Prevalence of Depression and Associated Relationship with Lifestyles in Chinese Adults with Multi-Level Generalized Estimation Equation Model

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Research article

Abstract

Background

Most epidemiological surveys paid more attention to the occurrence of depression in the elderly and adolescents, while ignored the young and middle-aged people. Besides, depression resulted from a complex interaction of heredity, biochemistry, social, psychological and biological factors. The aim of our study was to examine the prevalence of depression and the relationship between depression and lifestyle factors in Chinese adults based on a large-scale cross-sectional survey.

Methods

The Composite International Diagnostic Interview Short Form for Major Depression was used to assess the depression status of all subjects. We used multi-level generalized estimating equation model to determine the relationship between depression and lifestyles.

Results

Of the 7985 respondents, 4252 were considered as being depressive with a prevalence of 53.25%. After controlling for the cluster effect of living environment and confounding effect of demographic characteristics, the following factors increased the risk of depression: overweight(OR=1.269, 95% CI: 1.117-1.444), obesity(OR=1.415, 95%CI: 1.152-1.740), single status(OR=2.003, 95% CI: 1.635-2.457), alcohol drinking(OR=1.333, 95%CI: 1.137-1.563), sleeping less than 6h a day(OR=1.485, 95% CI: 1.267-1.743), poor sleep quality (OR=1.553, 95% CI: 1.392-1.732), feeling stressed(OR=2.133, 95% CI: 1.744-2.621), adverse life events(OR=1.513, 95% CI: 1.333-1.718),unhealthy dietary patterns(OR=1.472, 95% CI: 1.324-1.638), irregular meal times (OR=2.482, 95% CI: 2.138-2.887) and suboptimal health status(OR=7.919, 95% CI: 6.843-9.185). Those with medical insurance (OR=0.774, 95% CI: 0.649-0.921) was less likely to have depression.

Conclusions

Unhealthy lifestyles were found closely associated with depression. By altering lifestyle behaviors for the better, the depressive symptoms could be effectively improved.

1. Introduction

With the rapid development of society, work pressure and competition people are confronting with are also increasing. People tend to feel fatigued, or even suffer from psychological sickness under severe pressure. The incidence rate of depression in China has been increasing gradually in recent years. Depression is a kind of affective disorder with long-lasting depressed mood as the main clinical feature [1]. The core symptoms are "three low", that is, depressed mood, reduced energy, loss of interest and enjoyment, which also be accompanied by slow reaction, sleep disorder and poor concentration [2]. As a chronic mental disease, depression has the characteristics of high prevalence, high disability rate, high

suicide rate, high comorbidity rate, high recurrence rate and high disease burden [3]. Depression can not only cause disorders of the nervous and endocrine system, leading to a variety of diseases, but also impair social function, resulting in problems such as inability to continue with social, work or domestic activities. At its worst, depression can lead to suicide, causing great harm to themselves and their families [4]. Globally, there are about 300 million to 400 million people suffering from depression, and the global prevalence is about 4.4% [5]. In China, depression is the most common mental disorder with a lifetime prevalence of 6.9% and a 12-month prevalence of 3.6% [6]. Based on this prevalence, we estimate that there are more than 95 million depression patients in China. WHO lists MDD as the third cause of disease burden in the world and the first cause of disease burden in high- and middle-income countries [7]. Therefore, it is necessary to study depression, a major public health problem.

At present, most epidemiological surveys paid more attention to the occurrence of depression in special populations such as the elderly and pregnant women, while ignored the depression in young and middle-aged people. China has entered an aging society since 1999 [8], chronic mental diseases such as depression in the elderly have seriously impaired the physical health, mental health and quality of life of the elderly[9]. However, it should be noted that the problem of disease care for the elderly and the sharp reduction in retirement income of the elderly have brought great pressure to the only-child family[10]. In addition, with the rapid development of economy and the intensification of social competition, the economic and spiritual burden of the young and middle-aged people has greatly increased, and various psychological stress factors of people have increased sharply. Therefore, the mental health of young and middle-aged people should also be paid enough attention.

Depression results from a complex interaction of heredity, biochemistry [11, 12], social, psychological and biological factors. Psychological and social environment factors are important factors affecting the occurrence and development of depression [13]. Adverse cultural and educational environment, tensional interpersonal relationship, unhappy marriage, unemployment and psychological trauma are all likely to lead to the occurrence of depression [14, 15]. Depression is also highly correlated with lifestyle. Long-term unhealthy lifestyles not only lead to disorders of body functions, resulting in many chronic diseases, but is also closely related to the occurrence of depression. Lifestyle includes sleep time, sleep quality, stress, diet choices, smoking, exercise and so on.

In addition, people living in the same community may be affected by the same socioeconomic environment, while previous studies did not consider the clustering effect of similar living environment, which may have confounding effects on the accuracy of the research results on the relationship between adult depression and lifestyle. Therefore, the aim of the present study was to determine the prevalence of depression and associated factors in Chinese adults across a broad age range, above 18 years, using a large-scale, cross-sectional survey. A multi-level generalized estimation equation (GEE) was constructed to evaluate the relationship between depression and lifestyles, controlling for the cluster effect of location and the confounding effect of demographic characteristics.

2. Materials And Methods

2.1. Sample and Participants

The sample was taken from a large-scale population survey about Chinese people's physiological and psychological constants conducted in 2010. This survey was conducted in Yunnan Province, southwest of China and two-stage cluster sampling method was used. Firstly, two cities were sampled and then several communities and villages were randomly selected in the cities. In these selected communities, all the eligible individuals were surveyed: those aged 18 years old or above, who had not suffered from certain severe chronic diseases and had not experienced a high fever in the preceding 15 days. After providing written informed consent, the participants attended temporary physical examination centers voluntarily to take part in the survey. The study was approved by the ethics review board of the Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences (No. 005-2008).

8,151 participants signed the informed consent form and were willing to take part in this survey, among which 7,985 participants completed all survey scales and the completion rate was 97.96%.

2.2. DefinitionA of Depression and Covariates

The Composite International Diagnostic Interview Short Form for Major Depression was used to assess the depression status of all subjects [16, 17]. Each subject was asked with seven questions about his or her feeling during the past year. If a subject has responded as 'yes' for one or more questions, he or she will be considered as being depressive.

Overweight and obesity was defined based on the Chinese Guidelines for the Prevention and Control of Adult Overweight and Obesity and the criteria of the Working Group on Obesity in China [18]. Overweight was defined by a body mass index (BMI) $\geq$ 24 kg/m2, but < 28 kg/m2, and obesity by a BMI $\geq$ 28 kg/m2.

Stress and life event defined about whether the participant felt about some economic stress, life stress or work stress and negative events or positive events recently. Diet choice included a routine diet choice or an unhealthy diet choice and the unhealthy diet choice meant highly spicy, sweet, salty or greasy food. Irregular meal time indicated the participant could not have breakfast, lunch and dinner at fixed time period. Sub-health status was assessed with the Delphi sub-health scale [19, 20].

2.3. Statistical Analysis

The case report forms were double-checked and the raw data were inputted twice, by two data managers, to guarantee its accuracy and integration. All statistical analysis was performed by SAS9.4 software. P < 0.05 was defined as statistically significant. Continuous data were described with mean and standard deviation. Categorical data were described with numbers and percentages and compared using the chi-square test. A multi-level GEE model was used to determine the relationship between depression and lifestyles to control for the cluster effect of location and the confounding effect of demographic characteristics. Odds ratios (ORs) and their 95% confidence intervals (CIs) were used to assess the strength of each relationship.

3. Results

The mean age of the 7,985 participants was 37.6 ± 16.1 years, that of the 3,073 men was 38.8 ± 15.8 years, and that of the 4,912 females was 36.9 ± 16.3 years. The participants were of dozens of ethnicities, including Han (5,034; 63.04%), Yi (2,412; 30.21%), and others (539; 6.75%). 37.42% of all participants took mental work, such as teacher, doctor, professionals, students, governmental and institute employees et al. Percentages of current smokers and alcohol consumers were 21.16% and 17.58% respectively. Percent of overweight and obese participants were 21.96% and 71.2% respectively. 768 participants (9.62%) reported feeling about strong stress in work, home or economy. 2040 participants (25.55%) suffered from some positive or negative life events recently. 28.68% of all participants exercised regularly. 12.79% of all participants normally slept for < 6 h a day and only 36.66% of all participants reported good sleep quality. 59.97% of all participants habitually consumed a special diet and 16.18% of all participants could not have breakfast, lunch and dinner in fixed hours regularly. 89.04% of all participants had medical insurance.

Of all 7,985 participants, 4,252 reported one or many depression symptoms and the prevalence of depression was 53.25%. The median number of depression symptoms was 1 (0, 2). The prevalence of depression in males (49.11%) was lower than in females (55.84%, P < 0.0001). The prevalence of depression was 60.07% in young participants, 44.66% in middle-aged participants, and 57.52% in older adult participants, and then the prevalence of depression was lowest in middle-aged participants (P < 0.0001). Among the ethnicities studied, Yi participants had a lower prevalence of depression (39.26%) than Han (58.68%) and others (65.12%). Physical laborers had a lower prevalence (47.73%) of depression than their counterparts (62.48%). Married participants had a lower prevalence (47.07%) than single ones (64.52%) and widowed or divorced ones (65.12%). The prevalence of depression was 43.50% in participants with primary school educational level, 56.98% in ones with middle school educational level, and 62.36% in ones with college educational level. The prevalence of depression increased gradually with educational level (P < 0.0001). Current smokers had a lower prevalence of depression (49.47%) than their counterparts (54.27%), but current alcohol consumers had a higher prevalence of depression (55.91%) than their counterparts (52.68%). Participants who normally slept for < 6 h a day had a higher prevalence of depression (64.84%) than their counterparts (51.55%). Participants who had a poor sleep quality had a higher prevalence of depression (60.00%) than their counterparts (41.58%). Respondents who felt about some stress (78.78% VS 50.53%) or suffered from some life events (67.45% VS 48.38%) had higher prevalence rates of depression than counterparts. Participants who habitually consumed a special diet (59.62%) had higher prevalence of depression than their counterparts (43.71%). Respondents who had breakfast, lunch and dinner at fixed hours regularly had lower prevalence rates of depression than counterparts (50.83% VS 65.79%). Respondents in sub-health status had higher prevalence rates of depression status than counterparts (60.41% VS 25.37%). Compared with participants without medical insurance, those with medical insurance had lower prevalence rates of depression (51.97% VS 63.66%). The prevalence and factors related to depression, classified according to demographic characteristics, are listed in Table 1.

Table 1
Prevalence (%) of depression about demographic characteristics

	Total	depression		Chi-square test	
		no	Yes	Chi-square	*P**
All subjects	7985	3733(46.75%)	4252(53.25%)		
Age (years)				175.7001	< 0.0001
18−34	3691	1474(39.93%)	2217(60.07%)		
35−59	3383	1872(55.34%)	1511(44.66%)		
>=60	911	387(42.48%)	524(57.52%)		
Gender				34.4724	< 0.0001
Male	3073	1564(50.89%)	1509(49.11%)		
Female	4912	2169(44.16%)	2743(55.84%)		
Occupation				163.5198	< 0.0001
Physical laborer	4997	2612(52.27%)	2385(47.73%)		
Mental laborer	2988	1121(37.52%)	1867(62.48%)		
Marrital status				218.0576	< 0.0001
Married	5097	2698(52.93%)	2399(47.07%)		
Single	2652	941(35.48%)	1711(64.52%)		
Widowed or divorced	236	94(39.83%)	142(60.17%)		
Education level				204.4340	< 0.0001
Primary school	3069	1734(56.50%)	1335(43.50%)		
Middle school	2759	1187(43.02%)	1572(56.98%)		
College	2157	812(37.64%)	1345(62.36%)		
Smoker				12.3196	0.0004
No	6295	2879(45.73%)	3416(54.27%)		
Yes	1690	854(50.53%)	836(49.47%)		
Alcohol drinker				4.8485	0.0277
No	6581	3114(47.32%)	3467(52.68%)		
Yes	1404	619(44.09%)	785(55.91%)		

	Total	depression		Chi-square test	
		no	Yes	Chi-square	P*
Ethnicity				279.7303	< 0.0001
Han	5034	2080(41.32%)	2954(58.68%)		
Yi	2412	1465(60.74%)	947(39.26%)		
Others	539	188(34.88%)	351(65.12%)		
BMI				1.9884	0.3700
Normal	5685	2681(47.16%)	3004(52.84%)		
Overweight	1755	811(46.21%)	944(53. 79%)		
Obesity	545	241(44.22%)	304(55.78%)		
Sleep duration				63.1537	< 0.0001
>=Six hours	6964	3374(48.45%)	3590(51.55%)		
<six hours	1021	359(35.16%)	662(64.84%)		
Sleep quality				252.8518	< 0.0001
Good	2927	1710(58.42%)	1217(41.58%)		
Poor	5058	2023(40.00%)	3035(60.00%)		
Stress				222.4079	< 0.0001
No	7217	3570(49.47%)	3647(50.53%)		
Yes	768	163(21.22%)	605(78.78%)		
Life event				221.9719	< 0.0001
No	5945	3069(51.62%)	2876(48.38%)		
Yes	2040	664(32.55%)	1376(67.45%)		
Regular exercise				0.5227	0.4697
No	5695	2677(47.01%)	3018(52.99%)		
Yes	2290	1056(46.11%)	1234(53.89%)		
Diet choice				194.7767	< 0.0001
Routine	3196	1799(56.29%)	1397(43.71%)		
Unhealthy	4733	1934(40.38%)	2855(59.62%)		
Meal time				97.3609	< 0.0001

	Total	depression		Chi-square test	
		no	Yes	Chi-square	P*
Regular	6693	3291(49.17%)	3402(50.83%)		
Irregular	1292	442(34.21%)	850(65.79%)		
Sub-health status				640.5732	< 0.0001
No	1632	1218(74.63%)	414(25.37%)		
Yes	6353	2515(39.59%)	3838(60.41%)		
Medical insurance				42.7551	< 0.0001
No	875	318(36.34%)	557(63.66%)		
Yes	7110	3415(48.03%)	3695(51.97%)		

Table 2 shows the results of the univariate and multivariate multi-level GEE models constructed using the factors associated with depression. After controlling for the cluster effect of location and the confounding effect of other covariates, no significant associations were found between smoking status or exercise and depression. Compared with young participants, middle-aged (OR = 0.812, 95% CI: 0.687−0.960) had lower prevalence of depression. Compared with participants with primary school educational level, participants with middle school educational level (OR = 1.462, 95% CI: 1.171−1.826) and participants with college educational level (OR = 1.354, 95% CI: 1.172−1.565) had higher prevalence of depression. Compared with normal-weight participants, overweight (OR = 1.269, 95% CI: 1.117−1.444) and obese participants (OR = 1.415, 95% CI: 1.152−1.740) had higher prevalence of depression. Thus, having a higher BMI or educational level increases the risk of depression. Compared with Hans, Yis (OR = 0.498, 95% CI: 0.438−0.566) were less likely to have depression.

Table 2
Risk factors associated with depression with multi-level GEE model

Characteristics	Univariate		Multivariate	
	OR	95%CI	OR	95%CI
Age (years)				
18–34	1.000	-	1.000	-
35–59	0.537	0.488–0.590	0.812	0.687–0.960
>=60	0.900	0.777–1.043	1.189	0.947–1.492
Gender				
Male	1.000	-	1.000	-
Female	1.311	1.197–1.435	1.384	1.211–1.582
Occupation				
Physical laborer	1.000	-	1.000	-
Mental laborer	1.824	1.663–2.001	1.293	1.075–1.556
Marrital status				
Married	1.000	-	1.000	-
Single	2.045	1.857–2.253	2.003	1.635–2.457
Widowed or divorced	1.699	1.304–2.223	1.155	0.856–1.563
Education level				
Primary school	1.000	-	1.000	-
Middle school	1.720	1.551–1.909	1.462	1.171–1.826
College	2.151	1.923–2.408	1.354	1.172–1.565
Smoker				
No	1.000	-	1.000	-
Yes	0.825	0.741–0.919	0.972	0.829–1.138
Alcohol drinker				
No	1.000	-	1.000	-
Yes	1.139	1.015–1.279	1.333	1.137–1.563
Ethnicity				

* OR: Odds ratio; CI: confidence interval; GEE: generalized estimation equation

Characteristics	Univariate		Multivariate	
	OR	95%CI	OR	95%CI
Han	1.000	-	1.000	-
Yi	0.455	0.412−0.502	0.498	0.438−0.566
Others	1.315	1.093−1.585	1.018	0.820−1.267
BMI				
Normal	1.000	-	1.000	-
Overweight	1.039	0.933−1.157	1.269	1.117−1.444
Obesity	1.125	0.944−1.344	1.415	1.152−1.740
Sleep duration				
>=Six hours	1.000	-	1.000	-
<six hours	1.733	1.513−1.989	1.485	1.267−1.743
Sleep quality				
Good	1.000	-	1.000	-
Poor	2.108	1.922−2.313	1.553	1.392−1.732
Stress				
No	1.000	-	1.000	-
Yes	3.633	3.046−4.358	2.133	1.744−2.621
Life event				
No	1.000	-	1.000	-
Yes	2.211	1.990−2.459	1.513	1.333−1.718
Regular exercise				
No	1.000	-	1.000	-
Yes	1.037	0.941−1.142	0.925	0.821−1.042
Diet choice				
Routine	1.000	-	1.000	-
Unhealthy	1.901	1.736−2.082	1.472	1.324−1.638
Meal time				

* OR: Odds ratio; CI: confidence interval; GEE: generalized estimation equation

Characteristics	Univariate		Multivariate	
	OR	95%CI	OR	95%CI
Regular	1.000	-	1.000	-
Irregular	1.860	1.643−2.108	2.482	2.138−2.887
Sub-health status				
No	1.000	-	1.000	-
Yes	4.490	3.976−5.078	7.919	6.843−9.185
Medical insurance				
No	1.000	-	1.000	-
Yes	0.618	0.534−0.714	0.774	0.649−0.921
* OR: Odds ratio; CI: confidence interval; GEE: generalized estimation equation				

Females (OR = 1.384, 95% CI: 1.211−1.582), laborers with mental workers (OR = 1.293, 95% CI: 1.075−1.556), single participants (OR = 2.003, 95% CI: 1.635−2.457), current drinkers (OR = 1.333, 95% CI: 1.137−1.563), those who typically slept for < 6 h a day (OR = 1.485, 95% CI: 1.267−1.743), those with poor sleep quality (OR = 1.553, 95% CI: 1.392−1.732), those feeling some stress (OR = 2.133, 95% CI: 1.744−2.621) or with life event (OR = 1.513, 95% CI: 1.333−1.718), those consuming a special diet (OR = 1.472, 95% CI: 1.324−1.638), those without regular meal time (OR = 2.482, 95% CI: 2.138−2.887), and those in sub-health status (OR = 7.919, 95% CI: 6.843−9.185) had higher risk of depression. Compared with participants without medical insurance, those with medical insurance (OR = 0.774, 95% CI: 0.649−0.921) was less likely to have depression.

In summary, after controlling for the cluster effect of location, age, gender, occupation, marital status, educational level, current alcohol consumption, ethnicity, BMI, sleep duration, sleep quality, stress, life event, diet choice, meal time, sub-health status, and medical insurance were associated with depression.

4. Discussion

In our research, we verified that some factors including overweight, obesity, stress, adverse life events, excessive drinking, unhealthy dietary patterns, irregular meal times, short sleep duration, poor sleep quality, lack of medical insurance and being in a sub-health status will increase the risk of depression.

This study observed that smokers have lower risk of depression than non-smokers. After using the multivariate GEE model, it was found that there was no significant correlation between smoking and depression. It was speculated that the observed association between smoking and mental health might be the result of common genetic and environmental factors. Nicotine reported in a review that relevant studies have shown that smoking can increase the risk of depression[21]. There are also studies have

shown that smoking can relieve depression after suffering from depression, so depression is a susceptible factor of smoking [22]. However, the overall conclusions are still inconsistent at present, and few studies support the two-way relationship between smoking and depression [23], which requires strong causal inference [21].

In the longitudinal study of Gemes'K, mild and moderate drinkers have lower risk of depression than non-drinkers, but excessive drinking can increase the risk of depression [24]. On one hand, alcoholics often find it difficult to control their emotions and behaviors, which can easily lead to family conflicts. Long-term alcohol abuse is one of the main reasons for divorce, and it will also cause resistance to work. On the other hand, alcoholism will lead to changes in body metabolism. Overall, adverse life events and damage of physical health will make people more prone to suffer from depression [25].

There is insufficient evidence in previous studies to support that less physical activity is a risk factor of depression, which can only show that it affects the development or continuation of depression to some extent, that is, people with depression who have less physical activity are more likely to have continued depression over time[26]. Teychenne's research confirms that sedentary lifestyle is related to the increased risk of depression [27], and this research shows that the risk of physical workers is lower than that of mental workers. Although there is no significant association between regular exercise and depression in our study, previous studies show that exercise has a positive effect on the prevention and treatment of depression[28, 29].

In this study, we observed that unhealthy dietary patterns increased the risk of depression, and previous studies have shown that healthy dietary patterns are associated with low-level depression prevalence[30]. For example, Mediterranean diet includes vegetables, fruits, nuts, grains, beans, fish, and full-fat yogurt, and the intake of these dietary components can ameliorate the symptoms of depression, while unhealthy dietary patterns such as fast food and high-fat diet are directly related to depression[27, 31].

Some researches show that people with depression have higher levels of obesity [32], and there is sufficient evidence that obesity is a risk factor of depression. The underlying mechanism may be two-fold. Psychologically, people's ridicule to obesity brings stigma to obese people, and social pressure may even lead to their suicidal thoughts. Physiologically, obese people suffer more severe impairment of body functions [33]. Although the pathogenesis of diseases is different, the common biological mechanisms of depression and obesity are the over-activation of the hypothalamic-pituitary-adrenal axis (HPA axis) and the dysregulation of stress response system [34].

Short sleep duration and poor sleep quality are both closely associated with higher risk of depression [35, 36]. Insomnia is one of the most common prodromal features of depression, and 40% of cases have insomnia symptoms before the onset of depression. A meta-analysis has confirmed that the risk of depression in non-depressed people with insomnia is expected to increase by twice compared with those without sleep disorder [27, 37]. Many studies have confirmed that insufficient sleep and sleep disorders are related to many chronic diseases, such as hypertension, cancer, obesity and diabetes, as well as higher mortality [38–41].

The high-level prevalence of mental disorders has become a serious public health problem, and the development of mental health requires government support at all levels. Otherwise, the Ministry of Mental Health will be difficult to independently complete the management of psychotic patients [42]. Many studies have shown that access to health insurance can improve health. For example, when receiving emergency services, the psychological burden is small, and the decision-making time required is shortened, thus grasping the best time to treat diseases and improving the cure rate. However, the participants without medical insurance have higher risk of depression than those with medical insurance [43], which may be due to the fact that the participants with medical insurance do not have to worry about the cost of treatment, and they are more willing to ask professional doctors for help, thus improving the utilization rate of health care [44], which is consistent with the result of our study.

Sub-health is the intermediate state between health and disease [45], which is characterized by disorders of mental behavior or physiological characteristics or certain physical examination indexes and has no typical pathological characteristics [46]. Our study found that sub-health status increased the epidemic risk of depression by about 8 times.

Compared with the national prevalence of depression of 3.6% [6],the prevalence of depression obtained in our study is higher, and the difference in the prevalence of depression between different studies can be attributed to the different tools for evaluating depression to some extent [47]. The limitation of this study is to use the CIDI-SFMD questionnaire as the diagnostic tool, and CIDI-SFMD is a brief description of the full version of CIDI [48]. Its problem is relatively rough [49], and it does not contain as many details as the full version of CIDI [50], which may lead to lack of specificity, overestimating the prevalence of depression [23]. It is also inevitable that mental illness is assessed by self-reported symptoms, which represent a possible clinical diagnosis rather than a definitive clinical diagnosis. Therefore, we cannot exclude that self-reported symptoms may be affected by recall bias [51, 52]. Another limitation has to be mentioned. Due to the cross-sectional design, it is impossible to verify the causal relationship between depression and lifestyles, which need to be researched further in a prospective study.

5. Conclusions

As a serious public health challenge, depression need be attached more attention in Chinese adults. Unhealthy lifestyles were found closely associated with depression, including current alcohol consumption, overweight, obesity, less sleep duration, poor sleep quality, unhealthy diet choice, irregular meal time, stress, life event, without medical insurance and sub-health status. By changing these lifestyle behaviors for the better, depression could be effectively improved.

Declarations

Ethics approval and consent to participate

The study was approved by the ethics review board of the Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences (No. 005-2008). All included subjects gave their written informed consent forms to participate in the study.

Consent for publications

All participants gave verbal or written consent for their accounts to be anonymously published.

Availability of data and material

Data are held at the Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences. All relevant data are within the paper.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

LY drafted the manuscript. TX participated in the design of the study, preformed the statistical analysis and reviewed the manuscript. SH conceived of the study and participated in its design. All authors read and approved the final manuscript.

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