

# World Journal of *Diabetes*

*World J Diabetes* 2024 April 15; 15(4): 575-796



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The primary aim of *World Journal of Diabetes* (*WJD*, *World J Diabetes*) is to provide scholars and readers from various fields of diabetes with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

*WJD* mainly publishes articles reporting research results and findings obtained in the field of diabetes and covering a wide range of topics including risk factors for diabetes, diabetes complications, experimental diabetes mellitus, type 1 diabetes mellitus, type 2 diabetes mellitus, gestational diabetes, diabetic angiopathies, diabetic cardiomyopathies, diabetic coma, diabetic ketoacidosis, diabetic nephropathies, diabetic neuropathies, Donohue syndrome, fetal macrosomia, and prediabetic state.

**INDEXING/ABSTRACTING**

The *WJD* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, PubMed Central, Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2023 Edition of Journal Citation Reports® cites the 2022 impact factor (IF) for *WJD* as 4.2; IF without journal self cites: 4.1; 5-year IF: 4.5; Journal Citation Indicator: 0.69; Ranking: 51 among 145 journals in endocrinology and metabolism; and Quartile category: Q2.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: *Yu-Xi Chen*; Production Department Director: *Xu Guo*; Cover Editor: *Jia-Ru Fan*.

**NAME OF JOURNAL**

*World Journal of Diabetes*

**ISSN**

ISSN 1948-9358 (online)

**LAUNCH DATE**

June 15, 2010

**FREQUENCY**

Monthly

**EDITORS-IN-CHIEF**

Lu Cai, Md. Shahidul Islam, Michael Horowitz

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/1948-9358/editorialboard.htm>

**PUBLICATION DATE**

April 15, 2024

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**INSTRUCTIONS TO AUTHORS**

<https://www.wjgnet.com/bpg/gerinfo/204>

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<https://www.wjgnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjgnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>



## Retrospective Study

# Prevalence and risk factors of diabetes mellitus among elderly patients in the Lugu community

Li-Zhen Zhao, Wei-Min Li, Ying Ma

**Specialty type:** Endocrinology and metabolism

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): B  
Grade C (Good): C  
Grade D (Fair): 0  
Grade E (Poor): 0

**P-Reviewer:** Lee JH, South Korea; Shapiro AMJ, Canada

**Received:** December 19, 2023

**Peer-review started:** December 19, 2023

**First decision:** January 9, 2024

**Revised:** January 29, 2024

**Accepted:** February 27, 2024

**Article in press:** February 27, 2024

**Published online:** April 15, 2024



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## Abstract

### BACKGROUND

Age is a significant risk factor of diabetes mellitus (DM). With the develop of population aging, the incidence of DM remains increasing. Understanding the epidemiology of DM among elderly individuals in a certain area contributes to the DM interventions for the local elderly individuals with high risk of DM.

### AIM

To explore the prevalence of DM among elderly individuals in the Lugu community and analyze the related risk factors to provide a valid scientific basis for the health management of elderly individuals.

### METHODS

A total of 4816 elderly people who came to the community for physical examination were retrospectively analyzed. The prevalence of DM among the elderly was calculated. The individuals were divided into a DM group and a non-DM group according to the diagnosis of DM to compare the differences in diastolic blood pressure (DBP) and systolic blood pressure (SBP), fasting blood glucose, body mass index (BMI), waist-to-hip ratio (WHR) and incidence of hypertension (HT), coronary heart disease (CHD), and chronic kidney disease (CKD).

### RESULTS

DM was diagnosed in 32.70% of the 4816 elderly people. The BMI of the DM group ( $25.16 \pm 3.35$ ) was greater than that of the non-DM group ( $24.61 \pm 3.78$ ). The WHR was  $0.90 \pm 0.04$  in the non-DM group and  $0.90 \pm 0.03$  in the DM group, with no significant difference. The left SBP and SBP in the DM group were  $137.9 \text{ mmHg} \pm 11.92 \text{ mmHg}$  and  $69.95 \text{ mmHg} \pm 7.75 \text{ mmHg}$ , respectively, while they were  $126.6 \text{ mmHg} \pm 12.44 \text{ mmHg}$  and  $71.15 \text{ mmHg} \pm 12.55 \text{ mmHg}$ , respectively, in the non-DM group. These findings indicate higher SBP and lower DBP in DM patients than in those without DM. In the DM group, 1274 patients were dia-

gnosed with HT, accounting for 80.89%. Among the 3241 non-DM patients, 1743 (53.78%) were hypertensive and 1498 (46.22%) were nonhypertensive. The DM group had more cases of HT than did the non-DM group. There were more patients with CHD or CKD in the DM group than in the non-DM group. There were more patients who drank alcohol more frequently ( $\geq 3$  times) in the DM group than in the non-DM group.

## CONCLUSION

Older adults in the Lugu community are at a greater risk of DM. In elderly individuals, DM is closely related to high BMI and HT, CHD, and CKD. Physical examinations should be actively carried out for elderly people to determine their BMI, SBP, DBP, and other signs, and sufficient attention should be given to abnormalities in the above signs before further diagnosis.

**Key Words:** Diabetes mellitus; Type 2 diabetes mellitus; Elderly; Risk factors

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**Core Tip:** Age is a significant risk factor of diabetes mellitus (DM). An investigation focusing on the prevalence and risk factors of DM among elderly individuals is necessary. A total of 4816 elderly people who came to the community for physical examination were retrospectively analyzed in this study. older adults in the Lugu community are at high risk of DM, a disease highly correlated with high body mass index (BMI) and hypertension, coronary heart disease and chronic kidney disease in the elderly population. Therefore, physical examinations should be actively carried out for elderly individuals in the Lugu community to determine their demographic indices, such as BMI, systolic pressure, and diastolic pressure. Moreover, adequate attention should be given to those with abnormal signs, and blood glucose levels should be further determined.

**Citation:** Zhao LZ, Li WM, Ma Y. Prevalence and risk factors of diabetes mellitus among elderly patients in the Lugu community. *World J Diabetes* 2024; 15(4): 638-644

**URL:** <https://www.wjgnet.com/1948-9358/full/v15/i4/638.htm>

**DOI:** <https://dx.doi.org/10.4239/wjd.v15.i4.638>

## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a multifactorial chronic metabolic disorder characterized by hyperglycemia and insulin resistance[1]. The pathogenesis of this type of DM mainly involves: (1) The lack of insulin secreted by pancreatic cells *in vivo*; and (2) the inability of insulin-sensitive tissues to respond to insulin[2]. In recent years, the number of people with DM has shown a significant upward trend, especially in Asia[3]. China has one of the highest prevalence rates of DM in Asia, and it faces an enormous burden of DM[4], with approximately 11% of the population affected by the disease [5]. In addition to causing problems such as metabolic disorders caused by their own diseases, DM may also increase the risk of patients suffering from retinopathy[6], stroke[7], nephropathy[8], cardiovascular diseases[9] and other diseases.

The aging population and changing lifestyles have made DM more common among older adults[10]. Currently, elderly individuals, especially those aged 60-79 years, have a high incidence of DM, with nearly 50% of patients being aged  $\geq 65$  years[11]. DM is associated with a high risk of metabolic disorders in elderly individuals, which may increase mortality and reduce quality of life in older adults[12]. It is argued that DM increases the risk of hypoglycemia in older adults, which can lead to cognitive impairment, cardiovascular disease and even death[13]. Therefore, it is necessary to consider the glycemic indices of the elderly population, focusing on elderly individuals who may have DM or have been diagnosed. Understanding the prevalence of DM among elderly people in a certain area and discussing the risk factors related to DM are conducive to carrying out targeted interventions for the local elderly population and developing effective blood glucose (BG) management strategies[14].

The purpose of this study was to explore the prevalence of DM among elderly individuals in the Lugu community and analyze the related risk factors. A total of 4816 older adults who came to the community for physical examination were included, and clinical signs such as body mass index (BMI), waist-to-hip ratio (WHR), and systolic blood pressure (SBP) and diastolic blood pressure (DBP) were collected to diagnose hypertension (HT) and DM. The findings of this study will help to understand the DM status of elderly individuals in the Lugu community and provide corresponding health management suggestions for elderly individuals who come to the community for physical examination.



## MATERIALS AND METHODS

### Case data

In this study, physical examination data were collected from 37562 people who had physical examinations in the Lugu community, among whom 4816 elderly people (aged  $\geq 60$  years) were analyzed retrospectively. The weight, height, waist circumference, hip circumference, DBP, SBP, fasting BG (FBG), BMI, and WHR of the elderly individuals were analyzed, as was the incidence of DM and its risk factors.

### Detection methods and observation indicators

**BP testing:** The subjects had no strenuous exercise within 30 min before BP testing. Left SBP and DBP were measured using a noninvasive automatic sphygmomanometer. Subjects who showed SBP was at least 140 mmHg and/or their DBP was at least 90 mmHg at each of the three non-same-day measurements was considered to be HT.

**FBG detection:** Venous blood was collected at 7:00-9:00 am in the morning after overnight fasting for 8-12 h. The blood sample was placed in a centrifuge tube containing heparin sodium (heparin sodium: blood = 1:9) and centrifuged at 3000 rpm for 10 min, after which the supernatant was carefully aspirated to obtain plasma samples. BG levels were measured by a BS-300 automatic biochemical analyzer. Patients with a FBG  $\geq 7.0$  mmol/L were further tested to determine whether they had DM.

**BMI:** The body weight (kg) and height (m) of the subjects were measured, and the BMI ( $\text{BMI} = \text{weight}/\text{height}^2$ ) was calculated.

**WHR:** Waist circumference (cm) and hip circumference (cm) were measured to calculate the WHR ( $\text{WHR} = \text{waist circumference}/\text{hip circumference}$ ).

### Data visualization and statistical analysis

The data visualization process of this study was carried out with GraphPad 9.0, and the research data are displayed as pie charts and histograms. This study employed SPSS 22.0 software for statistical analysis. The data were tested for normality using the Shapiro-Wilk test, and the mean and variance were calculated for normally distributed data. Intergroup differences in BMI, WHR, SBP, and DBP were identified using an independent sample *t* test, and the number of hypertensive patients was determined *via* a chi-square test.  $P < 0.05$  indicated statistical differences, and the confidence interval was set at 95%.

## RESULTS

### Prevalence of DM in the community physical examination population

This study enrolled 37562 community physical examinees, including 4816 (12.82%) elderly people (Figure 1A). Of the 6046 (16.10%) confirmed cases of DM in the total physical examination population, 1575 (26.05%) were elderly DM patients (Figure 1B). Among the 4816 elderly people, 32.70% were diagnosed with DM (Figure 1C). The age of patients in the DM group ranged from 65-81 years, and that of patients in the non-DM group ranged from 67-82 years. Additionally, of the patients in the DM group, 1029 were females and 546 were males. There were 1667 females and 1574 males in the non-DM group. Accordingly, we speculate that DM is a common disease among elderly individuals in the Lugu community.

### Comparison of BMI between the two groups

In this study, 4816 elderly people were divided into a DM group and a non-DM group according to their diagnosis of DM, and their BMI was determined. The results showed that the BMI of the individuals in the DM group was  $25.16 \pm 3.35$ , while that of the individuals in the non-DM group was  $24.61 \pm 3.78$  (Figure 2A), and these two groups were significantly different.

### Comparison of the WHR between the two groups

We also calculated the WHR of both groups and found that the WHR was  $0.90 \pm 0.04$  in the non-DM group and  $0.90 \pm 0.03$  in the DM group, with no significant difference ( $P > 0.05$ ; Figure 2B). Overall, we believe that DM patients have a slightly greater risk of obesity than non-DM patients.

### BP analysis of the two groups

The SBP and DBP of the elderly individuals in the two groups were calculated, and the results are shown in Table 1. The left SBP and DBP in the DM group were  $137.9 \text{ mmHg} \pm 11.92 \text{ mmHg}$  and  $69.95 \text{ mmHg} \pm 7.75 \text{ mmHg}$ , respectively, while they were  $126.6 \text{ mmHg} \pm 12.44 \text{ mmHg}$  and  $71.15 \text{ mmHg} \pm 12.55 \text{ mmHg}$ , respectively, in the non-DM group. The above data revealed significantly greater SBP and lower DBP in the DM group than in the non-DM group.

### Prevalence of HT in two groups

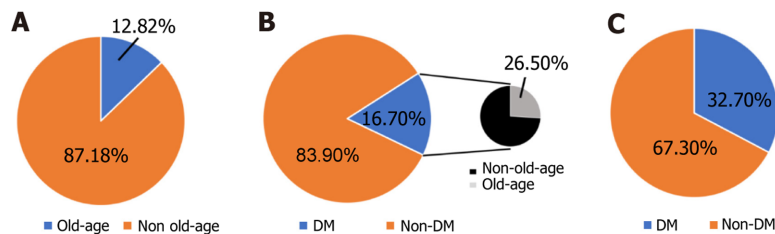
In this study, we analyzed the relationship between HT and DM incidence. In the DM group, 1274 patients were



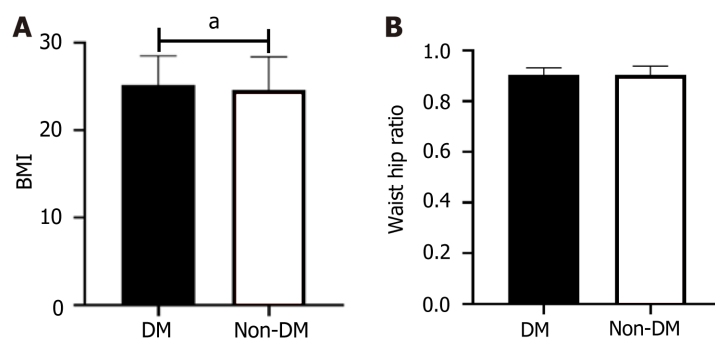
**Table 1 Comparison of hypertension and diastolic blood pressure between the two groups**

	DM group (n = 1575)	Non-DM group (n = 3241)	t value	P value
Systolic blood pressure (left side)	137.90 ± 11.92	126.60 ± 12.44	4.779	< 0.001
Diastolic blood pressure (left side)	69.95 ± 7.75	71.15 ± 12.55	3.475	0.005

DM: Diabetes mellitus; Non-DM: Nondiabetic mellitus.



**Figure 1 Statistics on the prevalence of diabetes mellitus in the community health examination population.** A: The proportion of elderly individuals in the total population who underwent community health examinations; B: The proportion of people with diabetes mellitus (DM) in the community physical examination population; C: The proportion of individuals with DM among the elderly individuals in the community physical examination population. DM: Diabetes mellitus; Non-DM: Nondiabetic mellitus; Nonold-age: Nonelderly; Old-age: Elderly.



**Figure 2 Comparison of body mass index and waist-to-hip ratios between the two groups.** A: Body mass index; B: Waist-to-hip ratios. \* $P < 0.001$ . BMI: Body mass index; DM: Diabetes mellitus; Non-DM: Nondiabetic mellitus.

confirmed to have HT, accounting for 80.89%. Among the 3241 non-DM patients, 1743 (53.78%) were hypertensive, and 1498 (46.22%) were nonhypertensive (Table 2). According to the statistical analysis, the number of hypertensive patients in the DM group was much greater than that in the non-DM group ( $P < 0.05$ ). There were more patients with coronary heart disease (CHD) or CKD in the DM group than in the non-DM group ( $P < 0.05$ ) (Table 2). Additionally, there were more patients who drank alcohol more frequently ( $\geq 3$  times) in the DM group than in the non-DM group. Therefore, the results obtained in this study suggested that HT is related to DM among elderly individuals in the Lugu community.

## DISCUSSION

The pathogenesis of DM is complicated and involves many factors. For elderly people, the pathophysiological changes caused by aging affect internal metabolic regulation, thus promoting the occurrence of DM; subsequently, aging and DM interact to further promote the progression of diabetic complications; this can also explain the ever-higher incidence of DM among elderly people[15]. A study of atherosclerosis risk based on 5791 older adults revealed that elderly individuals with pre-DM were at a lower risk of death, while those with long-term DM had a higher mortality rate[16], highlighting the importance of timely screening for DM among elderly individuals. In addition, DM is often asymptomatic, and identifying the presence of DM is often difficult until a blood sugar test is performed[17]. Hence, it is necessary to analyze the risk of DM according to other signs. This study included 4816 elderly people to analyze the prevalence of DM and associated risk factors and revealed that HT and high BMI were common in elderly diabetic patients.

The BMI of diabetic elderly individuals was found to be greater than that of nondiabetic elderly individuals. A person can be defined as underweight, normal weight, overweight or obese based on their BMI[18], with a higher BMI indicating a greater degree of fat accumulation. Older people often face the risk of obesity[19], which may further increase the risk of DM. Fat accumulation may be the pathological basis of DM. An obesity environment disrupts the dynamic balance of

Table 2 Statistics of underlying disease in the two groups				
	DM group (n = 1575)	Non-DM group (n = 3241)	$\chi^2$ value	P value
			332.9	< 0.001
Hypertension	1274	1743		
Nonhypertension	301	1498		
			227.8	< 0.001
Coronary heart disease	992	1291		
Noncoronary heart disease	583	1950		
			182.4	< 0.001
Chronic kidney disease	986	1357		
Non chronic kidney disease	589	1884		
Alcohol consumption, frequency per week			641.1	< 0.001
< 1 time	198	1569		
1-2 times	529	854		
≥ 3 times	848	818		

DM: Diabetes mellitus; Non-DM: Nondiabetic mellitus.

metabolism, which in turn causes fat accumulation and altered insulin secretion, leading to DM[20]. In contrast, weight loss is associated with improved glycemic control. For elderly individuals whose BMI is close to the warning value or who are already overweight, although they are not currently affected by DM, they should still be urged to control their diet and maintain good exercise habits to return their BMI to normal[21]. It is worth noting that the number of female diabetic patients in this study was higher than that of male patients, which may be related to the local dietary patterns, living habits, and health promotion. Therefore, it is necessary to expand the sample size in subsequent studies to verify the difference in the male-to-female ratio of diabetic patients.

We also noted that the incidence of HT in diabetic patients was greater than that in nondiabetic patients. HT and DM go hand in hand. On the one hand, insulin resistance leads to the destruction of vascular function, resulting in symptoms such as an increase in BP and vascular stiffness; on the other hand, arteriosclerosis and impaired vasodilation contribute to the progression of DM[22]. Research[23] has shown that HT can be an independent predictor of DM and that HT and DM have similar metabolic syndrome phenotypes. Over time, DM also interacts with HT, leading to microvascular and macrovascular lesions and increasing the risk of death[24]. Therefore, HT is an important symptom that cannot be ignored during the progression of DM. Older adults with abnormal BP, especially high BP, need attention before being diagnosed with DM. Additionally, we found that patients with DM have a high risk of CHD and CKD. High-frequency alcohol consumption seems to be related to the occurrence of DM in Lugu Lake.

## CONCLUSION

Overall, we believe that older adults in the Lugu community are at high risk of DM, a disease highly correlated with high BMI and HT, CHD and CKD in the elderly population. Therefore, physical examinations should be actively carried out for elderly individuals in the Lugu community to determine their demographic indices, such as BMI, SBP, and DBP. Moreover, adequate attention should be given to those with abnormal signs, and BG levels should be further determined. The findings of this paper provide a valid scientific basis for the health management of elderly individuals in the Lugu community.

## ARTICLE HIGHLIGHTS

### Research background

The pathogenesis of diabetes mellitus (DM) is complicated and involves many factors. For elderly people, the pathophysiological changes caused by aging affect internal metabolic regulation, thus promoting the occurrence of DM; subsequently, aging and DM interact to further promote the progression of diabetic complications. The aging population and changing lifestyles have made DM more common among older adults.

### Research motivation

It is necessary to consider the glycemic indices of the elderly population, focusing on those who may have DM or have been diagnosed. Understanding the prevalence of DM among elderly people in a certain area and discussing the risk factors related to DM are conducive to carrying out targeted interventions for the local elderly population and developing effective blood glucose (BG) management strategies.

### Research objectives

To explore the prevalence of DM among elderly people in the Lugu community and analyze the related risk factors to provide a valid scientific basis for the health management of elderly people.

### Research methods

A total of 4816 elderly people who came to the community for physical examination were retrospectively analyzed. The prevalence of DM among the elderly was calculated. The individuals were divided into a DM group and a non-DM group according to the diagnosis of DM to compare the differences blood pressure (DBP) in diastolic and systolic blood pressure (SBP), fasting BG (FBG), BMI, waist-to-hip ratio (WHR) and incidence of hypertension (HT), coronary heart disease, and chronic kidney disease (CKD).

### Research results

DM was diagnosed in 32.70% of the 4816 elderly people. The BMI of the DM group ( $25.16 \pm 3.35$ ) was greater than that of the non-DM group ( $24.61 \pm 3.78$ ). The WHR was  $0.90 \pm 0.04$  in the non-DM group and  $0.90 \pm 0.03$  in the DM group, with no significant difference. The left SBP and SBP in the DM group were  $137.9 \text{ mmHg} \pm 11.92 \text{ mmHg}$  and  $69.95 \text{ mmHg} \pm 7.75 \text{ mmHg}$ , respectively, while they were  $126.6 \text{ mmHg} \pm 12.44 \text{ mmHg}$  and  $71.15 \text{ mmHg} \pm 12.55 \text{ mmHg}$ , respectively, in the non-DM group. These findings indicate higher SBP and lower DBP in DM patients than in those without DM. In the DM group, 1274 patients were diagnosed with HT, accounting for 80.89%. Among the 3241 non-DM patients, 1743 (53.78%) were hypertensive and 1498 (46.22%) were nonhypertensive. The DM group had more cases of HT than did the non-DM group. There were more patients with coronary heart disease or CKD in the DM group than in the non-DM group. There were more patients who drank alcohol more frequently ( $\geq 3$  times) in the DM group than in the non-DM group.

### Research conclusions

Older adults in the Lugu community are at a higher risk of DM. In the elderly population, DM is closely related to high BMI and HT. Physical examinations should be actively carried out for elderly people to determine their BMI, SBP, DBP, and other signs, and sufficient attention should be given to abnormalities in the above signs before further diagnosis.

### Research perspectives

The findings of this paper provide a valid scientific basis for the health management of elderly individuals in the Lugu community.

## FOOTNOTES

**Author contributions:** Zhao LZ designed the research and wrote the first manuscript; Zhao LZ and Li WM contributed to conceiving the research and analyzing data; Zhao LZ and Ma Y conducted the analysis and provided guidance for the research; and all authors reviewed and approved the final manuscript.

**Supported by** the Capital's Funds for Health Improvement and Research, No. 2023-3S-002.

**Institutional review board statement:** This study was reviewed and approved by the Ethic Committee of West Campus Beijing Chao-yang Hospital Affiliated to Capital Medical University (approval No. 2023-Section-149).

**Informed consent statement:** Patients were not required to give informed consent to the study because it is a retrospective study and the data came from electronic medical records in the hospital.

**Conflict-of-interest statement:** There is no conflict of interest.

**Data sharing statement:** All data and materials are available from the corresponding author.

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**Country/Territory of origin:** China

**ORCID number:** Li-Zhen Zhao 0009-0004-3434-5442.

S-Editor: Chen YL

L-Editor: A

P-Editor: Zhang YL

## REFERENCES

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