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Changes and risk factors of adult prediabetes, diabetes prevalence and diabetes control among adult residents in Xinjiang from 2010 to 2018

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To analyze the status and related risk factors of prediabetes, diabetes and diabetes control among adult residents in Xinjiang, so as to provide basis and guidance for local diabetes prevention and treatment. A multi-stage stratified sampling method was adopted to conduct preliminary screening of all residents aged 18 years old and above. Personal characteristics, blood glucose, hypertension and blood fat were collected by questionnaire survey, physical measurements and laboratory examinations respectively, and the risk factors of prediabetes, diabetes and blood glucose control were analyzed by binary logistic regression model. The prevalence of prediabetes and diabetes and the control rates of blood glucose in 2010 and 2018 were 17.47% and 20.13%, 12.27% and 15.43%, 35.05% and 38.82%, respectively. The increasing trend was found in prevalence of prediabetes and diabetes. Old age, marriage (including cohabitation), divorce (including separation), overweight or obesity, central obesity and dyslipidemia were risk factors in prediabetes, diabetes was related to old age, family history of diabetes, overweight and obesity, central obesity, hypertension and dyslipidemia, and diabetes blood glucose control was influenced by age, region, central obesity and dyslipidemia. Compared with 2010, the adverse effects on prediabetes of gender and diabetes of region were not significant, and the problem of impaired blood glucose caused by harmful drinking behavior was also alleviated. The prevalence of prediabetes and diabetes in Xinjiang residents is still at a high level, and the control of blood glucose needs to be further strengthened. Meanwhile, the elderly, region, married or divorced, family history of diabetes, overweight and obesity, central obesity, hypertension and dyslipidemia are the key groups for prevention and treatment of diabetes in this area. Active control of weight, blood pressure and blood lipids, screening and publicity of prediabetes and diabetes, and regular monitoring and early intervention are of great significance to reduce the incidence and adverse outcomes of diabetes.

Keywords Xinjiang, Diabetes, Prediabetes, Diabetic blood glucose control, Prevalence, Risk factors

Diabetes is a group of metabolic diseases characterized by chronic hyperglycemia that results from disturbed insulin secretion or function or both¹. The complications of diabetes is a major public health challenge due to its large effect on health². The International Diabetes Federation (IDF) estimated the global prevalence of diabetes to be 451 million in 2017, and this number was expected to increase to 693 million by 2045³, owing to increases in age, obesity, and urbanization of the world's population and so on². Likewise, the China's chronic disease and risk factor monitoring report indicated that the prevalence of diabetes among adult who aged 18 and above in China in 2018 has reached 11.9%⁴.

Studies have shown that diabetes has become the third chronic non-infectious disease endangering human life and health after cardiovascular and cerebrovascular diseases and tumors^{5,6}, and it was associated with significantly increased mortality from a wide range of diseases, such as diabetic ketoacidosis or coma and chronic kidney disease, ischaemic heart disease, stroke, other vascular, chronic liver disease, infection, certain

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cancers (mainly liver, pancreatic, female breast and endometrial cancers) and external causes⁷. Therefore, it is important to identify and control risk factors for diabetes to reduce the disease burden.

Xinjiang is located in the northwest of China⁸, and most residents in Xinjiang eat high salt and high oil diet for a long time, and the prevalence rate of chronic diseases is higher than that of the whole country⁹. Previous study have shown that the crude prevalence of diabetes in Xinjiang was 7.95% in urban and 7.88% in rural areas, respectively in 2013⁸. And the detectable rate of type 2 diabetes in Kirgiz nationality was 4.49% in 2020 in Xinjiang¹⁰. More research findings on the economic burden of chronic diseases in Xinjiang found that the economic burden imposed by diabetes was 66 million yuan⁹. However, large samples and up-to-date information on diabetes prevalence and associated risk factors in Xinjiang are limited, and there are few studies on prediabetes and post-diabetes glycemic control and their risk factors. It should be noted that prediabetes is a pre-disease state intermediate between health and diabetes, including impaired fasting glucose (IFG) and/or impaired glucose tolerance tolerance (IGT)¹¹. Prediabetes also is a high-risk group for secondary diabetes, and if prediabetes patients are not intervened, 5–10% of prediabetes population progresses to diabetes every year¹². Thus, we conducted a study among Xinjiang residents aged 18 years and older, investigating prediabetes, diabetes and blood glucose control in diabetes patients in 2010 and 2018, and further analyzing and comparing their risk factors to provide basis for the comprehensive prevention and treatment of diabetes in residents of Xinjiang in the future.

Methods

Participants

The participants were selected who have lived for 6 months or more in monitored points and are ≥ 18 years old. The monitored points were Tianshan District of Urumqi City, Xinhe County of Aksu Prefecture, Xinyuan County of Yili Autonomous Prefecture, Hetian County of Hotan Prefecture and Shache County of Kashgar Prefecture in 2010 years, and Tianshan District of Urumqi City, Hami City of Hami Prefecture, Xinhe County of Aksu Prefecture, Xinyuan County of Yili Autonomous Prefecture, Fukang City of Changji Autonomous Prefecture, Hetian County of Hotan Prefecture, Shache County of Kashgar Prefecture and Tacheng City of Tacheng Prefecture) in 2018 years. This study adopted amultistage cluster random sampling scheme to select a representative sample of individuals aged 18 and above in the Xinjiang Uyghur Autonomous Region in 2010 and 2018 years. In the first stage, 3 towns or streets were randomly selected from each monitoring point. In the second stage, 4 villages or neighborhood committees in 2010 and 2 villages or neighborhood committees in 2018 were randomly selected from each selected town or street. In the third stage, 50 permanent residents in 2010 and 45 permanent residents in 2018 were randomly selected from each villages and neighborhood committees. In the fourth stage, one person aged 18 and above was randomly selected from each household by KISH table method in 2010 and All permanent residents over the age of 18 in the survey households conducted surveys in 2018. Pregnant women, residents with cognitive impairments, serious diseases or disabilities diagnosed by medical institutions, and others may affect the survey are excluded from the survey. This investigation was reviewed by the Ethics Committee of China Center for Disease Control and Prevention, and all methods used by this investigation were performed in accordance with the relevant guidelines and regulations. All the subjects signed the informed consent form.

Data collection

Questionnaire

The questionnaire mainly includes basic personal information, prevalence and control of major chronic diseases, family history, smoking, drinking, eating habits and physical activity status. Investigations are conducted by uniformly trained investigators using face-to-face interviews.

Body measurement

Measure the height, weight, waist circumference and blood pressure of all respondents. Height was measured using a height meter with a length of 2.0 m and an accuracy of 0.1 cm, weight was measured using a weight meter with a maximum weight of 150 kg and an accuracy of 0.1 kg, waist circumference was measured using a waist ruler with a length of 1.5 m and a width of 1 cm and an accuracy of 0.1 cm, and blood pressure was measured using an electronic sphygmomanometer with an accuracy of 1 mmHg.

Laboratory tests

Fasting venous blood, fingertip blood and oral administration of 75 g of anhydrous glucose venous blood at 2 h (those with diabetes history did not performed). Blood glucose and lipids were measured.

Definitions

Diabetes diagnosis according to the diagnostic criteria of WHO 1999 and Guidelines for the Prevention and Treatment of Type 2 Diabetes in China (2017): fasting plasma glucose (FPG) ≥ 7.1 mmol/L and/or blood glucose ≥ 11.1 mmol/L in oral glucose tolerance test-2 hours (OGTT-2 h), and/or diagnosed as diabetes by township (community) level hospitals or above. prediabetes is defined according to the diagnostic criteria of WHO 1999 and Chinese Guidelines for the Prevention and Treatment of Type 2 Diabetes (2017): impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT). IFG was defined as Fbg 6.1–6.9 mmol/L and OGTT-2h < 7.8 mmol/L; IGT was defined as Fbg > 7 mmol/L and OGTT-2 h 7.8–11.0 mmol/L. diabetes control refers to diabetes patients whose FPG is currently controlled at 7mmol/L or below. Hypertension refers to patients with systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, and/or patients who have been diagnosed as hypertension by township (community) level hospitals or above and who have taken medicine in the past 2 weeks. Dyslipidemia according to the diagnostic criteria for

dyslipidemia in adults of China (2007): Cholesterol (TC) ≥ 6.22 mmol/L, high density lipoprotein (HDL-C) < 1.04 mmol/L, low density lipoprotein (LDL-C) ≥ 4.14 mmol/L and triglycerides (TG) ≥ 2.26 mmol/L have one or more could be considered dyslipidemia. Overweight or obesity is defined according to People's Republic of China Health Industry Standard Adult Weight Determination (WS/T 428–2013): $24.0 \text{ kg/m}^2 \leq \text{Body Mass Index (BMI)} < 28.0 \text{ kg/m}^2$ is overweight, and $\text{BMI} \geq 28.0 \text{ kg/m}^2$ is obesity. Central obesity is defined as waist circumference ≥ 85 cm (male) or ≥ 80 cm (female) according to People's Republic of China Health Industry Standard Adult Weight Determination (WS/T 428–2013). Current smoking is considered that participants are still smoking at the time of the survey, including daily smokers and occasional smokers. Dangerous drinking is defined according to the index definition of World Health Organization (WHO) International Guide For Monitoring Alcohol Consumption and Related Harm: it refers to the drinking behavior of male drinkers with daily alcohol intake greater than or equal to 41 g and less than 61 g, and the drinking behavior of female drinkers with daily alcohol intake greater than or equal to 21 g and less than 41 g. Harmful drinking is defined according to the index definition of WHO International Guide For Monitoring Alcohol Consumption and Related Harm: it refers to the drinking behavior of male drinkers with daily alcohol intake of 61 g or more, and female drinkers with daily alcohol intake of 41 g or more. Insufficient daily intake of fruits and vegetables is defined according to the indicator definition of WHO's Global Integrated Monitoring Framework for the Prevention and Control of Non-communicable Diseases (including indicators) and Voluntary Targets (2013–2025): daily intake of vegetables and fruits below 400 g is considered insufficient intake. Insufficient physical activity is defined according to the indicator definition of WHO's Global Integrated Monitoring Framework for Prevention and Control of Noncommunicable Diseases (including indicators) and Voluntary Targets (2013–2025): it refers to the total activity time (high-intensity activity time $\times 2$, moderate-intensity activity time) less than 150 min in a week. In 2010, Tianshan District is urban, Xinhe County, Xinyuan County and Shache County are rural; In 2018, Tianshan District, Fukang City, Yizhou District and Tacheng City are urban; Hotan County, Xinhe County, Shache County and Xinyuan County are rural.

Statistical analysis

Basic characteristics were presented as means \pm SD or n (%) according to sex. Comparison between groups were tested by t-test or χ^2 test. Multivariate logistic regression analysis, using a enter method, was performed to estimate the risk factors related to prediabetes, diabetes and diabetes control status (prediabetes, diabetes and diabetes control status as a dependent variable, respectively; gender, age, urban and rural, education level, overweight or obese, central obesity, physical activity, hypertension, smoking status, drinking status, vegetable and fruit intake, red meat intake as independent variables). The odds ratio (OR) and its 95% confidence interval (CI) were presented to show the risks. *P*-values < 0.05 were considered to be statistically significant. Statistical analysis was performed by SPSS software, version 27.

Results

General characteristics of participants

The 2010 and 2018 surveys included 2999 and 4857 participants, respectively. In 2010 and 2018, most of the participants were in the 18–44 age group (50.65% and 37.49% respectively), rural population (79.99% and 60.39% respectively) were more than those in cities (20.01% and 39.61% respectively), and the proportion of married population was the highest, accounting for 80.41% and 89.17% respectively. In 2010, the education level of the respondents was mainly primary school or below, accounting for 49.82%. And in 2018, the education level of junior high school was mainly 40.66%. 92.88% and 85.83% of the participants reported no family history of diabetes in 2010 and 2018, respectively.

In terms of lifestyle, the vast majority of participants in 2010 and 2018 did not have dangerous drinking, harmful drinking or drinking in the past 30 days, and more than 50% of the respondents had adequate intake of vegetables and fruits and sufficient physical activity.

In terms of laboratory test results, the average BMI of the participants was 24.77 kg/cm^2 and 25.69 kg/cm^2 , the SBP and DBP were 129.62 mmHg and 77.89 mmHg, and 126.09 mmHg and 74.15 mmHg, the FPG and OGTT-2 h level were 5.69 mmol/L and 6.55 mmol/L, and 5.75 mmol/L and 6.84 mmol/L in 2010 and 2018, respectively. The results of TC, TG, LDL-C and HDL-C in 2010 and 2018 were 3.63 mmol/L, 1.35 mmol/L, 2.08 mmol/L and 0.90 mmol/L, and 4.46 mmol/L, 1.52 mmol/L, 2.55 mmol/L and 1.23 mmol/L, respectively. The results are shown in Table 1.

Prevalence of diabetes and other major chronic diseases

The prevalence of chronic diseases in 2010 and 2018 years is shown in Table 2. The prevalence of prediabetes was 17.47% and 20.13%, the prevalence of diabetes was 12.27% and 15.43%, and the diabetes blood glucose control was 35.05% and 38.82%, in 2010 and 2018, respectively. The prevalence of overweight was 34.46% and 38.10%, the prevalence of obesity was 18.96% and 25.70%, the prevalence of central obesity was 40.51% and 58.92% in 2010 and 2018, respectively. The prevalence of hypertension was 32.28% and 28.02% in 2010 and 2018, and the prevalence of dyslipidemia was 79.06% and 42.28% respectively. Compared with 2010, the prevalence of prediabetes, diabetes, overweight, obesity and central obesity increased significantly in 2018 ($P < 0.005$), while the prevalence of hypertension and dyslipidemia decreased significantly ($P < 0.001$).

Relationship of each factor to prediabetes, diabetes, and diabetes blood glucose control

In 2010, gender, age, urban and rural areas, education level, marital status, harmful drinking, overweight or obesity, central obesity, hypertension and dyslipidemia were the influencing factors for prediabetes ($P < 0.05$). Age, urban and rural areas, marital status, family history of diabetes, alcohol consumption in the past 30 days, overweight or obesity, central obesity, hypertension and dyslipidemia were the influencing factors for diabetes

Variable	2010 (n = 2999)			2018 (n = 4857)		
	Male	Female	Total	Male	Female	Total
Age (year)						
18 ~ 44	675 (50.07)	844 (51.56)	1519 (50.65)	771 (35.45)	1050 (39.15)	1821 (37.49)
45 ~ 59	361 (26.78)	444 (26.89)	805 (26.84)	769 (35.36)	1031 (38.44)	1800 (37.06)
Aged 60 and over	312 (23.15)	363 (21.99)	675 (22.51)	635 (29.20)	601 (22.41)	1236 (25.45)
Region						
Urban	244 (18.10)	356 (21.56)	600 (20.01)	781 (35.91)	1143 (42.62)	1924 (39.61)
Rural	1104 (81.90)	1295 (78.44)	2399 (79.99)	1394 (64.09)	1539 (57.38)	2933 (60.39)
Education level						
Primary and lower	642 (47.63)	852 (51.61)	1494 (49.82)	800 (36.78)	1119 (41.72)	1919 (39.51)
Junior high school	426 (31.60)	474 (28.71)	900 (30.01)	958 (44.05)	1017 (37.92)	1975 (40.66)
Senior high school	182 (13.50)	207 (12.54)	389 (12.97)	295 (13.56)	339 (12.64)	634 (13.05)
Junior college and above	98 (7.27)	118 (7.15)	216 (7.20)	122 (5.61)	207 (7.72)	329 (6.77)
Marital status						
Unmarried	120 (8.92)	63 (3.82)	183 (6.11)	161 (7.40)	69 (2.57)	230 (4.74)
Married (including cohabitation)	1108 (82.32)	1301 (78.85)	2409 (80.41)	1951 (89.70)	2380 (88.74)	4331 (89.17)
Divorced/widowed (including separation)	118 (8.77)	286 (17.33)	404 (13.48)	63 (2.90)	233 (8.69)	296 (6.09)
Family history of diabetes						
No	1111 (44.37)	1393 (92.56)	2504 (92.88)	1812 (83.53)	2197 (85.25)	4009 (85.83)
Yes	80 (6.72)	112 (7.44)	192 (7.12)	282 (13.47)	380 (14.75)	662 (14.17)
Current smoking						
No	937 (69.51)	1614 (97.76)	2551 (85.06)	1187 (54.65)	2652 (98.92)	3839 (79.11)
Yes	411 (30.49)	37 (8.26)	448 (14.94)	985 (45.35)	29 (1.08)	1014 (20.89)
Dangerous drinking						
No	1332 (98.81)	1650 (99.94)	2982 (99.43)	2130 (98.16)()	2671 (99.78)	2801 (98.85)
Yes	16 (1.19)	1 (0.06)	17 (0.57)	40 (1.84)	6 (0.22)	46 (0.95)
Harmful drinking						
No	1338 (99.26)	1647 (99.76)	2985 (99.53)	2094 (96.50)	2672 (99.81)	4766 (98.33)
Yes	10 (0.74)	4 (0.24)	14 (0.47)	76 (3.50)	5 (0.19)	81 (1.67)
Alcohol consumption in the past 30 days						
No	1134 (84.12)	1547 (93.70)	2681 (89.40)	1568 (72.26)	2553 (95.37)	4121 (85.02)
Yes	214 (15.88)	104 (6.30)	318 (10.60)	602 (27.74)	124 (4.63)	726 (14.98)
Insufficient daily intake of fruits and vegetables						
No	1345 (99.78)	1648 (99.82)	2993 (99.80)	1426 (65.77)	1772 (66.29)	3198 (66.06)
Yes	3 (0.22)	3 (0.18)	6 (0.20)	742 (34.23)	901 (33.71)	1643 (33.94)
Insufficient physical activity						
No	1033 (76.63)	1293 (78.32)	2326 (77.56)	1434 (66.20)	1890 (70.73)	3324 (68.71)
Yes	315 (23.37)	358 (21.68)	673 (22.44)	732 (33.80)	782 (29.27)	1514 (31.29)
Height (cm)	166.42 ± 7.17	155.91 ± 7.00	160.63 ± 8.80	167.56 ± 46.3	156.28 ± 39.98	161.33 ± 74.27
Weight (kg)	67.84 ± 11.45	61.00 ± 11.11	64.08 ± 11.77	72.19 ± 143.27	62.81 ± 119.58	67.01 ± 151.9
BMI (kg/cm ²)	24.45 ± 3.50	25.04 ± 4.05	24.77 ± 3.82	25.66 ± 13.26	25.71 ± 17.83	25.69 ± 15.78
SBP (mmHg)	130.73 ± 19.09	128.71 ± 23.09	129.62 ± 21.40	127.64 ± 310.87	124.83 ± 450.91	126.09 ± 390.02
DBP (mmHg)	77.34 ± 11.42	78.34 ± 12.40	77.89 ± 11.97	75.74 ± 131.08	72.87 ± 128.89	74.15 ± 131.88
FPG (mmol/L)	5.67 ± 1.64	5.71 ± 1.75	5.69 ± 1.70	5.83 ± 2.97	5.69 ± 2.53	5.75 ± 2.73
OGTT-2 h (mmol/L)	6.23 ± 3.01	6.80 ± 3.08	6.55 ± 3.06	6.78 ± 7.90	6.88 ± 7.12	6.84 ± 7.47
TC (mmol/L)	3.63 ± 1.03	3.62 ± 0.98	3.63 ± 1.00	4.42 ± 0.79	4.49 ± 0.85	4.46 ± 0.83
TG (mmol/L)	1.49 ± 1.49	1.23 ± 0.88	1.35 ± 1.20	1.64 ± 1.71	1.43 ± 0.86	1.52 ± 1.25
LDL-C (mmol/L)	2.11 ± 0.71	2.06 ± 0.71	2.08 ± 0.71	2.54 ± 0.57	2.55 ± 0.61	2.55 ± 0.6
HDL-C (mmol/L)	0.85 ± 0.23	0.94 ± 0.24	0.90 ± 0.24	1.14 ± 0.1	1.29 ± 0.11	1.23 ± 0.11

Table 1. General characteristics of participants in 2010 and 2018 (n (%)) / $\bar{x} \pm s$.

($P < 0.05$). Age and urban and rural areas were influencing factors for blood glucose control in diabetes patients ($P < 0.05$), and the results were shown in Table 3.

In 2018, age, urban and rural areas, education level, marital status, overweight or obesity, central obesity, hypertension and dyslipidemia were the influencing factors for prediabetes ($P < 0.05$). Gender, age, urban and rural areas, education level, marital status, family history of diabetes, insufficient physical activity, overweight

Variable	2010(<i>n</i> = 2999)			2018(<i>n</i> = 4857)			χ^2	<i>P</i> value ^c
	Number of respondents ^a	The number of patients	Prevalence (%)	Number of respondents ^a	The number of patients	Prevalence (%)		
Prediabetes	2999	524	17.47	4788	964	20.13	8.448	0.004
Diabetes	2999	368	12.27	4840	747	15.43	15.185	<0.001
Diabetes blood glucose control	368	129 ^a	35.05 ^b	747	290 ^a	38.82 ^b	1.492	0.22
Overweight	2995	1032	34.46	4774	1819	38.10	10.525	0.001
Obesity	2995	568	18.96	4774	1227	25.70	47.013	<0.001
Central obesity	2999	1215	40.51	4774	2813	58.92	250.038	<0.001
Hypertension	2999	968	32.28	4789	1342	28.02	16.002	<0.001
Dyslipidemia	2999	2371	79.06	4775	2019	42.28	1013.564	<0.001

Table 2. The prevalence comparison of diabetes and other chronic diseases in 2010 and 2018. *: Missing data. ^a: Number of participants with diabetes whose blood glucose levels are controlled. ^b: The rate of blood glucose control in diabetics. ^c: Comparison of prevalence in 2010 and 2018.

or obesity, central obesity, hypertension and dyslipidemia were the influencing factors for diabetes ($P<0.05$). Central obesity and dyslipidemia were influencing factors for blood glucose control in diabetes patients ($P<0.05$), and the results were shown in Table 4.

Binary logistic regression analysis of prediabetes, diabetes and blood glucose control in diabetes patients

Binary Logistics regression was applied to incorporate the above factors into the analysis as independent variables. Whether the subjects had prediabetes, diabetes and blood glucose control in diabetes patients were taken as independent variables to analyze their influencing factors respectively. In 2010, gender, age, harmful drinking and hypertension were the influence factors for prediabetes, among which female, 45 years old and above, harmful drinking and hypertension were the risk factors for prediabetes ($P<0.05$). Age, urban and rural areas, family history of diabetes, central obesity, hypertension and dyslipidemia were the influence factors for diabetes. Among them, 45 years old and above, family history of diabetes, central obesity, hypertension and dyslipidemia were the risk factors for diabetes. Living in rural area was a protective factor for diabetes ($P<0.05$). 45–59 years old was a risk factor for blood glucose control in diabetes patients ($P<0.05$), and the results were shown in Table 5.

In 2018, age, marital status, insufficient daily intake of fruits and vegetables, overweight or obesity, central obesity and dyslipidemia were the influence factors for prediabetes, among which over 45 years old, married (including cohabitation), divorced/widowed (including separation), sufficient daily intake of fruits and vegetables, overweight or obesity and dyslipidemia were the risk factors for prediabetes ($P<0.05$); Age, family history of diabetes, overweight or obesity, central obesity, hypertension and dyslipidemia were the influence factors for diabetes, among which 45 years old and above, family history of diabetes, overweight or obesity, central obesity, hypertension and dyslipidemia were the risk factors for diabetes ($P<0.05$). Age, region, central obesity and dyslipidemia were the influence factors for blood glucose control in diabetes patients, while rural was the risk factor, but 60 years old and above, central obesity and dyslipidemia were the protect factors for blood glucose control in diabetes patients ($P<0.05$), as shown in Table 6.

Discussion

With the development of social economy and the improvement of people’s living standards, the incidence of diabetes in China progressively increase, which not only seriously endangers people’s health, but also brings serious economic burden¹³. Xinjiang with a majority of ethnic minorities and unique diet customs is located in the northwest of China, and most residents have a long-term high salt and oil diet, resulting in a higher prevalence of chronic diseases than the national level⁹. However, there are few large-scale population analyses on the prevalence and risk factors of diabetes in Xinjiang. Therefore, by collecting the health-related data of residents in Xinjiang in 2010 and 2018 to analyzes the characteristics of diabetes and its risk factors, so as to provide reference basis of improving the management and intervention of diabetes for government departments and relevant medical institutions.

Prediabetes is a risk state that defined a high chance of developing diabetes, and around 5–10% of people with prediabetes become diabetes annually although conversionrate varies by population characteristics and the definition of prediabetes¹⁴. The results shown that the prevalence of prediabetes increased from 17.47 to 20.13% between 2010 and 2018, which may be due to the development of social economy and the change of residents diet structure. Secondly, there is no obvious clinical manifestation of prediabetes and it early warning effect has not yet been exerted so that residents are likely to continue to follow unhealthy lifestyles⁵. At the same time, the education and intervention of prediabetes are insufficient, and people lack awareness of its prevention¹⁵. Compared with the whole country, the prevalence of prediabetes in 2010 and 2018 was higher than China in 2013¹¹, and similar to Gansu Province¹⁶ and Yunnan Province¹⁷ in 2018. The results suggest that there are many prediabetes patients in Xinjiang, medical institutions and relevant government departments still need to popularize knowledge of diabetes and prediabetes, actively organize the development of related diabetes

Variable	Prediabetes	χ^2	P value	Diabetes	χ^2	P value	Diabetes blood glucose control	χ^2	P value
Sex									
Male	202 (38.55)	10.506	0.001	165 (44.84)	0.002	0.963	56 (43.41)	0.163	0.686
Female	322 (61.45)			203 (55.16)			73 (56.59)		
Age									
18 ~ 44	182 (34.73)	68.621	< 0.001	94 (25.52)	169.123	< 0.001	36 (27.91)	9.935	0.007
45 ~ 59	171 (32.63)			99 (26.90)			22 (17.05)		
Aged 60 and over	171 (32.63)			175 (47.55)			71 (55.04)		
Region									
Urban	129 (24.62)	8.438	0.004	131 (35.60)	63.714	< 0.001	55 (42.64)	4.291	0.038
Rural	395 (75.38)			237 (64.40)			74 (57.36)		
Education level									
Primary and lower	290 (55.34)	8.508	0.037	200 (54.35)	3.509	0.320	66 (51.16)	3.664	0.300
Junior high school	136 (25.95)			99 (26.90)			32 (24.81)		
Senior high school	60 (11.45)			44 (11.96)			20 (15.50)		
Junior college and above	38 (7.25)			25 (6.79)			11 (8.53)		
Marital status									
Unmarried	24 (4.59)	10.048	0.007	14 (3.80)	13.730	0.001	2 (1.55)	3.107	0.212
Married (including cohabitation)	408 (78.01)			284 (77.17)			104 (80.62)		
Divorced/widowed (including separation)	91 (17.40)			70 (19.02)			23 (17.83)		
Family history of diabetes									
No	420 (92.72)	0.022	0.882	268 (87.30)	16.320	< 0.001	95 (88.79)	0.328	0.567
Yes	33 (7.28)			39 (12.70)			12 (11.21)		
Current smoking									
No	453 (86.45)	0.964	0.326	314 (85.33)	0.023	0.879	113 (87.60)	0.818	0.366
Yes	71 (13.55)			54 (14.67)			16 (12.40)		
Dangerous drinking									
No	521 (99.43)	0.000	1.000	368 (100.00)	1.328	0.240	129 (100.00)	-	-
Yes	3 (0.57)			0 (0.00)			0 (0.00)		
Harmful drinking									
No	518 (98.85)	6.286	0.012	368 (100.00)	0.989	0.320	129 (100.00)	-	-
Yes	6 (1.15)			0 (0.00)			0 (0.00)		
Alcohol consumption in the past 30 days									
No	473 (90.27)	0.508	0.476	318 (86.41)	3.939	0.047	110 (85.27)	0.221	0.639
Yes	51(9.73)			50 (13.59)			19 (14.73)		
Insufficient daily intake of fruits and vegetables									
No	1 (0.19)	0.000	1.000	1 (0.27)	0.108	0.743	1 (0.78)	0.098	0.754
Yes	523 (99.81)			367 (99.73)			128 (99.22)		
Insufficient physical activity									
No	413 (78.82)	0.577	0.448	288 (78.26)	0.119	0.730	108 (83.72)	3.481	0.062
Yes	111 (21.18)			80 (21.74)			21 (16.28)		
Overweight or obesity									
No	192 (36.71)	24.789	< 0.001	108 (29.43)	49.438	< 0.001	37 (28.91)	0.026	0.873
Yes	331 (63.29)			259 (70.57)			91 (71.09)		
Central obesity									
No	258 (49.24)	27.679	< 0.001	145 (39.40)	70.210	< 0.001	55 (42.64)	0.870	0.351
Yes	266 (50.76)			223 (60.60)			74 (57.36)		
Hypertension									
No	281 (53.63)	57.721	< 0.001	156 (42.39)	123.136	< 0.001	57 (44.19)	0.262	0.609
Yes	243 (46.37)			212 (57.61)			72 (55.81)		
Dyslipidemia									
No	93 (17.75)	3.908	0.048	48 (13.04)	15.801	< 0.001	20 (15.50)	1.060	0.303
Yes	431 (82.25)			320 (86.96)			109 (84.50)		

Table 3. The comparison of general characteristics in prediabetes, diabetes and blood glucose control diabetes patients of Xinjiang in 2010 (n, (%)).

Variable	Prediabetes	χ^2	P value	Diabetes	χ^2	P value	Diabetes blood glucose control	χ^2	P value
Sex									
Male	423 (43.88)	0.341	0.559	371 (49.67)	8.625	0.003	138 (47.59)	0.820	0.365
Female	541 (56.12)			376 (50.33)			152 (52.4)		
Age									
18 ~ 44	223 (23.13)	113.759	< 0.001	82 (10.98)	361.321	< 0.001	37 (12.76)	1.948	0.378
45 ~ 59	405 (42.01)			297 (39.76)			109 (37.59)		
Aged 60 and over	336 (34.86)			368 (49.26)			144 (49.66)		
Region									
Urban	441 (45.75)	18.155	< 0.001	397 (53.15)	66.598	< 0.001	167 (57.59)	3.753	0.053
Rural	523 (54.25)			350 (46.85)			123 (42.41)		
Education level									
Primary and lower	446 (46.27)	23.576	< 0.001	337 (45.11)	15.455	0.001	139 (47.93)	2.385	0.496
Junior high school	341 (35.37)			257 (34.40)			94 (32.41)		
Senior high school	121 (12.55)			101 (13.52)			35 (12.07)		
Junior college and above	56 (5.81)			52 (6.96)			22 (7.59)		
Marital status									
Unmarried	19 (1.97)	26.422	< 0.001	12 (1.61)	30.048	< 0.001	3 (1.03)	1.030	0.598
Married (including cohabitation)	868 (90.04)			668 (89.42)			260 (89.66)		
Divorced/widowed (including separation)	77 (7.99)			67 (8.97)			27 (9.31)		
Family history of diabetes									
No	796(85.41)	0.079	0.779	493 (70.83)	149.927	< 0.001	200 (74.07)	2.242	0.134
Yes	136(14.59)			203 (29.17)			70 (25.93)		
Current smoking									
No	774 (80.29)	1.040	0.308	596 (79.79)	0.271	0.603	236 (81.38)	0.746	0.388
Yes	190 (19.71)			151 (20.21)			54 (18.62)		
Dangerous drinking									
No	957 (99.27)	0.708	0.400	738 (98.80)	0.589	0.439	288 (99.31)	1.057	0.304
Yes	7 (0.73)			9 (1.20)			2 (0.69)		
Harmful drinking									
No	952 (98.76)	1.468	0.226	738 (98.80)	1.193	0.275	285 (98.28)	1.074	0.300
Yes	12 (1.24)			9 (1.20)			5 (1.72)		
Alcohol consumption in the past 30 days									
No	817 (84.75)	0.117	0.732	626 (83.80)	1.018	0.313	247 (85.17)	0.656	0.418
Yes	147 (15.25)			121 (16.20)			43 (14.83)		
Insufficient daily intake of fruits and vegetables									
No	664 (69.09)	5.012	0.025	504 (67.56)	0.920	0.337	200 (69.20)	0.582	0.446
Yes	297 (30.91)			242 (32.44)			89 (30.80)		
Insufficient physical activity									
No	680 (70.61)	1.965	0.161	539 (72.45)	5.602	0.018	203 (70.49)	0.904	0.342
Yes	283 (29.39)			205 (27.55)			85 (29.51)		
Overweight or obesity									
No	248 (25.91)	55.747	< 0.001	153 (20.73)	90.567	< 0.001	66 (22.84)	1.282	0.258
Yes	709 (74.09)			585 (79.27)			223 (77.16)		
Central obesity									
No	288 (30.09)	60.510	< 0.001	167 (22.63)	122.559	< 0.001	77 (26.64)	4.373	0.037
Yes	669 (69.91)			571 (77.37)			212 (73.36)		
Hypertension									
No	596 (62.28)	56.841	< 0.001	345 (46.37)	285.538	< 0.001	144 (49.66)	2.061	0.151
Yes	361 (37.72)			399 (53.63)			146 (50.34)		
Dyslipidemia									
No	490 (50.94)	23.406	< 0.001	303 (40.95)	100.932	< 0.001	140 (48.44)	11.022	0.001
Yes	472 (49.06)			437 (59.05)			149 (51.56)		

Table 4. The comparison of general characteristics in prediabetes, diabetes and blood glucose control diabetes patients of Xinjiang in 2018 (n, (%)).

Variable	Prediabetes			Diabetes			Diabetes blood glucose control		
	β	P value	OR (95% CI)	β	P value	OR (95% CI)	β	P value	OR (95% CI)
Female	0.379	0.002	1.461 (1.144 ~ 1.866)	-0.043	0.773	0.958 (0.717 ~ 1.281)	0.230	0.429	1.258 (0.712 ~ 2.224)
Age									
45 ~ 59	0.514	<0.001	1.672 (1.287 ~ 2.172)	0.448	0.010	1.566 (1.113 ~ 2.203)	-0.794	0.034	0.452 (0.216 ~ 0.943)
Aged 60 and over	0.718	<0.001	2.050 (1.507 ~ 2.790)	1.261	<0.001	3.528 (2.455 ~ 5.071)	0.028	0.938	1.028 (0.509 ~ 2.077)
Rural	-0.164	0.299	0.849 (0.623 ~ 1.157)	-0.608	0.001	0.544 (0.384 ~ 0.772)	-0.350	0.323	0.705 (0.352 ~ 1.410)
Education level									
Junior high school	-0.184	0.157	0.832 (0.645 ~ 1.074)	-0.097	0.547	0.908 (0.663 ~ 1.243)	-0.093	0.776	0.931 (0.480 ~ 1.730)
Senior high school	-0.295	0.108	0.745 (0.520 ~ 1.067)	-0.235	0.281	0.790 (0.515 ~ 1.212)	0.649	0.119	1.913 (0.847 ~ 4.322)
Junior college and above	-0.040	0.860	0.961 (0.616 ~ 1.498)	-0.285	0.307	0.752 (0.436 ~ 1.299)	0.749	0.150	2.116 (0.763 ~ 5.869)
Marital status									
Married (including cohabitation)	-0.324	0.198	0.723 (0.441 ~ 1.185)	-0.470	0.136	0.625 (0.337 ~ 1.159)	1.032	0.221	2.806 (0.537 ~ 14.661)
Divorced/widowed (including separation)	-0.300	0.304	0.741 (0.418 ~ 1.313)	-0.589	0.102	0.555 (0.274 ~ 1.124)	0.358	0.693	1.431 (0.241 ~ 8.508)
Family history of diabetes	0.008	0.969	1.008 (0.667 ~ 1.524)	0.809	<0.001	2.245 (1.475 ~ 3.418)	-0.101	0.803	0.904 (0.411 ~ 1.991)
Current smoking	0.185	0.285	1.204 (0.857 ~ 1.691)	0.065	0.750	1.067 (0.717 ~ 1.588)	-0.441	0.306	0.643 (0.276 ~ 1.498)
Dangerous drinking	0.357	0.661	1.430 (0.290 ~ 7.047)	-19.283	0.999	0.000 (0.000)	-	-	-
Harmful drinking	1.463	0.011	4.319 (1.389 ~ 13.428)	-19.741	0.998	0.000 (0.000)	-	-	-
Alcohol consumption in the past 30 days	-0.192	0.347	0.825 (0.553 ~ 1.231)	0.158	0.446	1.172 (0.765 ~ 1.793)	-0.019	0.964	0.981 (0.421 ~ 2.284)
Insufficient daily intake of fruits and vegetables	0.221	0.843	1.247 (0.139 ~ 11.168)	0.164	0.888	1.178 (0.120 ~ 11.615)	-21.074	1.000	0.000 (0.000)
Insufficient physical activity	-0.189	0.158	0.828 (0.636 ~ 1.076)	0.138	0.348	1.148 (0.841 ~ 1.566)	-0.473	0.157	0.623 (0.323 ~ 1.200)
Overweight or obesity	0.233	0.083	1.263 (0.970 ~ 1.644)	0.170	0.322	1.185 (0.847 ~ 1.659)	0.439	0.235	1.551 (0.752 ~ 3.196)
Central obesity	0.201	0.120	1.223 (0.949 ~ 1.576)	0.585	<0.001	1.794 (1.315 ~ 2.449)	-0.451	0.171	0.637 (0.334 ~ 1.215)
Hypertension	0.382	0.001	1.465 (1.164 ~ 1.845)	0.741	<0.001	2.098 (1.600 ~ 2.752)	-0.131	0.622	0.877 (0.521 ~ 1.477)
Dyslipidemia	0.158	0.257	1.171 (0.891 ~ 1.539)	0.494	0.010	1.639 (1.125 ~ 2.386)	-0.382	0.314	0.682 (0.324 ~ 1.436)

Table 5. The logistic analysis on prediabetes, diabetes and blood glucose control in diabetes patients of Xinjiang in 2010. OR, odds ratio; CI, confidence interval.

screening activities, and clarify the their characteristics as soon as possible, so as to take targeted measures to reduce incidence¹³. Consistent with the trend of prediabetes, the prevalence of diabetes in this area also increased significantly from 12.27 to 15.43% from 2010 to 2018, which was lower than people lived in 8 counties in Xinjiang in 2013¹⁸, and higher than nationwide in 2018⁴. From vertical perspective, the prevalence of diabetes increased first and then decreased, which is consistent with the national trend¹⁹, and this result indicates that the diabetes prevention and control work in this area has achieved initial effects from 2010 to 2018. However, the prevalence of diabetes in this area is still at a high level from horizontal perspective, which may be related to the genetic characteristics, dietary habits, and air pollution of residents^{20,21}. This result may also be related to the corresponding intervention policies implemented by the government, such as the implementation of national health examination and graded diagnosis and treatment policy in 2016, which actively promoted the early intervention effect of diabetes and provided accessibility for effective management of diabetes patients, popularization of health knowledge, diet, medication and exercise guidance, as well as follow-up of patients 'condition in the community. At the same time, It's has greatly improved residents' health awareness and chronic disease prevention and control level. In the future, a multi-dimensional prevention and control system for chronic diseases should be constructed on this basis, and a new "four-in-one" model of prevention, treatment, management and education for chronic diseases at the grass-roots level should be explored.

In order to better control and avoid the development of prediabetes into diabetes, we analyzed the risk factors of prediabetes. From the results of 2018, the population distribution characteristics of the prediabetes are that the prevalence of married (including cohabitation) and divorced/widowed (including separation) is higher than unmarried people, and the prevalence increases with age. Married people (including cohabitants) have prediabetes may be related to the impact by family life on eating habits and lifestyle. For widowed/divorced/separated people, which may be related to the fear and anxiety. The study found that anxiety can induce the hypothalamus pituitary adrenal cortex axis to produce stress response, promote the secretion of adrenaline, norepinephrine, glucagon, etc., increase the peripheral cortisol, and then induce insulin resistance, thus affecting the blood sugar level, increasing the possibility of prediabetes²². The results of this study also found that people with a family history of diabetes are high-risk groups for diabetes. At present, a large number of studies have confirmed that people with a family history of diabetes have a much higher probability of suffering from diabetes than the general population^{10,23,24}, and genetic factors are also recognized as important risk factors for diabetes. Although genetic factors determine the susceptibility of individuals to diabetes, genetic factors are relatively stable, and the impact of external stimuli inducing diabetes such as multiple environmental and behavioral factors on diabetes may be more important. For people with a family history of diabetes, early prevention and screening, improving the education and management, and advocating a healthy and scientific lifestyle. In

Variable	Prediabetes			Diabetes			Diabetes blood glucose control		
	β	P value	OR (95% CI)	β	P value	OR (95% CI)	β	P value	OR (95% CI)
Female	0.074	0.437	1.077 (0.893 ~ 1.298)	-0.162	0.144	0.851 (0.685 ~ 1.057)	0.119	0.547	1.127 (0.764 ~ 1.662)
Age									
45 ~ 59	0.546	<0.001	1.726 (1.417 ~ 2.103)	1.144	<0.001	3.139 (2.367 ~ 4.162)	0.444	0.111	1.559 (0.902 ~ 2.695)
Aged 60 and over	0.715	<0.001	2.045 (1.612 ~ 2.594)	1.819	<0.001	6.168 (4.507 ~ 8.440)	0.614	0.039	1.849 (1.033 ~ 3.310)
Rural	-0.141	0.106	0.868 (0.732 ~ 1.030)	-0.143	0.166	0.867 (0.709 ~ 1.061)	-0.554	0.003	0.575 (0.398 ~ 0.829)
Education level									
Junior high school	-0.128	0.157	0.880 (0.737 ~ 1.050)	0.117	0.287	1.124 (0.907 ~ 1.392)	0.278	0.160	1.320 (0.896 ~ 1.944)
Senior high school	-0.173	0.176	0.841 (0.655 ~ 1.081)	0.023	0.877	1.023 (0.762 ~ 1.375)	0.493	0.072	1.636 (0.957 ~ 2.798)
Junior college and above	-0.207	0.247	0.813 (0.572 ~ 1.155)	0.187	0.357	1.206 (0.809 ~ 1.797)	0.029	0.943	1.030 (0.516 ~ 2.054)
Marital status									
Married (including cohabitation)	0.582	0.028	1.789 (1.065 ~ 3.007)	0.094	0.771	1.098 (0.584 ~ 2.064)	-0.913	0.199	0.401 (0.099 ~ 1.618)
Divorced/widowed (including separation)	0.724	0.017	2.062 (1.138 ~ 3.736)	0.190	0.599	1.210 (0.595 ~ 2.461)	-0.820	0.282	0.403 (0.099 ~ 1.964)
Family history of diabetes	-0.064	0.560	0.938 (0.755 ~ 1.164)	1.157	<0.001	3.182 (2.555 ~ 3.962)	0.284	0.124	1.328 (0.925 ~ 1.907)
Current smoking	0.041	0.726	1.042 (0.830 ~ 1.308)	0.029	0.828	1.029 (0.792 ~ 1.338)	0.042	0.864	1.043 (0.643 ~ 1.693)
Dangerous drinking	-0.347	0.416	0.707 (0.306 ~ 1.631)	0.465	0.266	1.592 (0.702 ~ 3.612)	0.618	0.458	1.855 (0.362 ~ 9.497)
Harmful drinking	-0.214	0.525	0.807 (0.410 ~ 1.589)	-0.411	0.368	0.663 (0.271 ~ 1.624)	-0.600	0.837	0.486 (0.102 ~ 2.964)
Alcohol consumption in the past 30 days	0.081	0.509	1.084 (0.853 ~ 1.377)	-0.066	0.639	0.936 (0.709 ~ 1.235)	0.031	0.749	1.091 (0.640 ~ 1.861)
Insufficient daily intake of fruits and vegetables	0.174	0.036	1.190 (1.012 ~ 1.398)	0.078	0.432	1.081 (0.891 ~ 1.311)	0.180	0.330	1.197 (0.834 ~ 1.719)
Insufficient physical activity	0.006	0.947	1.006 (0.851 ~ 1.188)	0.007	0.945	1.007 (0.822 ~ 1.234)	-0.285	0.128	0.752 (0.521 ~ 1.085)
Overweight or obesity	0.298	0.004	1.347 (1.012 ~ 1.646)	0.276	0.030	1.318 (1.026 ~ 1.691)	-0.176	0.455	0.839 (0.528 ~ 1.331)
Central obesity	0.239	0.016	1.270 (1.046 ~ 1.540)	0.368	0.003	1.445 (1.136 ~ 1.839)	0.497	0.028	1.643 (1.056 ~ 2.557)
Hypertension	0.164	0.063	1.178 (0.991 ~ 1.401)	0.650	<0.001	1.915 (1.579 ~ 2.322)	0.114	0.508	1.121 (0.799 ~ 1.572)
Dyslipidemia	0.205	0.010	1.227 (1.050 ~ 1.434)	0.511	<0.001	1.666 (1.385 ~ 2.004)	0.536	0.002	1.708 (1.222 ~ 2.389)

Table 6. The logistic analysis on prediabetes, diabetes and blood glucose control in diabetes patients of Xinjiang in 2018. OR, odds ratio; CI, confidence interval.

addition, the glucose control of diabetes is affected by region. Rural is a risk factor for glucose control, which is consistent with the conclusions of other studies^{25,26}. This phenomenon is largely caused by BMI and lifestyle factors, changing the unhealthy lifestyle of diabetic patients, improving treatment compliance, strengthening patient self-management and blood glucose monitoring can help improve blood glucose control level²⁷. This study also found that age is an independent risk factor for prediabetes and diabetes, which is higher risk suffering from prediabetes and diabetes with the increase of age. This may be due to the function decline of various organs and tissues in elderly, the decline of material metabolism and sugar regulation ability²⁸, and the relatively low educational level of older people, which led to the emergence of diabetes⁵.

From the perspective of lifestyle and behavior, dyslipidemia is a risk factor that increases the prevalence of prediabetes and diabetes and affects glucose control, which may be due to the increase of free fatty acid level in the body caused by lipid metabolism disorder, which leads to insulin resistance¹⁵. Then, the comorbidity of overweight, obesity and hypertension is an adverse biological factor for people with prediabetes and diabetes. This may be due to the dysfunction of glucose oxidation or non-oxidation utilization in the surrounding tissues of obesity, the reduced role of insulin in the production of liver glycogen, the replacement and utilization of glucose by too many free fatty acids in the body, and the reduction of insulin receptors in the target tissues of insulin action. In order to balance the internal environment, the compensatory secretion of too much insulin eventually lead to the dysfunction or even failure of B cell²⁹. The possible mechanism of the increase of prediabetes and diabetes caused by hypertension is that the increase of blood pressure leads to the activation of renin angiotensin system, the weakening of the role of insulin growth factor, leading to hyperinsulinemia, followed by insulin resistance, which leads to abnormal glycemic increase³⁰. In addition, there are many common pathophysiological mechanisms and multiple risk factors overlap between hypertension and diabetes, which may lead to their simultaneous prevalence. Current research suggests that the correlation between hyperglycemia and hypertension may be mainly related to changes in sodium homeostasis, increased peripheral vascular resistance, hyperinsulinemia, insulin resistance, and other pathophysiological mechanisms, as well as obesity⁶. Central obesity can cause diabetes and lead to poor glycemic control, this strong correlation between visceral fat accumulation and both insulin resistance and hyperinsulinemia is primarily attributed to a more deleterious secretory, lipolytic and pro-inflammatory profile of adipocytes in visceral fat depots³¹. Since the increase of central obesity is now considered as an independent risk factor for diabetes, some anthropometric indicators of central obesity (such as waist circumference, WHR and waist height ratio) are now used in clinical practice and research to better assess the obesity related risks of diabetes³². To sum up, in order to avoid the occurrence of diabetes or the treatment of diabetes, it is necessary to reasonably and actively control weight, avoid obesity, and properly exercise, develop good habits, and monitor and control blood pressure and blood lipids daily. According to the results of this study, targeted intervention programs and screening strategies were proposed for specific high-

risk groups. For overweight and obese people, it is suggested to carry out diet guidance, exercise guidance, etc., and improve the health awareness of such patients in the form of case sharing and disease education. For people with insufficient physical activity, it is recommended that the diet should be light, less salt and low sugar. Patients are encouraged to eat more vegetables and fruits, eat less fat meat and actively participate in exercise. At the same time, people with a family history of diabetes regularly check their blood sugar levels, and pay attention to controlling their diet in daily life, pay attention to the combination of coarse and fine grains, exercise reasonably, and keep blood sugar within the normal range¹³. For people with other chronic diseases, attention should be paid to strengthening disease monitoring, early warning, balanced diet and reasonable exercise.

What is more noteworthy is that because age is an uncontrollable factor and the aging of the population in China is serious, the elderly is the key population for the prevention and treatment of diabetes. It is necessary to strengthen the health management of the elderly, pay more attention to the rehabilitation of chronic diseases and the prevention of severe complications, reduce the disease severity of elderly patients, and promote the improvement of the quality of life of elderly diabetes patients¹⁹.

After comparing the risk factors of prediabetes, diabetes and glycemic control in two years, it is found that the differences in gender and harmful drinking of prediabetes, and region in diabetes are no longer significant. This result suggests that the living habits and behavior patterns of different gender and region residents in the past eight years are gradually close, while the intervention of unhealthy lifestyle has improved, such as harmful drinking. However, urban-rural differences and co-occurrence of other chronic diseases (such as central obesity and dyslipidemia) are new independent factors affecting glycemic control in diabetic patients. Therefore, the prevention and treatment of diabetes in this area cannot be relaxed, and the intervention strategies and measures should also be adjusted accordingly.

There are still some limitations in this study. First, the conclusions of this study are based on cross-sectional data. It is impossible to determine the causal relationship between prediabetes, diabetes and glycemic control and influencing factors in local adult populations. Future prospective cohort studies are still needed to clarify the causal relationship and longitudinal change of disease. Secondly, among the samples included in this study, the distribution of rural and urban populations is quite different, and there may be regional bias. Finally, in the questionnaire survey, the respondents may have biased memory of the questions in the questionnaire (such as life behavior habits), and some answers may have recall bias. Due to the uncertainty of the study site survey, a small number of variables were missing, but did not affect the overall analysis.

Conclusions

In this area, the prevalence of prediabetes and diabetes is still at a high level; The elderly, high school education, married or divorced, family history of diabetes, overweight and obesity, central obesity, hypertension and dyslipidemia are the key groups for prevention and treatment of diabetes in this area.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due our data from national projects research and public data is temporarily not allowed project requirements, but are available from the corresponding author on reasonable request.

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Author contributions

C.L., X.M., and A.S. wrote the main manuscript text and A.M., S.R., J.Z., Y.K., M.A. and P.M. prepared all table, and R.Z. reviewed full text. All authors reviewed the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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