staff to help them to understand the Chinese guidelines for the prevention and treatment of HTN. The establishment of continuing medical education was important to the healthcare systems, which could eventually incorporate prevention services into their practices and disseminate the information concerning healthy behaviors and lifestyles to rural residents. After training, the local healthcare staff could identify the risk factors of HTN and suggest reasonable behavioral goals.

Health education for participants. Multiple educational methods were implemented, including print media (newspaper, pamphlets, and so on.), classes and correspondence courses, which could increase the individuals' knowledge concerning HTN and its risk factors and generate some improvements related to health-related behavior. During the first year, participants in the intervention group were divided into small groups and informed to take part in six 1-h health education sessions. The sessions were held once a month to ensure that each participant in the intervention group was able to participate.

Our research team compiled pamphlets concerning HTN information and dietary and lifestyle behaviors, which were available to group I participants; one salt spoon (for 2 g) was also provided to every household in group I. The content of the dietary and lifestyle behavior booklet focused on:

- Reducing sodium intake
- Consuming more fruit and vegetables
- Choosing low-fat dairy products

- Restricting smoking
- Restricting alcohol consumption
- Increasing physical activity

Group C participants were not exposed to the intervention measures but did have access to normal, standard health care during the study period. The blood pressures, heights and weights of the group C participants were measured to compare the two groups. The follow-up lasted for 3 years. Figure 1 shows the trial profile.

Data collection

The baseline measurements were obtained in May 2003; the intervention was subsequently initiated and lasted for 3 years. In the first survey, the sample sizes of the intervention group and the control group were 826 and 806, respectively. A follow-up was performed in April 2006 for those who responded to the second survey. At 3 years after the baseline measurements, the actual number of respondents from group I and group C were 805 and 727, respectively. The response rate was 97.4% for group I and 90.2% for group C.

The same questionnaire was used for the measurements in 2003 and in 2006. Both groups of participants completed the questionnaire, which included questions regarding socio-demographical characteristics, knowledge and perceptions on HTN, and dietary and lifestyle behaviors. The questionnaire, which took within 15 min to complete, was developed to evaluate the effect of the intervention on improving HTN knowledge and on stimulating lifestyle modifications. The questions were related to knowledge and lifestyles (that is, which risk factors associated with HTN they were aware of, which approaches they were aware of that can effectively prevent and control HTN, how much importance they associated with lifestyle modification, how physically active they were, their levels of alcohol consumption, whether or not they smoked, and levels of salt and fat intake). The format of the knowledge-related questions involved a list of multiple answer choices with 1 or more correct answers and some incorrect options. The questionnaire was designed by the scientists of our research team.

The data pertaining to blood pressure, height and weight were obtained for all of the participants by the trained healthcare staff before the educational intervention and 3 years following the initiation of the intervention. The body mass index (BMI), which was used as an index of relative weight, was calculated as the participants' body weight (in kilograms) divided by the square of the height (in meters). Body weight was measured with a calibrated balance-beam scale. Height was measured with a vertical ruler. Height and weight were measured following a standard methodology with the participant wearing light clothing and no shoes.¹³ The data concerning the heights and weights were based on the mean of the two measurements. Three blood-pressure readings were obtained in a quiet setting with the participant in a sitting position using a mercury sphygmomanometer with a 2 mm Hg scale, which is in accordance with the standard procedure.¹⁴ The mean of three readings was used for the data analysis. The hypertensive patients were also diagnosed according to the diagnostic criteria of the Chinese Guidelines for the Prevention and Treatment of Patients with HTN (Revised version in 2005).² The subjects who were not taking antihypertensive medications were considered to be hypertensive if their average SBP (systolic blood pressure) or DBP (diastolic blood pressure) was greater than 139 mm Hg or greater than 89 mm Hg, respectively, at the time of examination.

HTN awareness was defined by a participant answering 'yes' to the question, 'Has a physician, nurse or other professional told you that you have high blood pressure?' HTN unawareness (newly diagnosed HTN) was defined by a participant answering 'no' or 'I don't know' to the question, 'Has a physician, nurse or other professional told you that you have high blood pressure?' This classification also required subsequently exhibiting blood-pressure measurements with an SBP reading of at least 140 mm Hg or a DBP reading of at least 90 mm Hg. Current treatment for HTN was defined by a participant answering 'yes' to the question, 'Are you currently on regular medication and lifestyle modifications from your physician for high blood pressure?' Finally, a controlled HTN state was defined by a participant being treated with an antihypertensive medication and having an average blood-pressure reading with an SBP of less than 140 mm Hg and a DBP reading of less than 90 mm Hg.

Figure 1 Schematic diagram of study design.

During the first visit in May 2003, participants of both groups completed the questionnaire and had their blood pressure, height and weight measured. For each patient, the blood-pressure measurement and whether or not the patient was hypertensive was recorded. After 3 years, the participants were called and asked to complete the questionnaire and to have their blood pressure, height and weight measured again. The measurement and hypertensive status were recorded again. The same healthcare staff made the repeated visits for each participant to minimize inter-interviewer variation.

Outcome variables and definitions

The dietary patterns consisted of salt intake, vegetable and fruit intake, fat intake and other data. A salty diet was defined as the consumption of an average of more than 6 g of salt per day. Excessive fat intake was defined as the consumption of an average of more than 25 g of fat per day. Pickled food is a type of food that is preserved in salt or by fermentation, such as kippers and bacon.

Many studies related to smoking exist with various definitions of smoking statuses.^{15–18} In this study, individuals who currently smoked and had smoked at least 100 cigarettes during their lifetime were defined as current smokers, which was the same definition used by the community intervention trial for smoking cessation (COMMIT) in the United States.¹⁵ In our survey, self-reported smoking was assessed by the following questions: ‘Do you smoke any cigarettes, self-made cigarettes and cigars now?’ and ‘Have you smoked at least 100 cigarettes during your lifetime?’

Alcohol consumption data were collected from the questionnaire using the question, ‘Considering all types of alcoholic beverages, how many times during the past 30 days did you drink?’ For men, moderate drinking was defined as consuming an average of two drinks or less per day, and heavy drinking was defined as consuming an average of more than two drinks per day. For women, moderate drinking was defined as consuming an average of one drink or less per day, and heavy drinking was defined as consuming an average of more than one drink per day.^{19,20} Therefore, in our survey, self-reported drinking was measured by the question, ‘Do you consume an average of more than one drink per day?’

Physical activity was also addressed by the questionnaire. On the basis of the definition of physical activity in the Behavioral Risk Factor Surveillance System (BRFSS) of the United States,²¹ physical activity was defined by the following:

physical work, walking, riding a bicycle, jogging, dancing or qigong for 30 or more minutes per day on 6 or more days per week. The respondents were asked how many days per week they engaged in at least 30 min of physical activity, including physical work, walking, riding a bicycle, jogging, dancing or qigong according to the following categories: 6–7 days per week, 3–5 days per week, 1–3 days per week or never.

Analyses

The questionnaire consisted of many closed-ended and a few open-ended questions. The responses to open-ended questions were categorized during the analysis. Frequencies were used to describe the characteristics of the participants with respect to demographics, knowledge and perceptions on HTN, dietary and lifestyle behaviors. The percentages were then calculated. Changes in the knowledge and perceptions concerning HTN were established with the use of Chi-square tests to detect changes within or between groups. The same tests were used to detect changes in dietary and lifestyle behaviors. All statistical analyses were performed with SPSS 13.0 for windows (SPSS, Chicago, IL, USA).

RESULTS

Characteristics of the participants

Figure 1 shows the flow diagram of the study design. In total, 1632 participants were originally recruited for the study. All participants consented to participate in the study. Of the 826 participants in group I, 2 participants dropped out, 19 died and 9 provided the incorrect information. Of the 806 participants in group C who agreed to participate in the study, 64 participants dropped out during the study, 15 died and 14 provided wrong information. The final analysis was completed with 1509 participants, which included 796 in group I (96.4%) and 713 in group C (88.5%). The age range of the subjects was from 35 to 94 years, with a mean age of 50.67 ± 12.65 years in group I and 49.04 ± 11.65 years in group C. The rural participants were mainly the recipients of a primary or middle school education. The occupation of the participants was predominately farming. The mean blood pressure of the participants was 118.7 ± 21.4 mm Hg for

Table 1 Baseline characteristics of the participants (*N*=1632)

	Intervention (<i>n</i> =826)		Control (<i>n</i> =806)	
	<i>n</i>	%	<i>n</i>	%
<i>Age (years)</i>				
35–44	323	39.1	330	40.9
45–54	222	26.9	255	31.6
55–64	138	16.7	109	13.5
≥ 65	143	17.3	112	13.9
<i>Gender</i>				
Males	431	52.2	413	51.2
Females	395	47.8	393	48.8
<i>Education</i>				
No education	127	15.4	129	16
Primary school	291	35.2	317	39.3
Middle school	319	38.6	295	36.6
High school	73	8.8	45	5.6
College	1	0.1	5	0.6
Unknown	15	1.8	15	1.9
<i>Occupation</i>				
Farmer	731	88.5	631	78.3
Laborer	14	1.7	50	6.2
Government worker	26	3.1	55	6.8
House duty	26	3.1	60	7.4
Unknown	29	3.5	10	1.2
<i>Categories of BMI</i>				
CED (BMI < 18.5)	123	14.9	82	10.2
Normal (18.5–24.9)	640	77.5	657	81.5
Over weight (25.0–29.9)	48	5.8	45	5.6
Obese (≥ 30.0)	15	1.8	22	2.7

Abbreviations: BMI, body mass index; CED, chronic energy deficiency.

SBP and 72.1 ± 11.7 mm Hg for DBP in group I, and it was 123.8 ± 16.5 mm Hg for SBP and 79.0 ± 26.8 mm Hg for DBP in group C. The differences between group I and group C were not substantial and were not statistically significant in terms of age, gender, educational grade, occupation or blood pressure. The differences between those who were lost before follow-up from group I and group C were also not substantially significant. The participants in each group had similar baseline characteristics. Table 1 shows the characteristics of the study participants.

Knowledge on hypertension

The rate of understanding HTN was very low for all participants. A repeat of the questionnaire was performed at the last visit by all participants in April, 2006. After 3 years the beginning of the intervention, the participants in group I exhibited a significant improvement in their knowledge and perceptions on HTN and dietary and lifestyle behaviors. Significantly, more participants in group I responded correctly to the questions than those in group C. Following the health guidance, most of participants in group I knew that they should consume more fruits and vegetables, reduce sodium intake, increase low-fat dairy products, restrict alcohol consumption and smoking, exercise regularly and monitor their blood pressure regularly. The results are shown in Table 2.

Dietary and lifestyle behaviors

Table 3 shows the dietary and lifestyle behavior modifications of the participants. After 3 years of follow-up, there were significant dietary modifications in group I, such as changes in salt and fat intake. No significant difference in pickled food intake was detected between group I and group C after 3 years, but there was a significant reduction within group I and an increase within group C. No significant change in smoking frequency was observed between group I and group C after 3 years. Markedly, alcohol consumption was more significantly reduced after 3 years in group I than in group C. The percentage of participants who were physically active increased remarkably in the two groups; the percentages increased from 43.4 to 59.7% in the intervention group and from 43.7 to 70.2% in the control group.

Prevalence, awareness, treatment and control rates of hypertension

After 3 years, there was only a significant reduction for the prevalence rate of HTN in only the intervention group, which was from 35.4 to 22.5%. There was no change in the prevalence of HTN in the control group, as demonstrated by the number and the prevalence rate of HTN (291 and 36%) remaining almost unchanged. There was a significant increase in the awareness, treatment and control rates in hypertensive patients in the two groups. Table 4 shows the awareness, treatment and control rates in the hypertensive patients.

DISCUSSION

Our motivational approach improved HTN knowledge and influenced participants to modify their unhealthy, traditional lifestyles. The results of the knowledge and lifestyle survey showed a statistically significant difference after 3 years of follow-up (a general positive trend toward healthy diets and lifestyles) in group I. An increased number of participants who correctly answered questions concerning HTN knowledge were found in group I. Remarkably, the knowledge item that was related to physical activity had the lowest scores in both groups. A possible explanation might involve the misconception surrounding the definition of physical activity in the study. Being mostly farmers, the participants did not think that physical activity included physical work. A precise interpretation of this concept should be used in future studies to eliminate the misconceptions. Significantly more participants in group I gave up the traditional, unhealthy dietary behaviors (excessive salty and fatty foods) and lifestyle behaviors (drinking) than those in group C. In contrast, most likely due to dietary changes accompanying lifestyle changes, there was a significant increase in the percent of participants in group C who consumed a high-fat diet (14.3–31.9%) and pickled food (6.5–15.3%). Our results showed that the community health intervention was associated with positive changes for rural residents. The intervention was successful in improving rural residents' HTN knowledge and modifying some unhealthy dietary and lifestyle behaviors.

The significant reduction of prevalence rate found in the intervention group may be explained by the fact that the participants belonging to this group received intervention measures during the study, and they also attended the data collection visit during the 3-year follow-up. These contacts may have enhanced the participants' awareness of blood-pressure measurements and improved adherence to the lifestyle modifications; they may have also felt that they were being provided with quality medical care. Alternatively, healthcare providers might have been more aggressive in identifying and treating HTN in the intervention group. The magnitude of the increase in the awareness, treatment and control rates of HTN in the control group was surprising. In our opinion, a possible explanation might be related to the popular HTN knowledge and better pharmacological treatment

Table 2 Number of participants who correctly answered questions on hypertension knowledge (Test performed in May, 2003 and in April, 2006)

	Intervention (n=826)			Control (n=806)			
	2003	2006	P-value ^a	2003	2006	P-value ^b	P-value ^c
<i>Risk factor</i>							
High-salt intake (n, %)	303 (36.7)	664 (80.4)	<0.05	274 (34.0)	281 (34.9)	0.714	<0.05
Smoking (n, %)	123 (14.9)	229 (27.7)	<0.05	172 (21.3)	180 (22.3)	0.630	<0.05
Alcohol abuse (n, %)	264 (32.0)	510 (61.7)	<0.05	307 (38.1)	319 (39.6)	0.540	<0.05
<i>Prevention and hazard</i>							
Measure blood pressure every year (n, %)	309 (37.4)	727 (88.0)	<0.05	373 (46.3)	631 (78.3)	<0.05	<0.05
High blood pressure can lead to stroke and coronary heart disease (n, %)	629 (76.2)	688 (83.4)	<0.05	559 (69.4)	599 (74.3)	<0.05	<0.05
Healthy lifestyle can prevent blood-pressure raising (n, %)	531 (64.3)	777 (94.1)	<0.05	476 (59.1)	729 (90.5)	<0.05	<0.05
<i>Treatment approach</i>							
Take medication according to doctor's advice (n, %)	235 (28.5)	693 (83.9)	<0.05	161 (20.0)	525 (65.1)	<0.05	<0.05
Improved dietary (n, %)	221 (26.8)	294 (35.6)	<0.05	190 (23.4)	203 (25.2)	0.451	<0.05
Take regular exercise (n, %)	40 (4.8)	94 (11.38)	<0.05	4 (0.5)	14 (1.7)	<0.05	<0.05
Reducing tensions (n, %)	70 (8.5)	187 (22.6)	<0.05	12 (1.5)	20 (2.5)	0.153	<0.05

^a χ^2 -test of Group I between the 2003 and 2006.

^b χ^2 -test of Group C between the 2003 and 2006.

^c χ^2 -test between intervention and control groups in April, 2006.

Table 3 Dietary and lifestyle behaviors of the participants (Test performed in May, 2003 and in April, 2006)

	Intervention (n=826)			Control (n=806)			
	2003	2006	P-value ^a	2003	2006	P-value ^b	P-value ^c
<i>Dietary</i>							
Salty diet (n, %)	352 (43.6)	112 (13.6)	<0.05	219 (27.2)	175 (21.7)	<0.05	<0.05
Fat intake (n, %)	264 (32.0)	189 (22.9)	<0.05	115 (14.3)	257 (31.9)	<0.05	<0.05
Pickled food (n, %)	248 (30.0)	132 (16.0)	<0.05	52 (6.5)	123 (15.3)	<0.05	0.689
<i>Lifestyle</i>							
Smoking (n, %)	244 (29.5)	215 (26.0)	0.111	193 (23.9)	218 (27.0)	0.153	0.641
Regular drinking (n, %)	114 (13.8)	79 (9.6)	<0.05	86 (10.7)	145 (18.0)	<0.05	<0.05
Physical exercise (n, %)	358 (43.3)	493 (59.7)	<0.05	352 (43.7)	566 (70.2)	<0.05	<0.05

^a χ^2 -test of Group I between the 2003 and 2006.

^b χ^2 -test of Group C between the 2003 and 2006.

^c χ^2 -test between intervention and control groups in April, 2006.

Table 4 Awareness, treatment and control rates of the patients with hypertension

	Intervention (n=292)			Control (n=291)			
	2003	2006	P-value ^a	2003	2006	P-value ^b	P-value ^c
Awareness (n, %)	114 (39.0)	168 (57.5)	<0.05	55 (18.9)	100 (34.4)	<0.05	<0.05
Treatment (n, %)	99 (33.9)	136 (46.6)	<0.05	41 (14.1)	82 (28.2)	<0.05	<0.05
Control (n, %)	35 (12.0)	106 (36.3)	<0.05	8 (2.7)	60 (20.6)	<0.05	<0.05

^a χ^2 -test of Group I between the 2003 and 2006.

^b χ^2 -test of Group C between the 2003 and 2006.

^c χ^2 -test between intervention and control groups in April, 2006.

with social development. Therefore, the awareness, treatment and control rates of HTN increased remarkably in both groups.

The goal of this intervention was to encourage the implementation of more health-conscious behavior and to reduce unhealthy dietary and lifestyle behaviors. Different from previous interventions, we

stressed both individual behavior change and information dissemination. We also emphasized the existence of comprehension differences in the healthcare staff so that they could effectively communicate with the participants. We confirmed that the unhealthy, traditional dietary behaviors and lifestyles in rural residents could be influenced by the

messages provided by healthcare staff. We also demonstrated that a health education contact could have an effect on the dietary behaviors and lifestyle modification even in the less-educated rural residents. The positive aspects of the present intervention include the evidence that the HTN knowledge of the participants improved greatly; thus the intervention should optimally have a positive effect on both the participants themselves and on their families. The positive influences will help the participants to form healthy behaviors for years to come.

One potential limitation of the study was that the active intervention was carried out directly with the study subjects. The ability to generalize the study to a larger population is limited because the rural health staff was limited to an area. We should select important persons as our intervention subjects and encourage them to disseminate HTN knowledge and healthy lifestyle information to their family members and neighbors. Another limitation to consider is the cost of such a program. According to the ESH-ESC (the European Society of Hypertension and the European Society of Cardiology) Guidelines,²² lifestyle recommendations should be implemented with adequate expert support, and they should be periodically reinforced. This motivational approach is time consuming, and future studies are needed to evaluate the economical aspect. In addition, another limitation of the study is that the measurements of blood pressure by the healthcare staff may have resulted in biased blood-pressure measurements. An electronic blood-pressure device should be used in future studies to ensure accurate readings.

CONCLUSIONS

Our intervention strengthened the participants' HTN knowledge and resulted in positive and healthy behavior modifications. Our findings show that this approach is a powerful tool for reducing HTN prevalence and improving long-term health outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Authors contributions: Nie SF and Wu J participated in the designing of the study and supervised all aspects of its implementation. Huang SQ participated in the designing of the study and led the writing and the statistical analyses. Hu XY, Chen HY and Xie DS carried out the data collection and performed the statistical analyses. Gan XM and Wu YQ assisted with the study and completed the statistical analyses. All authors helped to conceptualize ideas, interpret findings, read and approve the final manuscript.

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