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Prevalence of overweight and obesity and associated risk factors among adult residents of northwest China: A cross-sectional study

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**Prevalence of overweight and obesity and associated risk factors among adult residents of
northwest China: A cross-sectional study**

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Abstract

Objective: Overweight and obesity have been shown to be related to multiple chronic conditions and lead to a heavy economic burden on society throughout the world. This study aims to estimate the prevalence of overweight and obesity and determine potential influencing factors among adults in Xinjiang, northwest China.

Design: A community-based observational study.

Setting: The First Affiliated Hospital of Xinjiang Medical University.

Methods: In total, 14,618 adult participants (7,799 males; 6,819 females), aged over 35 years old, were recruited from the Cardiovascular Risk Survey conducted in 2010. Data were obtained from face-to-face interview and physical examination. The sample was used to estimate the prevalence of overweight (body mass index (BMI) 24-27.9 kg/m²) and obesity (BMI>28 kg/m²) in Xinjiang Province, and the influencing factors were analyzed based on statistical methods.

Results: The overall prevalence of overweight was 36.52% (male 40.1%; female; 33.4%), and the prevalence of obesity was 26.47% (male 27.2%; female 25.8%) in Xinjiang Province. The prevalence of both overweight and obesity were higher in women than men ($P<0.001$). The main influencing factors for overweight and obesity are sex, age, race, marriage status, education level, occupation, smoking, drinking, hypertension, diabetes and dyslipidemia ($P<0.05$).

Conclusions: This study estimated that the prevalence of overweight and obesity among adult residents of Xinjiang Province, northwest China, was high. These data suggest that efforts toward prevention and control of overweight and obesity should be a public health priority in the northwest of China.

Keywords: cross-sectional survey, overweight, obesity, risk factors

Strengths and limitations of this study

- The survey sample was demographically representative of Uygur obese adults aged 35–80 years in Xinjiang.
- The main strengths of our study are its large sample size and precise physical measurements, which increase the validity of our results.
- This is the first study to date that investigate the association of overweight and obesity and races in adults.
- However, the present study has several limitations. First, self-reported data and the nature of

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4 cross-sectional data may lead to recall and reporting biases, which may be the reason for the
5 insignificant difference in the effect of obesity on reasons.
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8 ➤ Moreover, other indicators of adiposity, such as body fat percentage and waist circumference
9 which plenty of studies reported to reflect the prevalence of overweight and obesity and body
10 fat distribution, were not obtained in our study.
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14 15 **Introduction**

16
17 Obesity is a complex chronic global disease affecting people worldwide across all ages, sexes,
18 ethnicities, and nationalities, which is the fifth leading cause of mortality globally [1, 2]. According
19 to the World Health Organization (WHO), the prevalence of worldwide obesity has doubled in more
20 than 70 countries since 1980 [3]; this trend has continuously increased in most other countries. In
21 2013, in order to make physicians pay more attention to the condition, the American Medical
22 Association classified obesity as a disease [4].
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26 Body mass index (BMI), which is calculated as weight/height squared (kg/m^2), is a common
27 and accepted measure that is used to report obesity rates. While BMI is not a true measure of
28 adiposity, it is simple to use in health screenings and epidemiological surveys [5]. According to the
29 WHO, obesity is defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$, and overweight as a BMI of $25\text{-}9.9 \text{ kg}/\text{m}^2$ [6]. For
30 Chinese people, obesity suggests a $\text{BMI} \geq 28 \text{ kg}/\text{m}^2$ and overweight indicates a BMI of $24\text{-}27.9 \text{ kg}/\text{m}^2$
31 [7].
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35 China is the largest developing country and has the largest population in the world. With the
36 rapid economic growth and changes in lifestyle such as dietary habits and physical activity [8], the
37 epidemiological data indicated that individuals with overweight and obesity had a higher prevalence
38 of traditional diseases including dyslipidemia, hypertension, cardiovascular disease, insulin
39 resistance or diabetes, fatty liver disease, and psychosocial complications and some cancers [5, 9].
40 Located in the northwest China, Xinjiang not only is an autonomous minority ethnic region of the
41 People's Republic of China, but also is one of the developing regions in China. It is the largest
42 Chinese administrative division and spans over 1.66 million km^2 which takes up about one sixth of
43 the country's territory. A few of studies had reported the prevalence of overweight among adults in
44 Xinjiang [10]. Nevertheless, the samples in above mentioned studies were small, those results
45 cannot represent accurately the status of overweight and obesity in the whole region of Xinjiang.
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4 In the present study, we estimate the prevalence of overweight and obesity in Xinjiang.
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6 Meanwhile, the potential influencing factors in adult residents of northwest China were explored.
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8 The results of this study will be considered as a reference for policy makers in making informed
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10 decisions.

11 **Materials and Methods**

12 **Ethics approval**

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15 This study was conducted according to the standards of the Declaration of Helsinki. Written
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17 informed consent was acquired from each participant prior to enrollment. Ethics approval was from
18
19 the Ethics Committee of the First Affiliated Hospital of Xinjiang Medical University.
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21 **Study design and population**

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23 This population-based cross-sectional survey is part of the Project on Present Situation and the
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25 Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The CRS was a
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27 prospective, multiple ethnicity and community-based observational study designed to investigate
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29 the prevalence and risk factors for cardiovascular disease (CVD) in the Han, Uyghur and Kazakh
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31 populations in Xinjiang Province [11]. All the subjects included had lived in Xinjiang Province for
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33 more than 1 year. Briefly, the CRS consisted of 16,460 adults aged ≥ 35 years old, of whom 14,618
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35 subjects (5,757 Han, 4,767 Uyghur and 4,094 Kazakh Chinese) completed the survey, yielding a
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37 response rate of 88.8%. We used a multistage stratified sampling method to select the study sample
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39 from 6 different administrative regions including Urumqi, Yili, Hetian, Kalamayi, Fukang, and
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41 Turpan. Finally, each participant was selected randomly from each household in the sites mentioned
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43 above.

44 **Data collection**

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46 The formal survey was made up of two parts: face-to-face interview and physical examination.
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48 Before the formal survey, we conducted a pre-survey to explore the feasibility of the questionnaire.
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50 During the investigation, each completed questionnaire was examined by two investigators to ensure
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52 validity and consistency. After the fieldwork, data were manipulated by parallel double entry, and
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54 we also performed three verifications to check for incomplete and inconsistent responses. The
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56 questionnaire provided demographics, general personal information and medical histories [12].
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58 Height and weight were measured using a standard protocol. Height was measured to the nearest
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60 0.1 cm, and weight was measured with a standard scale in the upright position to the nearest 0.1 kg.

Smoking and drinking conditions were self-reported.

Blood samples collection was conducted in examination centers at local hospital in the participants' residential area. At the time of the in-person interview, a 5 mL of venous blood was collected into EDTA tubes and processed to obtain plasma within 4h. All samples were stored at -80°C immediately after processing. We measured the concentration of fasting glucose using equipment for chemical analysis (Dimension AR/AVL Clinical Chemistry System, Newark, NJ, USA) employed by the Clinical Laboratory Department of the First Affiliated Hospital of Xinjiang Medical University. Biochemical markers in plasma including total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were measured.

Definition of variables

Overweight and obesity were defined by Chinese standards mentioned above. Obesity was defined as $BMI \geq 28 \text{ kg/m}^2$, and overweight was defined as a BMI of 25-29.9 kg/m^2 .

Education was classified into four levels: Primary school and below (including never attended school and elementary schooling only); Junior middle school; Senior middle school (including secondary vocational schooling); undergraduate and above (including post-secondary vocational schooling, Master and doctor). Manual labor included farmers, production and service workers. White collar occupations included office and other technical employment. Other occupations included unemployed, retiree, student and full-time housewife [13]. Smoking status classifications were current smokers (which had smoked at least one cigarette a day over the past 30 days), and never-smokers. Drinking status classifications were current drinkers (which had consumed more than one alcoholic drink a week), and never-drinkers. Hypertension was defined as mean systolic $BP \geq 140 \text{ mmHg}$, and/or mean diastolic $BP \geq 90 \text{ mmHg}$, and/or current use of antihypertensive medications [14]. Diabetes was defined as fasting plasma glucose $\geq 126 \text{ mg/dL}$ ($\geq 7.0 \text{ mmol/L}$) and/or self-reported history of diabetes and/or current use of insulin or antidiabetic medications [15]. Hypercholesterolemia was defined as serum total cholesterol level $> 6.22 \text{ mmol/L}$ (240 mg/dL), and hypertriglyceridemia was defined as serum triglyceride level $> 2.26 \text{ mmol/L}$ (200 mg/dL). A serum LDL-C level of $> 4.14 \text{ mmol/L}$ (160 mg/dL) was defined as high LDL-C, and a serum HDL-C level of $< 1.04 \text{ mmol/L}$ (40 mg/dL) was defined as low HDL-C. In total, dyslipidemia was defined as the existence of at least one of the four abnormal lipid concentrations mentioned above, or self-reported

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4 use of lipid-lowering drugs [16].

5 6 **Statistical analysis**

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8 Data was verified and corrected using EpiData3.02 software (EpiData, Association, Odense,
9 Denmark) by 2 staff members. Frequency distribution was used to present characteristics of the
10 subjects, and data presented as percentages were used to report the prevalence ratio. Continuous
11 variables were expressed as mean \pm standard deviation (SD) and or numerical data were expressed
12 as rates, and a Chi-square test (χ^2) was used to compare the prevalence of overweight and obesity
13 in different groups.
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17 To analyze the factors for obesity and adjust for potential confounding effects, a multivariate
18 logistic regression analyses were carried out to explore independent factors associated with
19 overweight and obesity. OR with 95% CI was used for the risk analysis. All statistical analyses were
20 conducted using the complex sampling function of Social Sciences SPSS for Windows version 22.0
21 (SPSS, Inc, Chicago, IL, USA), and a $p < 0.05$ level of significance was selected.
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24 25 **Patient and public involvement**

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27 This population-based cross-sectional survey is part of the Project on Present Situation and
28 the Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The study
29 was designed to investigate the prevalence of overweight and obesity among adult residents in
30 Xinjiang, the northwest China. However, no patients or members of the public were included in
31 the design, recruitment or conduct of the study. The results of measurements would be
32 disseminated to participants after the study which was completed by the study team. The burden of
33 the intervention will not be assessed by patients themselves.
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36 37 **Results**

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39 In this survey, we interviewed 14618 residents aged 35 to 101 years (mean age: 50.82 ± 12.62
40 years), comprised of 6,819 (46.6%) men and 7,799 (53.4%) women. Among these participants,
41 5,757 (39.4%) were Han ethnicities with a mean age of 52.47 ± 12.71 years, 4,767 (32.6%) were
42 Uygur ethnicities with a mean age of 50.70 ± 12.98 years, and 4,094 (28.0%) were Kazakh ethnicities
43 with a mean age of 48.63 ± 11.69 years. According to the BMI classification for Chinese people, the
44 overall prevalence of overweight was 36.52% (male 40.1%; female 33.4%), and the prevalence of
45 obesity was 26.47% (male 27.2%; female 25.8%) in Xinjiang Province (**Table 1**). There were
46 differences in age, area, race, occupation, education, marriage, drinking, hypertension history and
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4 plasma levels of TG, TC among the overweight and obesity groups, while there was no significant
5 difference in sex, smoking, diabetes history and the level of LDL-c and HDL-C among the 2 groups.
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8 From the age-stratified and gender-stratified results in **Table 2**, for men, the prevalence of both
9 overweight and obesity all peaked at 45-54 years, while no significant trend was illustrated in the
10 prevalence of overweight increased with age. For women, the prevalence of overweight and obesity
11 increased with age, peaking at 55-64 years, though there has a slight decrease at ≥ 65 years. In
12 addition, a higher proportion of enrolled males were overweight than females. Interestingly, the
13 proportions of females who were obese were higher than those of males.
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17 From the age-stratified and race-stratified results in **Table 3**, as a whole, obesity prevalence in
18 the different ethnicities was found to be the highest in Kazakh and the lowest in Han participants,
19 and there was a statistical significance among the three ethnic groups ($p < 0.001$). Further, overweight
20 prevalence also showed an interesting significant difference among the three ethnicities, the highest
21 in Han and the lowest in Kazakh participants.
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25 We divided the participants into two groups: normal weight; overweight and obese. **Table 1**
26 has showed that the following factors all had a significant effect: age, area, race, education, marriage
27 status, occupation, drinking, hypertension and dyslipidemia ($p < 0.05$). We applied multivariate
28 unconditional logistic regression analysis model on all identified risk factors and attempted to
29 identify any existing difference in these risk factors which may explain the difference in overweight
30 and obesity prevalence. **Table 4** shows the results of logistic regression models comparing the
31 prevalence of the potential risk factors: sex, age, area, marriage status, occupation, smoking,
32 drinking, hypertension, diabetes and the level of dyslipidemia, including hypercholesterolemia,
33 hypertriglyceridemia and low HDL-C. The multivariate logistic regression results reveal that female
34 adults are more likely to become overweight and obese than male adults (OR 0.77, 95% CI 0.71 to
35 0.84). We categorized age into four groups, which clearly showed that increasing age is a risk factor
36 for overweight/obesity, especially age 45-54 years (OR 1.46, 95% CI 1.33 to 1.61). Among the three
37 races, Kazak population (OR 1.66, 95% CI 1.49 to 1.84) and Uygur population (OR 1.44, 95% CI
38 1.30 to 1.59) are the risky people to become overweight and obese comparing with Han population.
39 Participants who have married (OR 1.83, 95% CI 1.36 to 2.47) or widowed (OR 1.81, 95% CI 1.30
40 to 2.51) are more likely to be overweight/obese than those who have unmarried. In addition, smokers
41 (OR 0.86, 95% CI 0.78 to 0.95) are less likely to become overweight and obese than nonsmokers.
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4 Participants who drink are more likely to become overweight or obese than those who never or
5 rarely drink (OR 1.45, 95% CI 1.28 to 1.64). Overweight and obesity are more common among
6 those who had hypertension (OR 2.14, 95% CI 1.97 to 2.32) and diabetes (OR 1.32, 95% CI 1.12
7 to 1.57) compared with those who had no hypertension and diabetes history. In the overweight and
8 obese population, hypertriglyceridemia (OR 2.43, 95% CI 2.22 to 2.66), hypercholesterolemia (OR
9 1.23, 95% CI 1.13 to 1.34) and low HDL-C (OR 1.11, 95% CI 1.02 to 1.20) remained as risk factors.

15 Discussion

16
17 The epidemic of obesity is one of the most important health problems worldwide and is
18 estimated to be the second leading cause of preventable death in developed countries, behind
19 cigarette smoking [3, 17]. The prevalence of overweight and obesity continues to increase around
20 the world, as have associated comorbidities and healthcare costs [18]. In the US, the prevalence of
21 obesity accounts for one-third of the general population, and another one-third is overweight [19].
22 Data from the China Chronic Disease Survey conducted by the Chinese Center for Disease Control
23 and Prevention demonstrated that the prevalence of overweight among Chinese adults (age 18–64
24 years) for 2007 and 2010 was 26.6% and 30.6%, respectively (male 27.4% and 32.1%; female 25.7%
25 and 29.1%), and the prevalence of obesity was 7.7% and 12.1%, respectively (male 6.7% and 12.5%;
26 female 8.7% and 11.1%). No doubt, we found that the prevalence of both overweight and obesity
27 was high. Our cross-sectional study indicates that the prevalence of overweight and obesity among
28 adults in northwest China was 36.52% (male 40.1%; female 33.4%), and 26.47% (male 27.2%;
29 female 25.8%). This implies that overweight and obesity have a higher prevalence in both sexes and
30 are more common in northwest China than in other areas, although effective actions might have
31 been taken to control the upward trend [20].

32
33 In this study, we found that the prevalence of both overweight and obesity is high in middle
34 age (45-64 years). Chinese people are more likely to have positive perceptions of obesity because it
35 is considered good fortune to become fat during middle age in traditional Chinese culture [21].
36 Through the present study, we found a very high prevalence of overweight and obesity in three
37 ethnicities in Xinjiang, and there is no doubt that the result is similar to the previous study in
38 Xinjiang [10]. In addition, the prevalence rate of obesity was significantly different among Han,
39 Uygur and Kazak groups and the prevalence in Kazak group was significantly higher compared
40 with Han and Uygur. Overall, our findings indicate that 16.28% of Han, 11.18% of Uygur, and 9.05%
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4 of Kazak people more than 35 years of age in Xinjiang have overweight, as with 7.40% of Han,
5 9.31% of Uygur, and 9.76% of Kazak people have obesity. Xinjiang is a multi-ethnic co-populated
6 area in China. The national census showed that lives 47 ethnicities in Xinjiang, and 13 of them are
7 confirmed to be native ethnicities, such as the Uygur and Kazak. The explanations for this increase
8 of prevalence as follows: firstly, Kazak live in the grassland and forests, whose dietary habits were
9 characterized by eating more animal and consuming fewer fresh vegetables; Secondly, Kazak is a
10 nomadic ethnic who usually lives in hypoxia area and high altitude where the climate is cold and
11 dry; Thirdly, different genetic backgrounds may also an important factor underlying the different
12 prevalence of obesity [22].

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21 Multivariate logistic regression analysis suggested that several factors are associated with the
22 prevalence of overweight and obesity. A previous review revealed that various marital transitions
23 are related with changes in body weight: transition into marriage appears to be associated with
24 weight gain, whereas transition out of marriage is associated with weight loss [23]. Our study found
25 a similar result that, transition into marriage including married, divorce and widowed are risk factors
26 for becoming overweight and obese. Plausible explanations are behaviors and lifestyle which differ
27 among married individuals, however, the exact mechanism is not clear to illustrate this apparent
28 association with marriage status. In our study, it is also found that different educational levels,
29 occupations and area of residence are closely related to body weight. We have observed that low
30 education level is a risk factor because of insufficient level of cognition. Urban population,
31 especially unemployed, retiree, student and full-time housewife, are more risky among overweight
32 and obese, which contribute to urban working conditions, for example sitting in the office, fast-
33 paced life and supermarket or fast food restaurant availability [24].

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46 The 2015 Global Burden of Disease Study, representing 195 countries and territories, estimated
47 that 25% of men and 5.4% of women worldwide smoked daily, which is the leading preventable
48 cause of death worldwide [25]. In this study, we found a lower prevalence of overweight and obesity
49 in smokers than non-smokers, which is consistent with studies conducted in Switzerland, India and
50 Jilin, China [26-28]. In addition, reasonable explanations to illustrated the issue according to two
51 different criteria. In terms of tobacco use, using tobacco is connected with multiple system functions,
52 especially cardiovascular and digestive systems [29]. In terms of the organism itself, smoking has
53 been considered as methods of pressure and energy relief. Affected by the traditional culture of
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4 drinking alcohol, especially in northwest China, it is generally believed that, the more you drink,
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6 the more weight you get. Wang et al [28] showed the consisted results.

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8 To the best of our knowledge, obesity is an independent risk factor both of CVD and death
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10 [30-32]. We explore that the prevalence of overweight and obesity are higher if subjects are with
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12 hypertension or diabetes or dyslipidemia. The results provide a compelling reason why the
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14 occurrence of obesity is combined with cardiovascular risk factors such as hypertension, diabetes
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16 or dyslipidemia. Previous studies reported that the benefits of weight loss are well established,
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18 with a 5–10% reduction in weight associated with improvement in health and quality of life, and a
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20 3% reduction being positive for health improvement where it is maintained [33].

21
22 These departments should heed the high prevalence of overweight and obesity in Xinjiang
23
24 Province and provide effective guidelines to help to reverse the trend. The main strengths of our
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26 study are its large sample size and precise physical measurements, which increase the validity of
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28 our results. However, the present study has several limitations. First, self-reported data and the
29
30 nature of cross-sectional data may lead to recall and reporting biases, which may be the reason for
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32 the insignificant difference in the effect of obesity on reasons. Moreover, other indicators of
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34 adiposity, such as body fat percentage and waist circumference which plenty of studies reported to
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36 reflect the prevalence of overweight and obesity and body fat distribution, were not obtained in
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38 our study [34, 35].

39 **Conclusions**

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41 In conclusion, the present study indicates that the prevalence of overweight and obesity
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43 among adult residents in Xinjiang, the northwest China, is very high during the past years.
44
45 Furthermore, the main influencing factors for overweight and obesity are sex, age, race, marriage
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47 status, education level, occupation, smoking, drinking, hypertension, diabetes and dyslipidemia.
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49 These data suggest that efforts toward prevention and control of overweight and obesity should be
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51 a public health priority in the northwest of China, which will be submitted to relevant departments
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53 as a reference to reverse the trends.

54
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57 Project(ID 2016E02072) and the Natural Science Foundation of China (ID 81660058).

58
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60
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Conflicts of Interest: The authors declare no conflict of interest.

References

1. De Luca M, Angrisani L, Himpens J, et al. Indications for Surgery for Obesity and Weight-Related Diseases: Position Statements from the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO). *Obesity surgery* 2016;26:1659-96.
2. Stevens G, Mascarenhas M, Mathers C. Global health risks: progress and challenges. *Bulletin of the World Health Organization* 2009;87:646.
3. Caballero B. The global epidemic of obesity: an overview. *Epidemiologic reviews* 2007;29:1-5.
4. Addo PN, Nyarko KM, Sackey SO, et al. Prevalence of obesity and overweight and associated factors among financial institution workers in Accra Metropolis, Ghana: a cross sectional study. *BMC research notes* 2015;8:599.
5. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *Jama* 2003;289:76-9.
6. Flegal KM, Kit BK, Orpana H, et al. Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis. *Jama* 2013;309:71-82.
7. Wang H, Zhai F. Programme and policy options for preventing obesity in China. *Obesity reviews : an official journal of the International Association for the Study of Obesity* 2013;14 Suppl 2:134-40.
8. Popkin BM, Du S, Zhai F, et al. Cohort Profile: The China Health and Nutrition Survey--monitoring and understanding socio-economic and health change in China, 1989-2011. *International journal of epidemiology* 2010;39:1435-40.
9. Ferretti F, Mariani M. Simple vs. Complex Carbohydrate Dietary Patterns and the Global Overweight and Obesity Pandemic. *International journal of environmental research and public health* 2017;14.
10. He J, Guo H, Ding YS, et al. [Epidemiological study on overweight and obesity among rural adult residents in Hazakh, Uygur and Han populations in Xinjiang]. *Zhonghua liu xing bing xue za zhi = Zhonghua liuxingbingxue zazhi* 2013;34:1164-8.
11. Xie X, Ma YT, Yang YN, et al. Alcohol consumption and ankle-to-brachial index: results from the Cardiovascular Risk Survey. *PloS one* 2010;5:e15181.
12. Xiang X, Ma YT, Fu ZY, et al. Haplotype analysis of the CYP8A1 gene associated with myocardial infarction. *Clinical and applied thrombosis/hemostasis : official journal of the International Academy of Clinical and Applied Thrombosis/Hemostasis* 2009;15:574-80.
13. Wang C, Yu Y, Zhang X, Li Y, et al. Awareness, treatment, control of diabetes mellitus and the risk factors: survey results from northeast China. *PloS one* 2014;9:e103594.
14. McManus RJ, Caulfield M, Williams B, National Institute for H, Clinical E. NICE hypertension guideline 2011: evidence based evolution. *Bmj* 2012;344:e181.
15. Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycaemia in type 2 diabetes mellitus: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetologia* 2009;52:17-30.
16. Joint Committee for Developing Chinese guidelines on P, Treatment of Dyslipidemia in A. [Chinese guidelines on prevention and treatment of dyslipidemia in adults]. *Zhonghua xin xue guan*

- bing za zhi 2007;35:390-419.
17. Lavie CJ, Arena R, Alpert MA, et al. Management of cardiovascular diseases in patients with obesity. *Nature reviews Cardiology* 2018;15:45-56.
18. Collaborators GBDO, Afshin A, Forouzanfar MH, et al. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. *The New England journal of medicine* 2017;377:13-27.
19. Vogelzangs N, Kritchevsky SB, Beekman AT, et al. Obesity and onset of significant depressive symptoms: results from a prospective community-based cohort study of older men and women. *The Journal of clinical psychiatry* 2010;71:391-9.
20. Catala-Lopez F, Genova-Maleras R. [Prevention and control of chronic non-communicable diseases in Spain: A call to action]. *Medicina clinica* 2013;140:502-3.
21. Carroll DD, Blanck HM, Serdula MK, et al. Obesity, physical activity, and depressive symptoms in a cohort of adults aged 51 to 61. *Journal of aging and health* 2010;22:384-98.
22. Wang YT, Adi D, Yu ZX, et al. The burden and correlates of hypertension among Chinese rural population in Han, Uygur, and Kazak: a cross-sectional study. *Journal of the American Society of Hypertension : JASH* 2017;11:737-45 e3.
23. Dinour L, Leung MM, Tripicchio G, et al. The Association between Marital Transitions, Body Mass Index, and Weight: A Review of the Literature. *Journal of obesity* 2012;2012:294974.
24. Saelens BE, Glanz K, Frank LD, et al. Two-Year Changes in Child Weight Status, Diet, and Activity by Neighborhood Nutrition and Physical Activity Environment. *Obesity* 2018;26:1338-46.
25. Collaborators GBDT. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015. *Lancet* 2017;389:1885-906.
26. Marques-Vidal P, Bochud M, Mooser V, et al. Prevalence of obesity and abdominal obesity in the Lausanne population. *BMC public health* 2008;8:330.
27. Siddiquee T, Bhowmik B, Da Vale Moreira NC, et al. Prevalence of obesity in a rural Asian Indian (Bangladeshi) population and its determinants. *BMC public health* 2015;15:860.
28. Wang R, Zhang P, Gao C, et al. Prevalence of overweight and obesity and some associated factors among adult residents of northeast China: a cross-sectional study. *BMJ open* 2016;6:e010828.
29. Marcus MD, Wildes JE. Obesity: is it a mental disorder? *The International journal of eating disorders* 2009;42:739-53.
30. Global BMIMC, Di Angelantonio E, Bhupathiraju Sh N, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet* 2016;388:776-86.
31. Lassale C, Tzoulaki I, Moons KGM, et al. Separate and combined associations of obesity and metabolic health with coronary heart disease: a pan-European case-cohort analysis. *European heart journal* 2018;39:397-406.
32. Fan J, Song Y, Chen Y, et al. Combined effect of obesity and cardio-metabolic abnormality on the risk of cardiovascular disease: a meta-analysis of prospective cohort studies. *International journal of cardiology* 2013;168:4761-8.
33. Espeland MA, Glick HA, Bertoni A, et al. Impact of an intensive lifestyle intervention on use and cost of medical services among overweight and obese adults with type 2 diabetes: the action for health in diabetes. *Diabetes care* 2014;37:2548-56.
34. Zeng Q, Dong SY, Sun XN, et al. Percent body fat is a better predictor of cardiovascular risk

factors than body mass index. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas 2012;45:591-600.

35. Ramirez-Velez R, Correa-Bautista JE, Gonzalez-Ruiz K, et al. The Role of Body Adiposity Index in Determining Body Fat Percentage in Colombian Adults with Overweight or Obesity. International journal of environmental research and public health 2017;14.

Table 1 Prevalence of overweight and obesity according to demographic characteristics

Characteristic	N	Overweight			Obesity		
		n (%)	χ^2	P	n (%)	χ^2	P
Sex							
Male	6819	2735(40.1)	71.13	<0.001	1856 (27.2)	3.70	0.054
Female	7799	2603(33.4)			2013(25.8)		
Age(years)							
35-44	5425	1866(34.4)	20.27	<0.001	1146(21.1)	149.82	<0.001
45-54	3759	1441(38.3)			1153(30.7)		
55-64	2932	1067(36.4)			919(31.3)		
≥65	2502	964(38.5)			651(26.0)		
Area							
Urban	7974	3163(39.7)	75.08	<0.001	1956(24.5)	33.85	<0.001
Rural	6644	2175(32.7)			1913(28.8)		
Ethnicity							
Han	5757	2380(16.28)	99.09	<0.001	1082(7.40)	331.94	<0.001
Uyghur	4767	1635(11.18)			1361(9.31)		
Kazak	4094	1323(9.05)			1426(9.76)		
Occupation							
Manual	4583	1760(12.04)	12.11	0.002	1095(7.49)	32.08	<0.001
White collar	7751	2736(18.72)			2086(14.27)		
Other	2284	842(5.76)			688(4.71)		
Education							

Primary school and below	5805	1993(13.63)	26.85	<0.001	1589(10.87)	21.17	<0.001
Junior middle school	3094	1196(8.18)			844(5.77)		
Senior middle school	4556	1676(11.46)			1191(8.15)		
Undergraduate and above	1163	473(3.24)			245(1.68)		
Marriage							
Unmarried	192	59(0.40)	14.11	<0.001	27(0.18)	23.05	<0.001
Married	12988	4795(32.80)			3427(23.44)		
divorced	201	53(0.36)			47(0.32)		
widowed	1237	431(2.95)			368(2.52)		
Drinking							
Yes	4169	923(6.31)	44.48	<0.001	663(4.54)	24.58	<0.001
No	10449	4415(30.20)			3206(21.93)		
Smoking							
Yes	2151	1688(11.55)	39.71	<0.001	1101(7.53)	0.01	0.92
No	12467	3650(24.97)			2768(18.94)		
Hypertension							
Yes	5701	2138(14.63)	3.92	0.048	2155(14.74)	616.77	<0.001
No	8917	3200(21.89)			1714(11.73)		
Diabetes							
Yes	859	335(2.29)	2.43	0.119	317(2.17)	51.02	<0.001
No	13759	5003(34.22)			3552(24.30)		
Dyslipidemia							
hypertriglyceridemia							
Yes	4113	1724(11.79)	71.97	<0.001	1497(10.24)	289.94	<0.001
No	10505	3614(24.72)			2372(16.23)		
hypercholesterolemia							
Yes	3787	1469(10.05)	11.40	0.001	1267(8.67)	128.29	<0.001

No	10831	3869(26.47)			2602(17.80)		
High LDL-C							
Yes	5251	1921(13.14)	0.016	0.90	1334(9.13)	4.76	0.029
No	9367	3417(23.38)			2535(17.34)		
Low HDL-C							
Yes	4437	1704(11.66)	9.79	0.002	1215(8.31)	2.75	0.097
No	10831	3634(24.86)			2654(18.16)		

Categorical variables are presented as counts and percentages. HDL-c, high density lipoprotein-cholesterol; LDL-c, low density lipoprotein-cholesterol.

Table 2 Prevalence of overweight and obesity in men and women according to age group

Age (years)	Overweight		<i>P</i>	Obesity		<i>P</i>
	Male(%)	female(%)		male(%)	female(%)	
35-44	994(40.2)	872(29.5)	<0.001	631(25.5)	515(17.4)	<0.001
45-54	735(43.1)	706(34.4)		517(30.3)	636(31.0)	
55-64	476(35.8)	591(36.8)		389(29.3)	531(33.0)	
≥65	530(40.3)	434(36.5)		319(24.3)	332(27.9)	

Table 3 Prevalence of overweight and obesity in Han, Uyghur and Kazak according to age group

Age (years)	Overweight			<i>P</i>	Obesity			<i>P</i>
	Han(%)	Uyghur(%)	Kazak(%)		Han(%)	Uyghur(%)	Kazak(%)	
35-44	712(35.0)	573(34.6)	581(33.6)	<0.001	273(13.4)	422(25.5)	451(26.1)	<0.001
45-54	599(43.9)	481(38.1)	361(31.9)		246(18.0)	436(34.5)	471(41.6)	
55-64	497(45.9)	354(32.6)	216(28.3)		268(24.7)	318(29.3)	333(43.6)	
≥65	572(45.0)	227(29.9)	165(35.1)		295(23.2)	185(24.3)	171(36.4)	

Table 4 Multivariate regression analysis of correlates of overweight and obesity in residents of Xinjiang Province

Characteristic	B	S.E.	Wald	df	P	OR	95%CI
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Area	-0.14	0.04	10.42	1	0.001	0.87	0.80-0.95
Sex	-0.26	0.05	32.52	1	<0.001	0.77	0.71-0.84
Ethnic			94.43	2	<0.001		
Han	-	-	-	-	-	1	-
Uygur	0.36	0.05	49.95	1	<0.001	1.44	1.30-1.59
Kazakh	0.50	0.05	86.21	1	<0.001	1.66	1.49-1.84
Age(years)			71.20	3	<0.001		
35-44	-	-	-	-	-	1	-
45-54	0.38	0.05	62.79	1	<0.001	1.46	1.33-1.61
55-64	0.27	0.05	24.63	1	<0.001	1.31	1.18-1.46
≥65	0.11	0.06	3.05	1	0.081	1.11	0.99-1.26
Education			17.87	3	<0.001		
Primary school and below	-	-	-	-	-	1	-
Junior middle school	0.20	0.05	15.61	1	<0.001	1.22	1.11-1.35
Senior middle school	0.15	0.06	7.02	1	0.008	1.16	1.04-1.29
Undergraduate and above	0.22	0.08	6.84	1	0.009	1.25	1.06-1.47
Occupation			10.36	2	0.006		
Manual	-	-	-	-	-	1	-
White collar	0.01	0.05	0.04	1	0.833	1.01	0.91-1.12
Other	0.18	0.06	7.90	1	0.005	1.20	1.06-1.36
Marriage			26.50	3	<0.001		
Unmarried	-	-	-	-	-	1	-
Married	0.60	0.15	15.54	1	<0.001	1.83	1.36-2.47
Divorced	0.10	0.21	0.20	1	0.656	1.10	0.72-1.67
widowed	0.59	0.17	12.44	1	<0.001	1.81	1.30-2.51
Smoking	-0.15	0.05	8.95	1	0.003	0.86	0.78-0.95
Drinking	0.37	0.06	34.83	1	<0.001	1.45	1.28-1.64
Hypertension	0.76	0.04	340.43	1	<0.001	2.14	1.97-2.32
Diabetes	0.28	0.09	10.41	1	0.001	1.32	1.12-1.57

Dyslipidemia

hypertriglyceridemia	0.89	0.05	371.44	1	<0.001	2.43	2.22-2.66
hypercholesterolemia	0.21	0.05	20.94	1	<0.001	1.23	1.13-1.34
Low HDL-C	0.10	0.04	6.44	1	0.011	1.11	1.02-1.20
High LDL-C	0.015	0.038	0.156	1	0.693	1.015	0.94-1.09
Constant	-1.01	0.17	35.28	1	<0.001	-	-

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Prevalence of overweight and obesity and associated risk factors among adult residents of northwest China: A cross-sectional study

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4 **1 Prevalence of overweight and obesity and associated risk factors among adult residents of**
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6 **2 northwest China: A cross- sectional study**
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3 Abstract

4 **Objective:** Overweight and obesity have been shown to be related to multiple chronic conditions
5 and lead to a heavy economic burden on society throughout the world. This study aims to estimate
6 the prevalence of overweight and obesity and determine potential influencing factors among adults
7 in Xinjiang, northwest China.

8 **Design:** A community-based observational study.

9 **Setting:** The First Affiliated Hospital of Xinjiang Medical University.

10 **Methods:** In total, 14,618 adult participants (7,799 males; 6,819 females), aged over 35 years old,
11 were recruited from the Cardiovascular Risk Survey conducted in 2010. Data were obtained from
12 face-to-face interview and physical examination. The sample was used to estimate the prevalence
13 of overweight (body mass index (BMI) [24-28] kg/m²) and obesity (BMI≥28 kg/m²) in Xinjiang
14 Province, and the influencing factors were analyzed based on statistical methods.

15 **Results:** The overall prevalence of overweight was 36.5% (male 40.1%; female 33.4%), and the
16 prevalence of obesity was 26.5% (male 27.2%; female 25.8%) in Xinjiang Province. The
17 prevalence of both overweight and obesity were higher in women than men ($P<0.001$). The main
18 influencing factors for overweight and obesity are sex, age, race, marriage status, education level,
19 occupation, smoking, drinking, hypertension, diabetes and dyslipidemia ($P<0.05$).

20 **Conclusions:** This study estimated that the prevalence of overweight and obesity among adult
21 residents of Xinjiang Province, northwest China, was high. These data suggest that efforts toward
22 prevention and control of overweight and obesity should be a public health priority in the
23 northwest of China.

24 **Keywords:** cross-sectional survey, overweight, obesity, risk factors

25 Strengths and limitations of this study

- 26 ➤ The survey sample was demographically representative of Uygur adults with obesity aged
27 35–80 years in Xinjiang.
28 ➤ The main strengths of our study are its large sample size and precise physical measurements,

1 which increase the validity of our results.

2 ➤ Due to the cross-sectional nature and self-designed questionnaire, indicators and experience
3 could have been affected by bias.

4 ➤ Moreover, other indicators of adiposity, such as body fat percentage and waist circumference
5 were not obtained in our study.

6 ➤ The results were from Xinjiang only and therefore cannot be generalised to the whole China.

7

8 **Introduction**

9 Obesity is a complex chronic global disease affecting people worldwide across all ages, sexes,
10 ethnicities, and nationalities, which is the fifth leading cause of mortality globally ^{1 2}. According to
11 the World Health Organization (WHO), the prevalence of worldwide obesity has doubled in more
12 than 70 countries since 1980 ³; this trend has continuously increased in most other countries. In 2013,
13 in order to make physicians pay more attention to the condition, the American Medical Association
14 classified obesity as a disease ⁴.

15 Body mass index (BMI), which is calculated as weight/height squared (kg/m^2), is a common
16 and accepted measure that is used to report obesity rates. While BMI is not a true measure of
17 adiposity, it is simple to use in health screenings and epidemiological surveys ⁵. According to the
18 WHO, obesity is defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$, and overweight as a BMI of $[25-30) \text{ kg}/\text{m}^2$ ⁶. For
19 Chinese people, a $\text{BMI} \geq 28 \text{ kg}/\text{m}^2$ suggests obesity and a BMI of $[24-28) \text{ kg}/\text{m}^2$ indicates
20 overweight ⁷.

21 China is the largest developing country and has the largest population in the world. With the
22 rapid economic growth and changes in lifestyle such as dietary habits and physical activity ⁸, the
23 epidemiological data indicated that individuals with overweight and obesity had a higher prevalence
24 of traditional diseases including dyslipidemia, hypertension, cardiovascular disease, insulin
25 resistance or diabetes, fatty liver disease, and psychosocial complications and some cancers ^{5 9}.
26 Located in the northwest China, Xinjiang not only is an autonomous minority ethnic region of the
27 People's Republic of China, but also is one of the developing regions in China. It is the largest
28 Chinese administrative division and spans over 1.66 million km^2 which takes up about one sixth of
29 the country's territory. A few of studies had reported the prevalence of overweight among adults in

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4 1 Xinjiang ¹⁰. Nevertheless, the samples in above mentioned studies were small, those results cannot
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6 2 represent accurately the status of overweight and obesity in the whole region of Xinjiang.

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8 3 In the present study, we estimated the prevalence of overweight and obesity in Xinjiang.
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10 4 Meanwhile, the potential influencing factors in adult residents of northwest China were explored.
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12 5 The results of this study will be considered as a reference for policy makers in making informed
13
14 6 decisions.

15 7 **Materials and Methods**

16 8 **Ethics approval**

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19 9 This study was conducted according to the standards of the Declaration of Helsinki. Written
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21 10 informed consent was acquired from each participant prior to enrollment. Ethics approval was from
22
23 11 the Ethics Committee of the First Affiliated Hospital of Xinjiang Medical University (the approval
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25 12 ID: 20100116-01).

26 13 **Study design and population**

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29 14 This population-based cross-sectional survey is part of the Project on Present Situation and the
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31 15 Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The CRS was a
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33 16 prospective, multiple ethnicity and community-based observational study designed to investigate
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35 17 the prevalence and risk factors for cardiovascular disease (CVD) in the Han, Uygur and Kazakh
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37 18 populations in Xinjiang Province ¹¹. All the subjects included had lived in Xinjiang Province for
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39 19 more than 1 year. Briefly, the CRS consisted of 16,460 adults aged ≥ 35 years old, of whom 14,618
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41 20 subjects (5,757 Han, 4,767 Uygur and 4,094 Kazakh Chinese) completed the survey, yielding a
42
43 21 response rate of 88.8%. We used a multistage stratified sampling method to select the study sample
44
45 22 from 6 different administrative regions including Urumqi, Yili, Hetian, Kelamayi, Fukang, and
46
47 23 Turpan. Finally, each participant was selected randomly from each household in the sites mentioned
48
49 24 above.

50 25 **Data collection**

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52 26 The formal survey was made up of two parts: face-to-face interview and physical examination.
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54 27 Before the formal survey, we conducted a pre-survey to explore the feasibility of the questionnaire.
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56 28 During the investigation, each completed questionnaire was examined by two investigators to ensure
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58 29 validity and consistency. After the fieldwork, data were manipulated by parallel double entry, and
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1 we also performed three verifications to check for incomplete and inconsistent responses. The
2 questionnaire provided demographics, general personal information and medical histories¹². Height
3 and weight were measured using a standard protocol. Height was measured to the nearest 0.1 cm,
4 and weight was measured with a standard scale in the upright position to the nearest 0.1 kg. Smoking
5 and drinking conditions were self-reported.

6 Blood samples collection was conducted in examination centers at local hospital in the
7 participants' residential area. At the time of the in-person interview, a 5mL of venous blood was
8 collected into EDTA tubes and processed to obtain plasma within 4h. All samples were stored at
9 -80°C immediately after processing. We measured the concentration of fasting glucose using
10 equipment for chemical analysis (Dimension AR/AVL Clinical Chemistry System, Newark, NJ,
11 USA) employed by the Clinical Laboratory Department of the First Affiliated Hospital of Xinjiang
12 Medical University. Biochemical markers in plasma including total cholesterol (TC), triglycerides
13 (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-
14 C) were measured.

15 **Definition of variables**

16 Overweight and obesity were defined by Chinese standards mentioned above. Obesity was
17 defined as $BMI \geq 28 \text{ kg/m}^2$, and overweight was defined as a BMI of [24-28) kg/m^2 .

18 Education was classified into four levels: Primary school and below (including never attended
19 school and elementary schooling only); Junior middle school; Senior middle school (including
20 secondary vocational schooling); undergraduate and above (including post-secondary vocational
21 schooling, master's degree and doctoral degree). Manual labor included farmers, production and
22 service workers. White collar occupations included office and other technical employment. Other
23 occupations included unemployed, retiree, student and full-time housewife¹³. Smoking status
24 classifications were current smokers (which had smoked at least one cigarette a day over the past
25 30 days), and never-smokers. Drinking status classifications were current drinkers (which had
26 consumed more than one alcoholic drink a week), and never-drinkers. Hypertension was defined as
27 mean systolic $BP \geq 140 \text{ mmHg}$, and/or mean diastolic $BP \geq 90 \text{ mmHg}$, and/or current use of
28 antihypertensive medications¹⁴. Diabetes was defined as fasting plasma glucose $\geq 126 \text{ mg/dL}$ (≥ 7.0
29 mmol/L) and/or self-reported history of diabetes and/or current use of insulin or antidiabetic

1 medications¹⁵. Hypercholesterolemia was defined as serum total cholesterol level >6.22 mmol/L
2 (240 mg/dL), and hypertriglyceridemia was defined as serum triglyceride level >2.26 mmol/L (200
3 mg/dL). A serum LDL-C level of >4.14 mmol/L (160 mg/dL) was defined as high LDL-C, and a
4 serum HDL-C level of <1.04 mmol/L (40 mg/dL) was defined as low HDL-C. In total, dyslipidemia
5 was defined as the existence of at least one of the four abnormal lipid concentrations mentioned
6 above, or self-reported use of lipid-lowering drugs¹⁶.

7 **Statistical analysis**

8 Data was verified and corrected using EpiData 3.02 software (EpiData, Association, Odense,
9 Denmark) by 2 staff members. Frequency distribution was used to present characteristics of the
10 subjects, and data presented as percentages were used to report the prevalence ratio. Continuous
11 variables were expressed as mean±standard deviation (SD) and numerical data were expressed as
12 rates, and a Chi-square test (χ^2) was used to compare the prevalence of overweight and obesity in
13 different groups.

14 To analyze the factors for obesity and adjust for potential confounding effects, a multivariable
15 logistic regression analyses were carried out to explore independent factors associated with
16 overweight and obesity. OR with 95% CI was used for the risk analysis. All statistical analyses were
17 conducted using the complex sampling function of Social Sciences SPSS for Windows version 22.0
18 (SPSS, Inc, Chicago, IL, USA), and a $P<0.05$ level of significance was selected.

19 **Patient and public involvement**

20 This population-based cross-sectional survey is part of the Project on Present Situation and
21 the Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The study
22 was designed to investigate the prevalence of overweight and obesity among adult residents in
23 Xinjiang, the northwest China. However, no patients or members of the public were included in
24 the design, recruitment or conduct of the study. The results of measurements would be
25 disseminated to participants after the study which was completed by the study team. The burden of
26 the intervention will not be assessed by patients themselves.

27 **Results**

28 In this survey, we interviewed 14618 residents aged 35 to 101 years (mean age: 50.8±12.6
29 years), comprised of 6,819 (46.6%) men and 7,799 (53.4%) women. Among these participants,

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4 1 5,757 (39.4%) were Han ethnicities with a mean age of 52.5±12.7 years, 4,767 (32.6%) were Uygur
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6 2 ethnicities with a mean age of 50.7±13.0 years, and 4,094 (28.0%) were Kazakh ethnicities with a
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8 3 mean age of 48.6±11.7 years. According to the BMI classification for Chinese people, the overall
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10 4 prevalence of overweight was 36.5% (male 40.1%; female 33.4%), and the prevalence of obesity
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12 5 was 26.5% (male 27.2%; female 25.8%) in Xinjiang Province (**Table 1**). There were differences in
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14 6 age, area, race, occupation, education, marriage, drinking, hypertension history and plasma levels
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16 7 of TG, TC among the overweight and obesity groups, while there was no significant difference in
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18 8 sex, smoking, diabetes history and the level of LDL-c and HDL-C among the 2 groups.

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20 9 From the age-stratified and gender-stratified results in **Table 2**, for men, the prevalence of both
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22 10 overweight and obesity all peaked at 45-54 years, while no significant trend was illustrated in the
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24 11 prevalence of overweight increased with age. For women, the prevalence of overweight and obesity
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26 12 increased with age, peaking at 55-64 years, though there has a slight decrease at ≥65 years. In
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28 13 addition, a higher proportion of enrolled males were overweight than females. Interestingly, the
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30 14 proportions of females who were obese were higher than those of males.

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32 15 From the age-stratified and race-stratified results in **Table 3**, as a whole, obesity prevalence in
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34 16 the different ethnicities was found to be the highest in Kazakh and the lowest in Han participants,
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36 17 and there was a statistical significance among the three ethnic groups ($P<0.001$). Further,
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38 18 overweight prevalence also showed an interesting significant difference among the three ethnicities,
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40 19 the highest in Han and the lowest in Kazakh participants.

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42 20 We divided the participants into two groups: normal weight; overweight and obese. **Table 1**
43
44 21 has shown that the following factors all had a significant effect: age, area, race, education, marriage
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46 22 status, occupation, drinking, hypertension and dyslipidemia ($P<0.05$). We applied multivariable
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48 23 unconditional logistic regression analysis model on all identified risk factors and attempted to
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50 24 identify any existing difference in these risk factors which may explain the difference in overweight
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52 25 and obesity prevalence. **Table 4** shows the results of logistic regression models comparing the
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54 26 prevalence of the potential risk factors: sex, age, area, marriage status, occupation, smoking,
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56 27 drinking, hypertension, diabetes and the level of dyslipidemia, including hypercholesterolemia,
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58 28 hypertriglyceridemia and low HDL-C. The multivariable logistic regression results reveal that
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60 29 female adults prefer to become overweight and obese than male adults (OR 0.8, 95% CI 0.7 to 0.8).

1 We categorized age into four groups, which clearly showed that increasing age is a risk factor for
2 overweight/obesity, especially age 45-54 years (OR 1.5, 95% CI 1.3 to 1.6). Among the three races,
3 Kazak population (OR 1.7, 95% CI 1.5 to 1.8) and Uygur population (OR 1.4, 95% CI 1.3 to 1.6)
4 carried higher risk to become overweight and obese. Participants who have married (OR 1.8, 95%
5 CI 1.4 to 2.5) or widowed (OR 1.8, 95% CI 1.3 to 2.5) are more likely to be overweight/obese than
6 those who have unmarried. In addition, smokers (OR 0.9, 95% CI 0.8 to 0.9) are less likely to
7 become overweight and obese than nonsmokers. Participants who drink are easier to become
8 overweight or obese than those who never or rarely drink (OR 1.5, 95% CI 1.3 to 1.6). Overweight
9 and obesity are more common among those who had hypertension (OR 2.1, 95% CI 2.0 to 2.3) and
10 diabetes (OR 1.3, 95% CI 1.1 to 1.6) compared with those who had no hypertension and diabetes
11 history. In the overweight and obese population, hypertriglyceridemia (OR 2.4, 95% CI 2.2 to 2.7),
12 hypercholesterolemia (OR 1.2, 95% CI 1.1 to 1.3) and low HDL-C (OR 1.1, 95% CI 1.0 to 1.2)
13 remained as risk factors.

14 **Discussion**

15 The epidemic of obesity is one of the most important health problems worldwide and is
16 estimated to be the second leading cause of preventable death in developed countries, behind
17 cigarette smoking^{17 18}. The prevalence of overweight and obesity continues to increase around the
18 world, as have associated comorbidities and healthcare costs¹⁹. In the US, the prevalence of obesity
19 accounts for one-third of the general population, and another one-third is overweight²⁰. Data from
20 the China Chronic Disease Survey conducted by the Chinese Center for Disease Control and
21 Prevention demonstrated that the prevalence of overweight among Chinese adults (age 18–64 years)
22 for 2007 and 2010 was 26.6% and 30.6%, respectively (male 27.4% and 32.1%; female 25.7% and
23 29.1%), and the prevalence of obesity was 7.7% and 12.1%, respectively (male 6.7% and 12.5%;
24 female 8.7% and 11.1%)²¹. No doubt, we found that the prevalence of both overweight and obesity
25 was high. Our cross-sectional study indicates that the prevalence of overweight and obesity among
26 adults in northwest China was 36.5% (male 40.1%; female 33.4%), and 26.5% (male 27.2%; female
27 25.8%). In the Russian population²², the overweight was 64.6% (male 42.3%; female 28.7%), and
28 approximately a third of the participants (30.3%) had obesity (male 27.5%; female 31.4%). Contrary
29 to what was observed in our research, the prevalence of overweight was higher than obesity. This

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4 1 implies that overweight and obesity have a higher prevalence in both sexes and are more common
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6 2 in northwest China and Russian than in other areas, although effective actions might have been
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8 3 taken to control the upward trend ²³.

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10 4 In this study, we found that the prevalence of both overweight and obesity is high in middle
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12 5 age (45-64 years). Similarly, age gradients in the prevalence of obesity are found in Russia ²². It is
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14 6 worth noting that more than half of all women aged 55–64 years have obesity, and nearly 80% men
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16 7 in the groups aged 45–54 years had overweight and obesity, which consists with our age gradients.
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18 8 Chinese people are more likely to have positive perceptions of obesity because it is considered good
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20 9 fortune to become fat during middle age in traditional Chinese culture ²⁴. Moreover, a large segment
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22 10 of the middle-aged and older adult population will be living with overweight and obesity, which is
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24 11 associated with additional health impairments ²⁵.

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26 12 Through the present study, we found a very high prevalence of overweight and obesity in three
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28 13 ethnicities in Xinjiang, and there is no doubt that the result is similar to the previous study in
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30 14 Xinjiang ¹⁰. In addition, the prevalence rate of obesity was significantly different among Han, Uygur
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32 15 and Kazak groups and the prevalence in Kazak group was significantly higher compared with Han
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34 16 and Uygur. Overall, our findings indicate that 16.3% of Han, 11.2% of Uygur, and 9.1% of Kazak
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36 17 people more than 35 years of age in Xinjiang have overweight, as with 7.4% of Han, 9.3% of Uygur,
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38 18 and 9.8% of Kazak people have obesity. Xinjiang is a multi-ethnic co-populated area in China. The
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40 19 national census showed that there are 47 ethnicities in Xinjiang, and 13 of them are confirmed to be
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42 20 native ethnicities, such as the Uygur and Kazak. The explanations for this increase of prevalence as
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44 21 follows: firstly, Kazak live in the grassland and forests, whose dietary habits were characterized by
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46 22 eating more animal and consuming fewer fresh vegetables; Secondly, Kazak is a nomadic ethnic
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48 23 who usually lives in hypoxia area and high altitude where the climate is cold and dry; Thirdly,
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50 24 different genetic backgrounds may also be an important factor underlying the different prevalence
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52 25 of obesity ²⁶.

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54 26 Multivariable logistic regression analysis suggested that several factors are associated with the
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56 27 prevalence of overweight and obesity. A previous review revealed that various marital transitions
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58 28 are related with changes in body weight: transition into marriage appears to be associated with
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60 29 weight gain, whereas transition out of marriage is associated with weight loss ²⁷. Our study found a

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4 1 similar result that, transition into marriage including married, divorce and widowed are risk factors
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6 2 for becoming overweight and obese. Plausible explanations are behaviors and lifestyle which differ
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8 3 among married individuals, however, the exact mechanism is not clear to illustrate this apparent
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10 4 association with marriage status. In our study, it is also found that different educational levels,
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12 5 occupations and area of residence are closely related to body weight. We have observed that low
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14 6 education level is a risk factor because of insufficient level of cognition. Urban population,
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16 7 especially unemployed, retiree, student and full-time housewife, are easier to become overweight
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18 8 and obese, which contribute to urban working conditions, for example sitting in the office, fast-
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20 9 paced life and supermarket or fast food restaurant availability ²⁸.

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22 10 The 2015 Global Burden of Disease Study, representing 195 countries and territories, estimated
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24 11 that 25.0% of men and 5.4% of women worldwide smoked daily, which is the leading preventable
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26 12 cause of death worldwide ²⁹. In this study, we found a lower prevalence of overweight and obesity
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28 13 in smokers than non-smokers, which is consistent with studies conducted in Switzerland, India and
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30 14 Jilin, China ^{21 30 31}. In addition, reasonable explanations to illustrated the issue according to two
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32 15 different criteria. In terms of tobacco use, using tobacco is connected with multiple system functions,
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34 16 especially cardiovascular and digestive systems ³². In terms of the organism itself, smoking has been
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36 17 considered as methods of pressure and energy relief. Affected by the traditional culture of drinking
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38 18 alcohol, especially in northwest China, it is generally believed that, the more you drink, the more
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40 19 weight you get. Wang et al ²¹ showed the consisted results.

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42 20 To the best of our knowledge, obesity is an independent risk factor both of CVD and death ³³⁻
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44 21 ³⁵. We explore that the prevalence of overweight and obesity are higher if subjects are with
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46 22 hypertension or diabetes or dyslipidemia. The results provide a compelling reason why the
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48 23 occurrence of obesity is combined with cardiovascular risk factors such as hypertension, diabetes
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50 24 or dyslipidemia. Previous studies reported that the benefits of weight loss are well established,
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52 25 with a 5–10% reduction in weight associated with improvement in health and quality of life, and a
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54 26 3% reduction being positive for health improvement where it is maintained ³⁶.

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56 27 These departments should heed the high prevalence of overweight and obesity in Xinjiang
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58 28 Province and provide effective guidelines to help to reverse the trend. The main strengths of our
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60 29 study are its large sample size and precise physical measurements, which increase the validity of

1 our results. However, the present study has several limitations. First, the main limitation is the
2 cross-sectional design which prohibits inferring a causal link between overweight and obesity and
3 risk factors. As in cross-sectional studies data on exposure and outcome are gathered
4 simultaneously in a specific time point, prospective studies are necessary to confirm our findings.
5 In addition, self-reported data and the nature of cross-sectional data may lead to recall and
6 reporting biases, which may be the reason for the insignificant difference in the effect of obesity
7 on reasons. Finally, other indicators of adiposity, such as body fat percentage and waist
8 circumference which plenty of studies reported to reflect the prevalence of overweight and obesity
9 and body fat distribution, were not obtained in our study^{37 38}.

10 **Conclusions**

11 In conclusion, the present study indicates that the prevalence of overweight and obesity
12 among adult residents in Xinjiang, the northwest China, is very high during the past years.
13 Furthermore, the main influencing factors for overweight and obesity are sex, age, race, marriage
14 status, education level, occupation, smoking, drinking, hypertension, diabetes and dyslipidemia.
15 These data suggest that efforts toward prevention and control of overweight and obesity should be
16 a public health priority in the northwest of China, which will be submitted to relevant departments
17 as a reference to reverse the trends.

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27 the study and revision: Yi-Ning Yang, Xiao-Mei Li. Wrote the paper: Ning Song. All authors read
28 and approved the final manuscript.

29 **Conflicts of Interest:** The authors declare no conflict of interest.

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4 1 **Ethics approval:** This study was carried out in accordance with the Declaration of Helsinki and the
5
6 2 study protocol was approved by the Ethics Committee of the First Affiliated Hospital of Xinjiang
7
8 3 Medical University (Xinjiang, China) (approval ID:20100116-01).

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10 4 **Data sharing statement:** All data relevant to the study are included in the article. No additional
11
12 5 data are available.

13 6 **References**

- 15 7 1. De Luca M, Angrisani L, Himpens J, et al. Indications for Surgery for Obesity and Weight-
16 8 Related Diseases: Position Statements from the International Federation for the Surgery of Obesity
17 9 and Metabolic Disorders (IFSO). *Obesity surgery* 2016;26(8):1659-96 doi: 10.1007/s11695-016-
18 10 2271-4[published Online First: Epub Date]].
- 11 2. Collaboration NCDRF. Trends in adult body-mass index in 200 countries from 1975 to 2014: a
12 12 pooled analysis of 1698 population-based measurement studies with 19.2 million participants.
13 13 *Lancet* 2016;387(10026):1377-96 doi: 10.1016/S0140-6736(16)30054-X[published Online First:
14 14 Epub Date]].
- 15 3. Pineda E, Sanchez-Romero LM, Brown M, et al. Forecasting Future Trends in Obesity across
16 16 Europe: The Value of Improving Surveillance. *Obesity facts* 2018;11(5):360-71 doi:
17 17 10.1159/000492115[published Online First: Epub Date]].
- 18 4. Addo PN, Nyarko KM, Sackey SO, et al. Prevalence of obesity and overweight and associated
19 19 factors among financial institution workers in Accra Metropolis, Ghana: a cross sectional study.
20 20 *BMC research notes* 2015;8:599 doi: 10.1186/s13104-015-1590-1[published Online First: Epub
21 21 Date]].
- 22 5. Lee DH, Keum N, Hu FB, et al. Comparison of the association of predicted fat mass, body mass
23 23 index, and other obesity indicators with type 2 diabetes risk: two large prospective studies in US
24 24 men and women. *European journal of epidemiology* 2018;33(11):1113-23 doi: 10.1007/s10654-
25 25 018-0433-5[published Online First: Epub Date]].
- 26 6. Flegal KM, Kit BK, Orpana H, et al. Association of all-cause mortality with overweight and
27 27 obesity using standard body mass index categories: a systematic review and meta-analysis. *Jama*
28 28 2013;309(1):71-82 doi: 10.1001/jama.2012.113905[published Online First: Epub Date]].
- 29 7. Wang H, Zhai F. Programme and policy options for preventing obesity in China. *Obesity*
30 30 *reviews : an official journal of the International Association for the Study of Obesity* 2013;14
31 31 Suppl 2:134-40 doi: 10.1111/obr.12106[published Online First: Epub Date]].
- 32 8. Lao XQ, Ma WJ, Sobko T, et al. Dramatic escalation in metabolic syndrome and cardiovascular
33 33 risk in a Chinese population experiencing rapid economic development. *BMC public health*
34 34 2014;14:983 doi: 10.1186/1471-2458-14-983[published Online First: Epub Date]].
- 35 9. Ferretti F, Mariani M. Simple vs. Complex Carbohydrate Dietary Patterns and the Global
36 36 Overweight and Obesity Pandemic. *International journal of environmental research and public*
37 37 *health* 2017;14(10) doi: 10.3390/ijerph14101174[published Online First: Epub Date]].
- 38 10. Lek N, Yan W, Zhang Y, et al. Indices of central and general obesity and cardiometabolic risk
39 39 among adolescents in three ethnic groups in north-west China. *Annals of human biology*
40 40 2016;43(1):18-24 doi: 10.3109/03014460.2015.1014418[published Online First: Epub Date]].
- 41 11. Xie X, Ma YT, Yang YN, et al. Alcohol consumption and ankle-to-brachial index: results

- 1 from the Cardiovascular Risk Survey. PloS one 2010;5(12):e15181 doi:
2 10.1371/journal.pone.0015181[published Online First: Epub Date]].
- 3 12. Awareness t, control of diabetes mellitus and the risk factors: survey results from northeast
4 ChinaKilpi, F., Webber L, Musaigner A, et al. Alarming predictions for obesity and non-
5 communicable diseases in the Middle East. Public health nutrition 2014;17(5):1078-86 doi:
6 10.1017/S1368980013000840[published Online First: Epub Date]].
- 7 13. Wang C, Yu Y, Zhang X, et al. Awareness, treatment, control of diabetes mellitus and the risk
8 factors: survey results from northeast China. PloS one 2014;9(7):e103594 doi:
9 10.1371/journal.pone.0103594[published Online First: Epub Date]].
- 10 14. McManus RJ, Caulfield M, Williams B, et al. NICE hypertension guideline 2011: evidence
11 based evolution. Bmj 2012;344:e181 doi: 10.1136/bmj.e181[published Online First: Epub Date]].
- 12 15. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of Hyperglycemia in Type 2
13 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the
14 European Association for the Study of Diabetes (EASD). Diabetes care 2018;41(12):2669-701
15 doi: 10.2337/dci18-0033[published Online First: Epub Date]].
- 16 16. Alshamiri M, Ghanaim MMA, Barter P, et al. Expert opinion on the applicability of
17 dyslipidemia guidelines in Asia and the Middle East. International journal of general medicine
18 2018;11:313-22 doi: 10.2147/IJGM.S160555[published Online First: Epub Date]].
- 19 17. Lavie CJ, Arena R, Alpert MA, et al. Management of cardiovascular diseases in patients with
20 obesity. Nature reviews Cardiology 2018;15(1):45-56 doi: 10.1038/nrcardio.2017.108[published
21 Online First: Epub Date]].
- 22 18. Rummo P, Kanchi R, Perlman S, et al. Correction to: Change in Obesity Prevalence among
23 New York City Adults: the NYC Health and Nutrition Examination Survey, 2004 and 2013-2014.
24 Journal of urban health : bulletin of the New York Academy of Medicine 2018;95(6):800 doi:
25 10.1007/s11524-018-0310-2[published Online First: Epub Date]].
- 26 19. Collaborators GBDO, Afshin A, Forouzanfar MH, et al. Health Effects of Overweight and
27 Obesity in 195 Countries over 25 Years. The New England journal of medicine 2017;377(1):13-27
28 doi: 10.1056/NEJMoa1614362[published Online First: Epub Date]].
- 29 20. Vogelzangs N, Kritchevsky SB, Beekman AT, et al. Obesity and onset of significant
30 depressive symptoms: results from a prospective community-based cohort study of older men and
31 women. The Journal of clinical psychiatry 2010;71(4):391-9 doi:
32 10.4088/JCP.08m04743blu[published Online First: Epub Date]].
- 33 21. Wang R, Zhang P, Gao C, et al. Prevalence of overweight and obesity and some associated
34 factors among adult residents of northeast China: a cross-sectional study. BMJ open
35 2016;6(7):e010828 doi: 10.1136/bmjopen-2015-010828[published Online First: Epub Date]].
- 36 22. Kontsevaya A, Shalnova S, Deev A, et al. Overweight and Obesity in the Russian Population:
37 Prevalence in Adults and Association with Socioeconomic Parameters and Cardiovascular Risk
38 Factors. Obesity facts 2019;12(1):103-14 doi: 10.1159/000493885[published Online First: Epub
39 Date]].
- 40 23. Catala-Lopez F, Genova-Maleras R. [Prevention and control of chronic non-communicable
41 diseases in Spain: A call to action]. Medicina clinica 2013;140(11):502-3 doi:
42 10.1016/j.medcli.2012.11.006[published Online First: Epub Date]].
- 43 24. Carroll DD, Blanck HM, Serdula MK, et al. Obesity, physical activity, and depressive
44 symptoms in a cohort of adults aged 51 to 61. Journal of aging and health 2010;22(3):384-98 doi:

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9
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46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- 1 10.1177/0898264309359421[published Online First: Epub Date]].
- 2 25. Mc Hugh S, O'Neill C, Browne J, et al. Body mass index and health service utilisation in the
3 older population: results from The Irish Longitudinal Study on Ageing. *Age and ageing*
4 2015;44(3):428-34 doi: 10.1093/ageing/afu177[published Online First: Epub Date]].
- 5 26. Wang YT, Adi D, Yu ZX, et al. The burden and correlates of hypertension among Chinese
6 rural population in Han, Uyгур, and Kazak: a cross-sectional study. *Journal of the American*
7 *Society of Hypertension : JASH* 2017;11(11):737-45 e3 doi: 10.1016/j.jash.2017.09.010[published
8 Online First: Epub Date]].
- 9 27. Dinour L, Leung MM, Tripicchio G, et al. The Association between Marital Transitions, Body
10 Mass Index, and Weight: A Review of the Literature. *Journal of obesity* 2012;2012:294974 doi:
11 10.1155/2012/294974[published Online First: Epub Date]].
- 12 28. Saelens BE, Glanz K, Frank LD, et al. Two-Year Changes in Child Weight Status, Diet, and
13 Activity by Neighborhood Nutrition and Physical Activity Environment. *Obesity*
14 2018;26(8):1338-46 doi: 10.1002/oby.22247[published Online First: Epub Date]].
- 15 29. Collaborators GBDT. Smoking prevalence and attributable disease burden in 195 countries
16 and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015.
17 *Lancet* 2017;389(10082):1885-906 doi: 10.1016/S0140-6736(17)30819-X[published Online First:
18 Epub Date]].
- 19 30. Marques-Vidal P, Bochud M, Mooser V, et al. Prevalence of obesity and abdominal obesity in
20 the Lausanne population. *BMC public health* 2008;8:330 doi: 10.1186/1471-2458-8-
21 330[published Online First: Epub Date]].
- 22 31. Siddiquee T, Bhowmik B, Da Vale Moreira NC, et al. Prevalence of obesity in a rural Asian
23 Indian (Bangladeshi) population and its determinants. *BMC public health* 2015;15:860 doi:
24 10.1186/s12889-015-2193-4[published Online First: Epub Date]].
- 25 32. Torigian DA, Green-McKenzie J, Liu X, et al. A Study of the Feasibility of FDG-PET/CT to
26 Systematically Detect and Quantify Differential Metabolic Effects of Chronic Tobacco Use in
27 Organs of the Whole Body-A Prospective Pilot Study. *Academic radiology* 2017;24(8):930-40
28 doi: 10.1016/j.acra.2016.09.003[published Online First: Epub Date]].
- 29 33. Global BMIMC, Di Angelantonio E, Bhupathiraju Sh N, et al. Body-mass index and all-cause
30 mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents.
31 *Lancet* 2016;388(10046):776-86 doi: 10.1016/S0140-6736(16)30175-1[published Online First:
32 Epub Date]].
- 33 34. Lassale C, Tzoulaki I, Moons KGM, et al. Separate and combined associations of obesity and
34 metabolic health with coronary heart disease: a pan-European case-cohort analysis. *European*
35 *heart journal* 2018;39(5):397-406 doi: 10.1093/eurheartj/ehx448[published Online First: Epub
36 Date]].
- 37 35. Fan J, Song Y, Chen Y, et al. Combined effect of obesity and cardio-metabolic abnormality on
38 the risk of cardiovascular disease: a meta-analysis of prospective cohort studies. *International*
39 *journal of cardiology* 2013;168(5):4761-8 doi: 10.1016/j.ijcard.2013.07.230[published Online
40 First: Epub Date]].
- 41 36. Espeland MA, Glick HA, Bertoni A, et al. Impact of an intensive lifestyle intervention on use
42 and cost of medical services among overweight and obese adults with type 2 diabetes: the action
43 for health in diabetes. *Diabetes care* 2014;37(9):2548-56 doi: 10.2337/dc14-0093[published
44 Online First: Epub Date]].

- 1 37. Zeng Q, Dong SY, Sun XN, et al. Percent body fat is a better predictor of cardiovascular risk
 2 factors than body mass index. Brazilian journal of medical and biological research = Revista
 3 brasileira de pesquisas medicas e biologicas 2012;45(7):591-600
 4 38. Ramirez-Velez R, Correa-Bautista JE, Gonzalez-Ruiz K, et al. The Role of Body Adiposity
 5 Index in Determining Body Fat Percentage in Colombian Adults with Overweight or Obesity.
 6 International journal of environmental research and public health 2017;14(10) doi:
 7 10.3390/ijerph14101093[published Online First: Epub Date]].
 8

9 **Table 1 Prevalence of overweight and obesity according to demographic characteristics**

Characteristic	N	Overweight			Obesity		
		n (%)	χ^2	<i>P</i>	n (%)	χ^2	<i>P</i>
Sex							
Male	6819	2735(40.1)	71.1	<0.001*	1856 (27.2)	3.7	0.05
Female	7799	2603(33.4)			2013(25.8)		
Age(years)							
35-44	5425	1866(34.4)	20.3	<0.001*	1146(21.1)	149.8	<0.001*
45-54	3759	1441(38.3)			1153(30.7)		
55-64	2932	1067(36.4)			919(31.3)		
≥65	2502	964(38.5)			651(26.0)		
Area							
Urban	7974	3163(39.7)	75.1	<0.001*	1956(24.5)	33.9	<0.001*
Rural	6644	2175(32.7)			1913(28.8)		
Ethnicity							
Han	5757	2380(16.3)	99.1	<0.001*	1082(7.4)	331.9	<0.001*
Uyghur	4767	1635(11.2)			1361(9.3)		
Kazak	4094	1323(9.1)			1426(9.8)		
Occupation							
Manual	4583	1760(12.0)	12.1	0.002*	1095(7.5)	32.1	<0.001*
White collar	7751	2736(18.7)			2086(14.3)		
Other	2284	842(5.8)			688(4.7)		
Education							

Primary school and below	5805	1993(13.6)	26.9	<0.001*	1589(10.87)	21.2	<0.001*
Junior middle school	3094	1196(8.2)			844(5.8)		
Senior middle school	4556	1676(11.5)			1191(8.2)		
Undergraduate and above	1163	473(3.2)			245(1.7)		
Marriage							
Unmarried	192	59(0.4)	14.1	<0.001*	27(0.2)	23.1	<0.001*
Married	12988	4795(32.8)			3427(23.4)		
divorced	201	53(0.4)			47(0.2)		
widowed	1237	431(3.0)			368(2.5)		
Drinking							
Yes	4169	923(6.3)	44.5	<0.001*	663(4.5)	24.6	<0.001*
No	10449	4415(30.2)			3206(21.9)		
Smoking							
Yes	2151	1688(11.6)	39.7	<0.001*	1101(7.5)	0.01	0.92
No	12467	3650(25.0)			2768(18.9)		
Hypertension							
Yes	5701	2138(14.6)	3.9	0.05	2155(14.7)	616.8	<0.001*
No	8917	3200(21.9)			1714(11.7)		
Diabetes							
Yes	859	335(2.3)	2.4	0.1	317(2.2)	51.0	<0.001*
No	13759	5003(34.2)			3552(24.3)		
Dyslipidemia							
hypertriglyceridemia							
Yes	4113	1724(11.8)	72.0	<0.001*	1497(10.2)	289.9	<0.001*
No	10505	3614(24.7)			2372(16.2)		
hypercholesterolemia							
Yes	3787	1469(10.1)	11.4	0.001*	1267(8.7)	128.3	<0.001*

No	10831	3869(26.5)			2602(17.8)			
High LDL-C								
Yes	5251	1921(13.1)	0.02	0.9	1334(9.1)	4.8	0.03*	
No	9367	3417(23.4)			2535(17.3)			
Low HDL-C								
Yes	4437	1704(11.7)	9.8	0.002*	1215(8.3)	2.8	0.09	
No	10831	3634(24.9)			2654(18.2)			

Categorical variables are presented as counts and percentages. HDL-c, high density lipoprotein-cholesterol; LDL-c, low density lipoprotein-cholesterol.

Data were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

Table 2 Prevalence of overweight and obesity in men and women according to age group

Age (years)	Overweight		<i>P</i>	Obesity		<i>P</i>
	Male(%)	female(%)		male(%)	female(%)	
35-44	994(40.2)	872(29.5)	<0.001	631(25.5)	515(17.4)	<0.001
45-54	735(43.1)	706(34.4)		517(30.3)	636(31.0)	
55-64	476(35.8)	591(36.8)		389(29.3)	531(33.0)	
≥65	530(40.3)	434(36.5)		319(24.3)	332(27.9)	

Data were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

Table 3 Prevalence of overweight and obesity in Han, Uyghur and Kazak according to age group

Age (years)	Overweight			<i>P</i>	Obesity			<i>P</i>
	Han(%)	Uyghur(%)	Kazak(%)		Han(%)	Uyghur(%)	Kazak(%)	
35-44	712(35.0)	573(34.6)	581(33.6)	<0.001	273(13.4)	422(25.5)	451(26.1)	<0.001
45-54	599(43.9)	481(38.1)	361(31.9)		246(18.0)	436(34.5)	471(41.6)	
55-64	497(45.9)	354(32.6)	216(28.3)		268(24.7)	318(29.3)	333(43.6)	
≥65	572(45.0)	227(29.9)	165(35.1)		295(23.2)	185(24.3)	171(36.4)	

Data were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

Table 4 Multivariable regression analysis of correlates of overweight and obesity in residents

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of Xinjiang Province

Characteristic	B	S.E.	Wald	df	P	OR	95%CI
Area	-0.1	0.04	10.4	1	0.001*	0.9	0.8-0.9
Sex	-0.3	0.05	32.5	1	<0.001*	0.8	0.7-0.8
Ethnic			94.4	2	<0.001*		
Han	-	-	-	-	-	1	-
Uygur	0.4	0.05	50.0	1	<0.001*	1.4	1.3-1.6
Kazakh	0.50	0.05	86.2	1	<0.001*	1.7	1.5-1.8
Age(years)			71.2	3	<0.001*		
35-44	-	-	-	-	-	1	-
45-54	0.4	0.05	62.8	1	<0.001*	1.5	1.3-1.6
55-64	0.3	0.05	24.6	1	<0.001*	1.3	1.2-1.5
≥65	0.1	0.06	3.1	1	0.08	1.11	1.0-1.3
Education			17.9	3	<0.001*		
Primary school and below	-	-	-	-	-	1	-
Junior middle school	0.2	0.05	15.6	1	<0.001*	1.2	1.1-1.4
Senior middle school	0.2	0.06	7.0	1	0.008*	1.2	1.0-1.3
Undergraduate and above	0.2	0.08	6.8	1	0.009*	1.3	1.1-1.5
Occupation			10.4	2	0.006*		
Manual	-	-	-	-	-	1	-
White collar	0.01	0.05	0.04	1	0.8	1.0	0.9-1.1
Other	0.2	0.06	7.9	1	0.005*	1.2	1.1-1.4
Marriage			26.5	3	<0.001		
Unmarried	-	-	-	-	-	1	-
Married	0.6	0.2	15.5	1	<0.001*	1.8	1.4-2.5
Divorced	0.1	0.2	0.2	1	0.7	1.1	0.7-1.7
widowed	0.6	0.2	12.4	1	<0.001*	1.8	1.3-2.5
Smoking	-0.2	0.05	9.0	1	0.003*	0.9	0.8-0.9
Drinking	0.4	0.06	34.8	1	<0.001*	1.5	1.3-1.6

Hypertension	0.8	0.04	340.4	1	<0.001*	2.1	2.0-2.3
Diabetes	0.3	0.09	10.4	1	0.001*	1.3	1.1-1.6
Dyslipidemia							
hypertriglyceridemia	0.9	0.05	371.4	1	<0.001*	2.4	2.2-2.7
hypercholesterolemia	0.2	0.05	20.9	1	<0.001*	1.2	1.1-1.3
Low HDL-C	0.1	0.04	6.4	1	0.01*	1.1	1.0-1.2
High LDL-C	0.02	0.04	0.16	1	0.69	1.0	0.9-1.1
Constant	-1.0	0.2	35.3	1	<0.001	-	-

1 * $P < 0.05$, Statistically significant.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (On page 1, line 1) (b) Provide in the abstract an informative and balanced summary of what was done and what was found (On page 2)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (On page 2, line 2-5)
Objectives	3	State specific objectives, including any prespecified hypotheses (On page 2, line 2-5)
Methods		
Study design	4	Present key elements of study design early in the paper (On page 4, line 9)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (On page 2, line 7)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (On page 4, line 9-20) (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (On page 5,6)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (On page 4,5)
Bias	9	Describe any efforts to address potential sources of bias (On page 11, line 1-3)
Study size	10	Explain how the study size was arrived at (On page 4, line 15-16)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (On page 4,5)
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (On page 6) (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (On page 6) (e) Describe any sensitivity analyses

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (On page 4, line 15-16) (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (On page 14, Table1) (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures (On page 6-7)
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (On page 6,7) (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (On page 6,7)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (On page 6,7)
Discussion		
Key results	18	Summarise key results with reference to study objectives (On page 8)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (On page 10,11)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (On page 11)
Generalisability	21	Discuss the generalisability (external validity) of the study results (On page 11)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (On page 11)

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence of overweight and obesity and associated risk factors among adult residents of northwest China: A cross-sectional study

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Primary Subject Heading:	Public health
Secondary Subject Heading:	Cardiovascular medicine, Epidemiology, Ethics, Global health
Keywords:	cross-sectional survey, overweight, obesity, risk factors



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4 1 **Prevalence of overweight and obesity and associated risk factors among adult residents of**
5
6 2 **northwest China: A cross- sectional study**

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67 2 **Abstract**

8 3 **Objective:** Overweight and obesity have been shown to be related to multiple chronic conditions
9 4 and lead to a heavy economic burden on society throughout the world. This study aims to estimate
10 5 the prevalence of overweight and obesity and determine potential influencing factors among adults
11 6 in Xinjiang, northwest China.

12 7 **Design:** A community-based observational study.

13 8 **Setting:** The First Affiliated Hospital of Xinjiang Medical University.

14 9 **Methods:** In total, 14,618 adult participants (7,799 males; 6,819 females), aged over 35 years old,
15 10 were recruited from the Cardiovascular Risk Survey conducted in 2010. Data were obtained from
16 11 face-to-face interview and physical examination. The sample was used to estimate the prevalence
17 12 of overweight (body mass index (BMI) [24-28] kg/m²) and obesity (BMI≥28 kg/m²) in Xinjiang
18 13 Province, and the influencing factors were analyzed based on statistical methods.

19 14 **Results:** The overall prevalence of overweight was 36.5% (male 40.1%; female 33.4%), and the
20 15 prevalence of obesity was 26.5% (male 27.2%; female 25.8%) in Xinjiang Province. The
21 16 prevalence of both overweight and obesity were higher in women than men ($P<0.001$). The main
22 17 influencing factors for overweight and obesity are sex, age, race, marriage status, education level,
23 18 occupation, smoking, drinking, hypertension, diabetes and dyslipidemia ($P<0.05$).

24 19 **Conclusions:** This study estimated that the prevalence of overweight and obesity among adult
25 20 residents of Xinjiang Province, northwest China, was high. These data suggest that efforts toward
26 21 prevention and control of overweight and obesity should be a public health priority in the
27 22 northwest of China.

28 23 **Keywords:** cross-sectional survey, overweight, obesity, risk factors

29 24 **Strengths and limitations of this study**

- 30 25 ➤ The survey sample was demographically representative of Uygur adults with obesity aged
31 26 35–80 years in Xinjiang.
- 32 27 ➤ The main strengths of our study are its large sample size and precise physical measurements,
33 28 which increase the validity of our results.
- 34 29 ➤ Due to the cross-sectional nature and self-designed questionnaire, indicators and experience

1 could have been affected by bias.

2 ➤ Moreover, other indicators of adiposity, such as body fat percentage and waist circumference
3 were not obtained in our study.

4 ➤ The results were from Xinjiang only and therefore cannot be generalised to the whole China.

6 **Introduction**

7 Obesity is a complex chronic global disease affecting people worldwide across all ages, sexes,
8 ethnicities, and nationalities, which is the fifth leading cause of mortality globally ^{1,2}. According to
9 the World Health Organization (WHO), the prevalence of worldwide obesity has doubled in more
10 than 70 countries since 1980 ³; this trend has continuously increased in most other countries. In 2013,
11 in order to make physicians pay more attention to the condition, the American Medical Association
12 classified obesity as a disease ⁴.

13 Body mass index (BMI), which is calculated as weight/height squared (kg/m^2), is a common
14 and accepted measure that is used to report obesity rates. While BMI is not a true measure of
15 adiposity, it is simple to use in health screenings and epidemiological surveys ⁵. According to the
16 WHO, obesity is defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$, and overweight as a BMI of $[25-30) \text{ kg}/\text{m}^2$ ⁶. For
17 Chinese people, a $\text{BMI} \geq 28 \text{ kg}/\text{m}^2$ suggests obesity and a BMI of $[24-28) \text{ kg}/\text{m}^2$ indicates overweight
18 ⁷.

19 China is the largest developing country and has the largest population in the world. With the
20 rapid economic growth and changes in lifestyle such as dietary habits and physical activity ⁸, the
21 epidemiological data indicated that individuals with overweight and obesity had a higher prevalence
22 of traditional diseases including dyslipidemia, hypertension, cardiovascular disease, insulin
23 resistance or diabetes, fatty liver disease, and psychosocial complications and some cancers ^{5,9}.
24 Located in the northwest China, Xinjiang not only is an autonomous minority ethnic region of the
25 People's Republic of China, but also is one of the developing regions in China. It is the largest
26 Chinese administrative division and spans over 1.66 million km^2 which takes up about one sixth of
27 the country's territory. A few of studies had reported the prevalence of overweight among adults in
28 Xinjiang ¹⁰. Nevertheless, the samples in above mentioned studies were small, those results cannot
29 represent accurately the status of overweight and obesity in the whole region of Xinjiang.

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4 1 In the present study, we estimated the prevalence of overweight and obesity in Xinjiang.
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6 2 Meanwhile, the potential influencing factors in adult residents of northwest China were explored.
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8 3 The results of this study will be considered as a reference for policy makers in making informed
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10 4 decisions.

11 **Materials and Methods**

12 **Ethics approval**

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15 7 This study was conducted according to the standards of the Declaration of Helsinki. Written
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17 8 informed consent was acquired from each participant prior to enrollment. Ethics approval was from
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19 9 the Ethics Committee of the First Affiliated Hospital of Xinjiang Medical University (the approval
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21 10 ID: 20100116-01).

11 **Study design and population**

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13 12 This population-based cross-sectional survey is part of the Project on Present Situation and the
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15 13 Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The CRS was a
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17 14 prospective, multiple ethnicity and community-based observational study designed to investigate
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19 15 the prevalence and risk factors for cardiovascular disease (CVD) in the Han, Uyghur and Kazakh
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21 16 populations in Xinjiang Province¹¹. All the subjects included had lived in Xinjiang Province for
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23 17 more than 1 year. Briefly, the CRS consisted of 16,460 adults aged ≥ 35 years old, of whom 14,618
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25 18 subjects (5,757 Han, 4,767 Uyghur and 4,094 Kazakh Chinese) completed the survey, yielding a
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27 19 response rate of 88.8%. We used a multistage stratified sampling method to select the study sample
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29 20 from 6 different administrative regions including Urumqi, Yili, Hetian, Kalamayi, Fukang, and
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31 21 Turpan. Finally, each participant was selected randomly from each household in the sites mentioned
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33 22 above.

23 **Data collection**

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25 24 The formal survey was made up of two parts: face-to-face interview and physical examination.
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27 25 Before the formal survey, we conducted a pre-survey to explore the feasibility of the questionnaire.
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29 26 During the investigation, each completed questionnaire was examined by two investigators to ensure
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31 27 validity and consistency. After the fieldwork, data were manipulated by parallel double entry, and
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33 28 we also performed three verifications to check for incomplete and inconsistent responses. The
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35 29 questionnaire provided demographics, general personal information and medical histories¹². Height
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1 and weight were measured using a standard protocol. Height was measured to the nearest 0.1 cm,
2 and weight was measured with a standard scale in the upright position to the nearest 0.1 kg. Smoking
3 and drinking conditions were self-reported.

4 Blood samples collection was conducted in examination centers at local hospital in the
5 participants' residential area. At the time of the in-person interview, a 5mL of venous blood was
6 collected into EDTA tubes and processed to obtain plasma within 4h. All samples were stored at
7 -80°C immediately after processing. We measured the concentration of fasting glucose using
8 equipment for chemical analysis (Dimension AR/AVL Clinical Chemistry System, Newark, NJ,
9 USA) employed by the Clinical Laboratory Department of the First Affiliated Hospital of Xinjiang
10 Medical University. Biochemical markers in plasma including total cholesterol (TC), triglycerides
11 (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-
12 C) were measured.

13 **Definition of variables**

14 Overweight and obesity were defined by Chinese standards mentioned above. Obesity was
15 defined as $BMI \geq 28 \text{ kg/m}^2$, and overweight was defined as a BMI of [24-28) kg/m^2 .

16 Education was classified into four levels: Primary school and below (including never attended
17 school and elementary schooling only); Junior middle school; Senior middle school (including
18 secondary vocational schooling); undergraduate and above (including post-secondary vocational
19 schooling, master's degree and doctoral degree). Manual labor included farmers, production and
20 service workers. White collar occupations included office and other technical employment. Other
21 occupations included unemployed, retiree, student and full-time housewife¹³. Smoking status
22 classifications were current smokers (which had smoked at least one cigarette a day over the past
23 30 days), and never-smokers. Drinking status classifications were current drinkers (which had
24 consumed more than one alcoholic drink a week), and never-drinkers. Hypertension was defined as
25 mean systolic BP $\geq 140 \text{ mmHg}$, and/or mean diastolic BP $\geq 90 \text{ mmHg}$, and/or current use of
26 antihypertensive medications¹⁴. Diabetes was defined as fasting plasma glucose $\geq 126 \text{ mg/dL}$
27 ($\geq 7.0 \text{ mmol/L}$) and/or self-reported history of diabetes and/or current use of insulin or antidiabetic
28 medications¹⁵. Hypercholesterolemia was defined as serum total cholesterol level $> 6.22 \text{ mmol/L}$
29 (240 mg/dL), and hypertriglyceridemia was defined as serum triglyceride level $> 2.26 \text{ mmol/L}$ (200

1 mg/dL). A serum LDL-C level of >4.14 mmol/L (160 mg/dL) was defined as high LDL-C, and a
2 serum HDL-C level of <1.04 mmol/L (40 mg/dL) was defined as low HDL-C. In total, dyslipidemia
3 was defined as the existence of at least one of the four abnormal lipid concentrations mentioned
4 above, or self-reported use of lipid-lowering drugs ¹⁶.

5 **Statistical analysis**

6 Data was verified and corrected using EpiData 3.02 software (EpiData, Association, Odense,
7 Denmark) by 2 staff members. Frequency distribution was used to present characteristics of the
8 subjects, and data presented as percentages were used to report the prevalence ratio. Continuous
9 variables were expressed as mean \pm standard deviation (SD) and or numerical data were expressed
10 as rates, and a Chi-square test (χ^2) was used to compare the prevalence of overweight and obesity
11 in different groups.

12 To analyze the factors for obesity and adjust for potential confounding effects, a multivariable
13 logistic regression analyses were carried out to explore independent factors associated with
14 overweight and obesity. OR with 95% CI was used for the risk analysis. All statistical analyses were
15 conducted using the complex sampling function of Social Sciences SPSS for Windows version 22.0
16 (SPSS, Inc, Chicago, IL, USA), and a $P<0.05$ level of significance was selected.

17 **Patient and public involvement**

18 This population-based cross-sectional survey is part of the Project on Present Situation and
19 the Cardiovascular Risk Survey (CRS) study in Xinjiang Province of China in 2010. The study
20 was designed to investigate the prevalence of overweight and obesity among adult residents in
21 Xinjiang, the northwest China. However, no patients or members of the public were included in
22 the design, recruitment or conduct of the study. The results of measurements would be
23 disseminated to participants after the study which was completed by the study team. The burden of
24 the intervention will not be assessed by patients themselves.

25 **Results**

26 In this survey, we interviewed 14618 residents aged 35 to 101 years (mean age: 50.8 ± 12.6
27 years), comprised of 6,819 (46.6%) men and 7,799 (53.4%) women. Among these participants,
28 5,757 (39.4%) were Han ethnicities with a mean age of 52.5 ± 12.7 years, 4,767 (32.6%) were Uyghur
29 ethnicities with a mean age of 50.7 ± 13.0 years, and 4,094 (28.0%) were Kazakh ethnicities with a

1 mean age of 48.6±11.7 years. According to the BMI classification for Chinese people, the overall
2 prevalence of overweight was 36.5% (male 40.1%; female 33.4%), and the prevalence of obesity
3 was 26.5% (male 27.2%; female 25.8%) in Xinjiang Province (**Table 1**). There were differences in
4 age, area, race, occupation, education, marriage, drinking, hypertension history and plasma levels
5 of TG, TC among the overweight and obesity groups, while there was no significant difference in
6 sex, smoking, diabetes history and the level of LDL-c and HDL-C among the 2 groups.

7 From the age-stratified and gender-stratified results in **Table 2**, for men, the prevalence of both
8 overweight and obesity all peaked at 45-54 years, while no significant trend was illustrated in the
9 prevalence of overweight increased with age. For women, the prevalence of overweight and obesity
10 increased with age, peaking at 55-64 years, though there has a slight decrease at ≥65 years. In
11 addition, a higher proportion of enrolled males were overweight than females. Interestingly, the
12 proportions of females who were obese were higher than those of males.

13 From the age-stratified and race-stratified results in **Table 3**, as a whole, obesity prevalence in
14 the different ethnicities was found to be the highest in Kazakh and the lowest in Han participants,
15 and there was a statistical significance among the three ethnic groups ($P<0.001$). Further,
16 overweight prevalence also showed an interesting significant difference among the three ethnicities,
17 the highest in Han and the lowest in Kazakh participants.

18 We divided the participants into two groups: normal weight; overweight and obese. **Table 1**
19 has shown that the following factors all had a significant effect: age, area, race, education, marriage
20 status, occupation, drinking, hypertension and dyslipidemia ($P<0.05$). We applied multivariable
21 unconditional logistic regression analysis model on all identified risk factors and attempted to
22 identify any existing difference in these risk factors which may explain the difference in overweight
23 and obesity prevalence. **Table 4** shows the results of logistic regression models comparing the
24 prevalence of the potential risk factors: sex, age, area, marriage status, occupation, smoking,
25 drinking, hypertension, diabetes and the level of dyslipidemia, including hypercholesterolemia,
26 hypertriglyceridemia and low HDL-C. The multivariable logistic regression results reveal that
27 female adults prefer to become overweight and obese than male adults (OR 0.8, 95% CI 0.7 to 0.8).
28 We categorized age into four groups, which clearly showed that increasing age is a risk factor for
29 overweight/obesity, especially age 45-54 years (OR 1.5, 95% CI 1.3 to 1.6). Among the three races,

1 Kazak population (OR 1.7, 95% CI 1.5 to 1.8) and Uygur population (OR 1.4, 95% CI 1.3 to 1.6)
2 carried higher risk to become overweight and obese. Participants who have married (OR 1.8, 95%
3 CI 1.4 to 2.5) or widowed (OR 1.8, 95% CI 1.3 to 2.5) are easier to be overweight/obese than those
4 who have unmarried. In addition, smokers (OR 0.9, 95% CI 0.8 to 0.9) are less likely to become
5 overweight and obese than nonsmokers. Participants who drink are more likely to become
6 overweight or obese than those who never or rarely drink (OR 1.5, 95% CI 1.3 to 1.6). Overweight
7 and obesity are more common among those who had hypertension (OR 2.1, 95% CI 2.0 to 2.3) and
8 diabetes (OR 1.3, 95% CI 1.1 to 1.6) compared with those who had no hypertension and diabetes
9 history. In the overweight and obese population, hypertriglyceridemia (OR 2.4, 95% CI 2.2 to 2.7),
10 hypercholesterolemia (OR 1.2, 95% CI 1.1 to 1.3) and low HDL-C (OR 1.1, 95% CI 1.0 to 1.2)
11 remained as risk factors.

12 Discussion

13 The epidemic of obesity is one of the most important health problems worldwide and is
14 estimated to be the second leading cause of preventable death in developed countries, behind
15 cigarette smoking^{17 18}. The prevalence of overweight and obesity continues to increase around the
16 world, as have associated comorbidities and healthcare costs¹⁹. In the US, the prevalence of obesity
17 accounts for one-third of the general population, and another one-third is overweight²⁰. Data from
18 the China Chronic Disease Survey conducted by the Chinese Center for Disease Control and
19 Prevention demonstrated that the prevalence of overweight among Chinese adults (age 18–64 years)
20 for 2007 and 2010 was 26.6% and 30.6%, respectively (male 27.4% and 32.1%; female 25.7% and
21 29.1%), and the prevalence of obesity was 7.7% and 12.1%, respectively (male 6.7% and 12.5%;
22 female 8.7% and 11.1%)²¹. No doubt, we found that the prevalence of both overweight and obesity
23 was high. Our cross-sectional study indicates that the prevalence of overweight and obesity among
24 adults in northwest China was 36.5% (male 40.1%; female 33.4%), and 26.5% (male 27.2%; female
25 25.8%). In the Russian population²², the overweight was 64.6% (male 42.3%; female 28.7%), and
26 approximately a third of the participants (30.3%) had obesity (male 27.5%; female 31.4%). Contrary
27 to what was observed in our research, the prevalence of overweight was higher than obesity. This
28 implies that overweight and obesity have a higher prevalence in both sexes and are more common
29 in northwest China and Russian than in other areas, although effective actions might have been

1 taken to control the upward trend ²³. The prevalence of underweight (according to the Chinese
2 standards: underweight<18.5 kg/m²) was significant difference among each group ($P<0.05$)
3 **(Supplementary Table 1)**, however, due to the special dietary habits (high sugar and high fat diet)
4 and living habits in Xinjiang, the number of low-weight people is too small.

5 In this study, we found that the prevalence of both overweight and obesity is high in middle
6 age (45-64 years). Similarly, age gradients in the prevalence of obesity are found in Russia ²². It is
7 worth noting that more than half of all women aged 55–64 years have obesity, and nearly 80% men
8 in the groups aged 45–54 years had overweight and obesity, which consists with our age gradients.
9 Chinese people are more likely to have positive perceptions of obesity because it is considered good
10 fortune to become fat during middle age in traditional Chinese culture ²⁴. Moreover, a large segment
11 of the middle-aged and older adult population will be living with overweight and obesity, which is
12 associated with additional health impairments ²⁵.

13 Through the present study, we found a very high prevalence of overweight and obesity in three
14 ethnicities in Xinjiang, and there is no doubt that the result is similar to the previous study in
15 Xinjiang ¹⁰. In addition, the prevalence rate of obesity was significantly different among Han, Uygur
16 and Kazak groups and the prevalence in Kazak group was significantly higher compared with Han
17 and Uygur. Overall, our findings indicate that 16.3% of Han, 11.2% of Uygur, and 9.1% of Kazak
18 people more than 35 years of age in Xinjiang have overweight, as with 7.4% of Han, 9.3% of Uygur,
19 and 9.8% of Kazak people have obesity. Xinjiang is a multi-ethnic co-populated area in China. The
20 national census showed that there are 47 ethnicities in Xinjiang, and 13 of them are confirmed to be
21 native ethnicities, such as the Uygur and Kazak. The explanations for this increase of prevalence as
22 follows: firstly, Kazak live in the grassland and forests, whose dietary habits were characterized by
23 eating more animal and consuming fewer fresh vegetables; Secondly, Kazak is a nomadic ethnic
24 who usually lives in hypoxia area and high altitude where the climate is cold and dry; Thirdly,
25 different genetic backgrounds may also be an important factor underlying the different prevalence
26 of obesity ²⁶.

27 Multivariable logistic regression analysis suggested that several factors are associated with the
28 prevalence of overweight and obesity. A previous review revealed that various marital transitions
29 are related with changes in body weight: transition into marriage appears to be associated with

1 weight gain, whereas transition out of marriage is associated with weight loss²⁷. Our study found a
2 similar result that, transition into marriage including married, divorce and widowed are risk factors
3 for becoming overweight and obese. Plausible explanations are behaviors and lifestyle which differ
4 among married individuals, however, the exact mechanism is not clear to illustrate this apparent
5 association with marriage status. In our study, it is also found that different educational levels,
6 occupations and area of residence are closely related to body weight. We have observed that low
7 education level is a risk factor because of insufficient level of cognition. Urban population,
8 especially unemployed, retiree, student and full-time housewife, are easier to become overweight
9 and obese, which contribute to urban working conditions, for example sitting in the office, fast-
10 paced life and supermarket or fast food restaurant availability²⁸.

11 The 2015 Global Burden of Disease Study, representing 195 countries and territories, estimated
12 that 25.0% of men and 5.4% of women worldwide smoked daily, which is the leading preventable
13 cause of death worldwide²⁹. In this study, we found a lower prevalence of overweight and obesity
14 in smokers than non-smokers, which is consistent with studies conducted in Switzerland, India and
15 Jilin, China^{21 30 31}. In addition, reasonable explanations to illustrate the issue according to two
16 different criteria. In terms of tobacco use, using tobacco is connected with multiple system functions,
17 especially cardiovascular and digestive systems³². In terms of the organism itself, smoking has been
18 considered as methods of pressure and energy relief. Affected by the traditional culture of drinking
19 alcohol, especially in northwest China, it is generally believed that, the more you drink, the more
20 weight you get. Wang et al²¹ showed the consistent results.

21 To the best of our knowledge, obesity is an independent risk factor both of CVD and death³³⁻
22 ³⁵. We explore that the prevalence of overweight and obesity are higher if subjects are with
23 hypertension or diabetes or dyslipidemia. The results provide a compelling reason why the
24 occurrence of obesity is combined with cardiovascular risk factors such as hypertension, diabetes
25 or dyslipidemia. Previous studies reported that the benefits of weight loss are well established,
26 with a 5–10% reduction in weight associated with improvement in health and quality of life, and a
27 3% reduction being positive for health improvement where it is maintained³⁶.

28 These departments should heed the high prevalence of overweight and obesity in Xinjiang
29 Province and provide effective guidelines to help to reverse the trend. The main strengths of our

1 study are its large sample size and precise physical measurements, which increase the validity of
2 our results. However, the present study has several limitations. First, the main limitation is the
3 cross-sectional design which prohibits inferring a causal link between overweight and obesity and
4 risk factors. As in cross-sectional studies data on exposure and outcome are gathered
5 simultaneously in a specific time point, prospective studies are necessary to confirm our findings.
6 In addition, self-reported data and the nature of cross-sectional data may lead to recall and
7 reporting biases, which may be the reason for the insignificant difference in the causes of obesity.
8 Finally, other indicators of adiposity, such as body fat percentage and waist circumference which
9 plenty of studies reported to reflect the prevalence of overweight and obesity and body fat
10 distribution, were not obtained in our study^{37 38}.

11 **Conclusions**

12 In conclusion, the present study indicates that the prevalence of overweight and obesity
13 among adult residents in Xinjiang, the northwest China, is very high during the past years.
14 Furthermore, the main influencing factors for overweight and obesity are sex, age, race, marriage
15 status, education level, occupation, smoking, drinking, hypertension, diabetes and dyslipidemia.
16 These data suggest that efforts toward prevention and control of overweight and obesity should be
17 a public health priority in the northwest of China, which will be submitted to relevant departments
18 as a reference to reverse the trends.

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3 **Ethics approval:** This study was carried out in accordance with the Declaration of Helsinki and
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6 **Data availability statement:** All data relevant to the study are included in the article or uploaded
7 as supplementary information. No additional data are available.

8 **References**

- 9 1. De Luca M, Angrisani L, Himpens J, et al. Indications for Surgery for Obesity and Weight-
10 Related Diseases: Position Statements from the International Federation for the Surgery of Obesity
11 and Metabolic Disorders (IFSO). *Obesity surgery* 2016;26(8):1659-96 doi: 10.1007/s11695-016-
12 2271-4[published Online First: Epub Date]].
- 13 2. Collaboration NCDRF. Trends in adult body-mass index in 200 countries from 1975 to 2014: a
14 pooled analysis of 1698 population-based measurement studies with 19.2 million participants.
15 *Lancet* 2016;387(10026):1377-96 doi: 10.1016/S0140-6736(16)30054-X[published Online First:
16 Epub Date]].
- 17 3. Pineda E, Sanchez-Romero LM, Brown M, et al. Forecasting Future Trends in Obesity across
18 Europe: The Value of Improving Surveillance. *Obesity facts* 2018;11(5):360-71 doi:
19 10.1159/000492115[published Online First: Epub Date]].
- 20 4. Addo PN, Nyarko KM, Sackey SO, et al. Prevalence of obesity and overweight and associated
21 factors among financial institution workers in Accra Metropolis, Ghana: a cross sectional study.
22 *BMC research notes* 2015;8:599 doi: 10.1186/s13104-015-1590-1[published Online First: Epub
23 Date]].
- 24 5. Lee DH, Keum N, Hu FB, et al. Comparison of the association of predicted fat mass, body mass
25 index, and other obesity indicators with type 2 diabetes risk: two large prospective studies in US
26 men and women. *European journal of epidemiology* 2018;33(11):1113-23 doi: 10.1007/s10654-
27 018-0433-5[published Online First: Epub Date]].
- 28 6. Flegal KM, Kit BK, Orpana H, et al. Association of all-cause mortality with overweight and
29 obesity using standard body mass index categories: a systematic review and meta-analysis. *Jama*
30 2013;309(1):71-82 doi: 10.1001/jama.2012.113905[published Online First: Epub Date]].
- 31 7. Wang H, Zhai F. Programme and policy options for preventing obesity in China. *Obesity*
32 *reviews : an official journal of the International Association for the Study of Obesity* 2013;14
33 Suppl 2:134-40 doi: 10.1111/obr.12106[published Online First: Epub Date]].
- 34 8. Lao XQ, Ma WJ, Sobko T, et al. Dramatic escalation in metabolic syndrome and cardiovascular
35 risk in a Chinese population experiencing rapid economic development. *BMC public health*
36 2014;14:983 doi: 10.1186/1471-2458-14-983[published Online First: Epub Date]].
- 37 9. Ferretti F, Mariani M. Simple vs. Complex Carbohydrate Dietary Patterns and the Global
38 Overweight and Obesity Pandemic. *International journal of environmental research and public*
39 *health* 2017;14(10) doi: 10.3390/ijerph14101174[published Online First: Epub Date]].
- 40 10. Lek N, Yan W, Zhang Y, et al. Indices of central and general obesity and cardiometabolic risk

- 1 among adolescents in three ethnic groups in north-west China. *Annals of human biology* 2016;43(1):18-24 doi: 10.3109/03014460.2015.1014418[published Online First: Epub Date]].
- 2 11. Xie X, Ma YT, Yang YN, et al. Alcohol consumption and ankle-to-brachial index: results
3 from the Cardiovascular Risk Survey. *PloS one* 2010;5(12):e15181 doi:
4 10.1371/journal.pone.0015181[published Online First: Epub Date]].
- 5 12. Awareness t, control of diabetes mellitus and the risk factors: survey results from northeast
6 China Kilpi, F., Webber L, Musaigner A, et al. Alarming predictions for obesity and non-
7 communicable diseases in the Middle East. *Public health nutrition* 2014;17(5):1078-86 doi:
8 10.1017/S1368980013000840[published Online First: Epub Date]].
- 9 13. Wang C, Yu Y, Zhang X, et al. Awareness, treatment, control of diabetes mellitus and the risk
10 factors: survey results from northeast China. *PloS one* 2014;9(7):e103594 doi:
11 10.1371/journal.pone.0103594[published Online First: Epub Date]].
- 12 14. McManus RJ, Caulfield M, Williams B, et al. NICE hypertension guideline 2011: evidence
13 based evolution. *Bmj* 2012;344:e181 doi: 10.1136/bmj.e181[published Online First: Epub Date]].
- 14 15. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of Hyperglycemia in Type 2
15 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the
16 European Association for the Study of Diabetes (EASD). *Diabetes care* 2018;41(12):2669-701
17 doi: 10.2337/dci18-0033[published Online First: Epub Date]].
- 18 16. Alshamiri M, Ghanaim MMA, Barter P, et al. Expert opinion on the applicability of
19 dyslipidemia guidelines in Asia and the Middle East. *International journal of general medicine*
20 2018;11:313-22 doi: 10.2147/IJGM.S160555[published Online First: Epub Date]].
- 21 17. Lavie CJ, Arena R, Alpert MA, et al. Management of cardiovascular diseases in patients with
22 obesity. *Nature reviews Cardiology* 2018;15(1):45-56 doi: 10.1038/nrcardio.2017.108[published
23 Online First: Epub Date]].
- 24 18. Rummo P, Kanchi R, Perlman S, et al. Correction to: Change in Obesity Prevalence among
25 New York City Adults: the NYC Health and Nutrition Examination Survey, 2004 and 2013-2014.
26 *Journal of urban health : bulletin of the New York Academy of Medicine* 2018;95(6):800 doi:
27 10.1007/s11524-018-0310-2[published Online First: Epub Date]].
- 28 19. Collaborators GBDO, Afshin A, Forouzanfar MH, et al. Health Effects of Overweight and
29 Obesity in 195 Countries over 25 Years. *The New England journal of medicine* 2017;377(1):13-27
30 doi: 10.1056/NEJMoa1614362[published Online First: Epub Date]].
- 31 20. Vogelzangs N, Kritchevsky SB, Beekman AT, et al. Obesity and onset of significant
32 depressive symptoms: results from a prospective community-based cohort study of older men and
33 women. *The Journal of clinical psychiatry* 2010;71(4):391-9 doi:
34 10.4088/JCP.08m04743blu[published Online First: Epub Date]].
- 35 21. Wang R, Zhang P, Gao C, et al. Prevalence of overweight and obesity and some associated
36 factors among adult residents of northeast China: a cross-sectional study. *BMJ open*
37 2016;6(7):e010828 doi: 10.1136/bmjopen-2015-010828[published Online First: Epub Date]].
- 38 22. Kontsevaya A, Shalnova S, Deev A, et al. Overweight and Obesity in the Russian Population:
39 Prevalence in Adults and Association with Socioeconomic Parameters and Cardiovascular Risk
40 Factors. *Obesity facts* 2019;12(1):103-14 doi: 10.1159/000493885[published Online First: Epub
41 Date]].
- 42 23. Catala-Lopez F, Genova-Maleras R. [Prevention and control of chronic non-communicable
43 diseases in Spain: A call to action]. *Medicina clinica* 2013;140(11):502-3 doi:
44

- 1
2
3
4 1 10.1016/j.medcli.2012.11.006[published Online First: Epub Date]].
5 2 24. Carroll DD, Blanck HM, Serdula MK, et al. Obesity, physical activity, and depressive
6 3 symptoms in a cohort of adults aged 51 to 61. *Journal of aging and health* 2010;22(3):384-98 doi:
7 4 10.1177/0898264309359421[published Online First: Epub Date]].
8 5 25. Mc Hugh S, O'Neill C, Browne J, et al. Body mass index and health service utilisation in the
9 6 older population: results from The Irish Longitudinal Study on Ageing. *Age and ageing*
10 7 2015;44(3):428-34 doi: 10.1093/ageing/afu177[published Online First: Epub Date]].
11 8 26. Wang YT, Adi D, Yu ZX, et al. The burden and correlates of hypertension among Chinese
12 9 rural population in Han, Uyгур, and Kazak: a cross-sectional study. *Journal of the American*
13 10 *Society of Hypertension : JASH* 2017;11(11):737-45 e3 doi: 10.1016/j.jash.2017.09.010[published
14 11 Online First: Epub Date]].
15 12 27. Dinour L, Leung MM, Tripicchio G, et al. The Association between Marital Transitions, Body
16 13 Mass Index, and Weight: A Review of the Literature. *Journal of obesity* 2012;2012:294974 doi:
17 14 10.1155/2012/294974[published Online First: Epub Date]].
18 15 28. Saelens BE, Glanz K, Frank LD, et al. Two-Year Changes in Child Weight Status, Diet, and
19 16 Activity by Neighborhood Nutrition and Physical Activity Environment. *Obesity*
20 17 2018;26(8):1338-46 doi: 10.1002/oby.22247[published Online First: Epub Date]].
21 18 29. Collaborators GBDT. Smoking prevalence and attributable disease burden in 195 countries
22 19 and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015.
23 20 *Lancet* 2017;389(10082):1885-906 doi: 10.1016/S0140-6736(17)30819-X[published Online First:
24 21 Epub Date]].
25 22 30. Marques-Vidal P, Bochud M, Mooser V, et al. Prevalence of obesity and abdominal obesity in
26 23 the Lausanne population. *BMC public health* 2008;8:330 doi: 10.1186/1471-2458-8-
27 24 330[published Online First: Epub Date]].
28 25 31. Siddiquee T, Bhowmik B, Da Vale Moreira NC, et al. Prevalence of obesity in a rural Asian
29 26 Indian (Bangladeshi) population and its determinants. *BMC public health* 2015;15:860 doi:
30 27 10.1186/s12889-015-2193-4[published Online First: Epub Date]].
31 28 32. Torigian DA, Green-McKenzie J, Liu X, et al. A Study of the Feasibility of FDG-PET/CT to
32 29 Systematically Detect and Quantify Differential Metabolic Effects of Chronic Tobacco Use in
33 30 Organs of the Whole Body-A Prospective Pilot Study. *Academic radiology* 2017;24(8):930-40
34 31 doi: 10.1016/j.acra.2016.09.003[published Online First: Epub Date]].
35 32 33. Global BMIMC, Di Angelantonio E, Bhupathiraju Sh N, et al. Body-mass index and all-cause
36 33 mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents.
37 34 *Lancet* 2016;388(10046):776-86 doi: 10.1016/S0140-6736(16)30175-1[published Online First:
38 35 Epub Date]].
39 36 34. Lassale C, Tzoulaki I, Moons KGM, et al. Separate and combined associations of obesity and
40 37 metabolic health with coronary heart disease: a pan-European case-cohort analysis. *European*
41 38 *heart journal* 2018;39(5):397-406 doi: 10.1093/eurheartj/ehx448[published Online First: Epub
42 39 Date]].
43 40 35. Fan J, Song Y, Chen Y, et al. Combined effect of obesity and cardio-metabolic abnormality on
44 41 the risk of cardiovascular disease: a meta-analysis of prospective cohort studies. *International*
45 42 *journal of cardiology* 2013;168(5):4761-8 doi: 10.1016/j.ijcard.2013.07.230[published Online
46 43 First: Epub Date]].
47 44 36. Espeland MA, Glick HA, Bertoni A, et al. Impact of an intensive lifestyle intervention on use
48
49
50
51
52
53
54
55
56
57
58
59
60

1 and cost of medical services among overweight and obese adults with type 2 diabetes: the action
2 for health in diabetes. *Diabetes care* 2014;37(9):2548-56 doi: 10.2337/dc14-0093[published
3 Online First: Epub Date].

4 37. Zeng Q, Dong SY, Sun XN, et al. Percent body fat is a better predictor of cardiovascular risk
5 factors than body mass index. *Brazilian journal of medical and biological research = Revista*
6 *brasileira de pesquisas medicas e biologicas* 2012;45(7):591-600

7 38. Ramirez-Velez R, Correa-Bautista JE, Gonzalez-Ruiz K, et al. The Role of Body Adiposity
8 Index in Determining Body Fat Percentage in Colombian Adults with Overweight or Obesity.
9 *International journal of environmental research and public health* 2017;14(10) doi:
10 10.3390/ijerph14101093[published Online First: Epub Date].
11

12 **Table 1 Prevalence of overweight and obesity according to demographic characteristics**

Characteristic	N	Overweight			Obesity		
		n (%)	χ^2	P	n (%)	χ^2	P
Sex							
Male	6819	2735(40.1)	71.1	<0.001*	1856 (27.2)	3.7	0.05
Female	7799	2603(33.4)			2013(25.8)		
Age(years)							
35-44	5425	1866(34.4)	20.3	<0.001*	1146(21.1)	149.8	<0.001*
45-54	3759	1441(38.3)			1153(30.7)		
55-64	2932	1067(36.4)			919(31.3)		
≥65	2502	964(38.5)			651(26.0)		
Area							
Urban	7974	3163(39.7)	75.1	<0.001*	1956(24.5)	33.9	<0.001*
Rural	6644	2175(32.7)			1913(28.8)		
Ethnicity							
Han	5757	2380(16.3)	99.1	<0.001*	1082(7.4)	331.9	<0.001*
Uyghur	4767	1635(11.2)			1361(9.3)		
Kazak	4094	1323(9.1)			1426(9.8)		
Occupation							
Manual	4583	1760(12.0)	12.1	0.002*	1095(7.5)	32.1	<0.001*
White collar	7751	2736(18.7)			2086(14.3)		

Other	2284	842(5.8)			688(4.7)			
Education								
Primary school and below	5805	1993(13.6)	26.9	<0.001*	1589(10.87)	21.2	<0.001*	
Junior middle school	3094	1196(8.2)			844(5.8)			
Senior middle school	4556	1676(11.5)			1191(8.2)			
Undergraduate and above	1163	473(3.2)			245(1.7)			
Marriage								
Unmarried	192	59(0.4)	14.1	<0.001*	27(0.2)	23.1	<0.001*	
Married	12988	4795(32.8)			3427(23.4)			
divorced	201	53(0.4)			47(0.2)			
widowed	1237	431(3.0)			368(2.5)			
Drinking								
Yes	4169	923(6.3)	44.5	<0.001*	663(4.5)	24.6	<0.001*	
No	10449	4415(30.2)			3206(21.9)			
Smoking								
Yes	2151	1688(11.6)	39.7	<0.001*	1101(7.5)	0.01	0.92	
No	12467	3650(25.0)			2768(18.9)			
Hypertension								
Yes	5701	2138(14.6)	3.9	0.05	2155(14.7)	616.8	<0.001*	
No	8917	3200(21.9)			1714(11.7)			
Diabetes								
Yes	859	335(2.3)	2.4	0.1	317(2.2)	51.0	<0.001*	
No	13759	5003(34.2)			3552(24.3)			
Dyslipidemia								
hypertriglyceridemia								
Yes	4113	1724(11.8)	72.0	<0.001*	1497(10.2)	289.9	<0.001*	
No	10505	3614(24.7)			2372(16.2)			

hypercholesterolemia

Yes	3787	1469(10.1)	11.4	0.001*	1267(8.7)	128.3	<0.001*
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No	10831	3869(26.5)			2602(17.8)		
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High LDL-C

Yes	5251	1921(13.1)	0.02	0.9	1334(9.1)	4.8	0.03*
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No	9367	3417(23.4)			2535(17.3)		
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Low HDL-C

Yes	4437	1704(11.7)	9.8	0.002*	1215(8.3)	2.8	0.09
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No	10831	3634(24.9)			2654(18.2)		
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1 Categorical variables are presented as counts and percentages. HDL-c, high density lipoprotein-cholesterol; LDL-c, low density lipoprotein-cholesterol.

2 Date were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

5 **Table 2 Prevalence of overweight and obesity in men and women according to age group**

Age (years)	Overweight		<i>P</i>	Obesity		<i>P</i>
	Male(%)	female(%)		male(%)	female(%)	
35-44	994(40.2)	872(29.5)	<0.001	631(25.5)	515(17.4)	<0.001
45-54	735(43.1)	706(34.4)		517(30.3)	636(31.0)	
55-64	476(35.8)	591(36.8)		389(29.3)	531(33.0)	
≥65	530(40.3)	434(36.5)		319(24.3)	332(27.9)	

6 Date were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

8 **Table 3 Prevalence of overweight and obesity in Han, Uyghur and Kazak according to age**

Age (years)	group						<i>P</i>	
	Overweight			Obesity				
	Han(%)	Uyghur(%)	Kazak(%)	Han(%)	Uyghur(%)	Kazak(%)		
35-44	712(35.0)	573(34.6)	581(33.6)	<0.001	273(13.4)	422(25.5)	451(26.1)	<0.001
45-54	599(43.9)	481(38.1)	361(31.9)		246(18.0)	436(34.5)	471(41.6)	
55-64	497(45.9)	354(32.6)	216(28.3)		268(24.7)	318(29.3)	333(43.6)	
≥65	572(45.0)	227(29.9)	165(35.1)		295(23.2)	185(24.3)	171(36.4)	

10 Date were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

1

2 **Table 4 Multivariable regression analysis of correlates of overweight and obesity in residents**
 3 **of Xinjiang Province**

Characteristic	B	S.E.	Wald	df	P	OR	95%CI
Area	-0.1	0.04	10.4	1	0.001*	0.9	0.8-0.9
Sex	-0.3	0.05	32.5	1	<0.001*	0.8	0.7-0.8
Ethnic			94.4	2	<0.001*		
Han	-	-	-	-	-	1	-
Uygur	0.4	0.05	50.0	1	<0.001*	1.4	1.3-1.6
Kazakh	0.50	0.05	86.2	1	<0.001*	1.7	1.5-1.8
Age(years)			71.2	3	<0.001*		
35-44	-	-	-	-	-	1	-
45-54	0.4	0.05	62.8	1	<0.001*	1.5	1.3-1.6
55-64	0.3	0.05	24.6	1	<0.001*	1.3	1.2-1.5
≥65	0.1	0.06	3.1	1	0.08	1.11	1.0-1.3
Education			17.9	3	<0.001*		
Primary school and below	-	-	-	-	-	1	-
Junior middle school	0.2	0.05	15.6	1	<0.001*	1.2	1.1-1.4
Senior middle school	0.2	0.06	7.0	1	0.008*	1.2	1.0-1.3
Undergraduate and above	0.2	0.08	6.8	1	0.009*	1.3	1.1-1.5
Occupation			10.4	2	0.006*		
Manual	-	-	-	-	-	1	-
White collar	0.01	0.05	0.04	1	0.8	1.0	0.9-1.1
Other	0.2	0.06	7.9	1	0.005*	1.2	1.1-1.4
Marriage			26.5	3	<0.001		
Unmarried	-	-	-	-	-	1	-
Married	0.6	0.2	15.5	1	<0.001*	1.8	1.4-2.5
Divorced	0.1	0.2	0.2	1	0.7	1.1	0.7-1.7
widowed	0.6	0.2	12.4	1	<0.001*	1.8	1.3-2.5

Smoking	-0.2	0.05	9.0	1	0.003*	0.9	0.8-0.9
Drinking	0.4	0.06	34.8	1	<0.001*	1.5	1.3-1.6
Hypertension	0.8	0.04	340.4	1	<0.001*	2.1	2.0-2.3
Diabetes	0.3	0.09	10.4	1	0.001*	1.3	1.1-1.6
Dyslipidemia							
hypertriglyceridemia	0.9	0.05	371.4	1	<0.001*	2.4	2.2-2.7
hypercholesterolemia	0.2	0.05	20.9	1	<0.001*	1.2	1.1-1.3
Low HDL-C	0.1	0.04	6.4	1	0.01*	1.1	1.0-1.2
High LDL-C	0.02	0.04	0.16	1	0.69	1.0	0.9-1.1
Constant	-1.0	0.2	35.3	1	<0.001	-	-

1 * $P < 0.05$, Statistically significant.

Supplementary Table 1 Prevalence of underweight

Characteristic	N	Underweight	
		n (%)	P
Sex			
Male	6819	71(1.04)	<0.001
Female	7799	219(2.81)	

* $P < 0.05$, Statistically significant.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (On page 1, line 1) (b) Provide in the abstract an informative and balanced summary of what was done and what was found (On page 2)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (On page 2, line 2-5)
Objectives	3	State specific objectives, including any prespecified hypotheses (On page 2, line 2-5)
Methods		
Study design	4	Present key elements of study design early in the paper (On page 4, line 9)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (On page 2, line 7)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (On page 4, line 9-20) (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (On page 5,6)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (On page 4,5)
Bias	9	Describe any efforts to address potential sources of bias (On page 11, line 1-3)
Study size	10	Explain how the study size was arrived at (On page 4, line 15-16)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (On page 4,5)
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (On page 6) (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (On page 6) (e) Describe any sensitivity analyses

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (On page 4, line 15-16) (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (On page 14, Table1) (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures (On page 6-7)
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (On page 6,7) (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (On page 6,7)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (On page 6,7)
Discussion		
Key results	18	Summarise key results with reference to study objectives (On page 8)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (On page 10,11)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (On page 11)
Generalisability	21	Discuss the generalisability (external validity) of the study results (On page 11)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (On page 11)

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence of overweight and obesity and associated risk factors among adult residents of northwest China: A cross-sectional study

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Primary Subject Heading:	Public health
Secondary Subject Heading:	Cardiovascular medicine, Epidemiology, Ethics, Global health
Keywords:	cross-sectional survey, overweight, obesity, risk factors



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4 1 **Prevalence of overweight and obesity and associated risk factors among adult residents of**
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6 2 **northwest China: A cross-sectional study**

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6
7 2 **Abstract**

8 3 **Objective:** Overweight and obesity have been shown to be related to multiple chronic conditions,
9 4 leading to a heavy economic burden on society throughout the world. This study aims to estimate
10 5 the prevalence of overweight and obesity and determine potential influencing factors among adults
11 6 in Xinjiang, northwest China.

12 7 **Design:** A community-based observational study.

13 8 **Setting:** The First Affiliated Hospital of Xinjiang Medical University.

14 9 **Methods:** In total, 14,618 adult participants (7,799 males; 6,819 females) over 35 years old were
15 10 recruited from the Cardiovascular Risk Survey conducted in 2010. Data were obtained from face-
16 11 to-face interviews and physical examinations. The sample was used to estimate the prevalence of
17 12 overweight (body mass index (BMI) [24-28] kg/m²) and obesity (BMI≥28 kg/m²) in Xinjiang
18 13 Province. Influencing factors were analysed based on statistical methods.

19 14 **Results:** In Xinjiang Province, the overall prevalence of overweight was 36.5% (male 40.1%;
20 15 female 33.4%), and the prevalence of obesity was 26.5% (male 27.2%; female 25.8%). The
21 16 prevalence of both overweight and obesity were higher in women than in men ($P<0.001$). The
22 17 main influencing factors for overweight and obesity were sex, age, race, marital status, education
23 18 level, occupation, smoking, drinking, hypertension, diabetes and dyslipidaemia ($P<0.05$).

24 19 **Conclusions:** This study estimated that the prevalence of overweight and obesity among adult
25 20 residents of Xinjiang Province, northwest China, was high. These data suggest that efforts related
26 21 to the prevention and control of overweight and obesity should be a public health priority in
27 22 northwest China.

28 23 **Keywords:** cross-sectional survey, overweight, obesity, risk factors

29 24 **Strengths and limitations of this study**

- 30 25 ➤ The survey sample was demographically representative of Uygur adults with obesity who are
31 26 35–80 years old and reside in Xinjiang.
- 32 27 ➤ The main strengths of our study are its large sample size and precise physical measurements,
33 28 which increase the validity of our results.
- 34 29 ➤ Due to the cross-sectional nature of the study and the self-designed questionnaire, indicators

1 and experience could have been affected by bias.

2 ➤ Moreover, other indicators of adiposity, such as body-fat percentage and waist
3 circumference, were not obtained in our study.

4 ➤ The results were from Xinjiang only and therefore cannot be generalised to all of China.

6 **Introduction**

7 Obesity is a complex chronic global disease affecting people worldwide across all ages, sexes,
8 ethnicities, and nationalities, and it is the fifth leading cause of mortality globally ^{1 2}. According to
9 the World Health Organization (WHO), the prevalence of worldwide obesity has doubled in more
10 than 70 countries since 1980 ³. Moreover, this trend has continuously increased in most other
11 countries. In 2013, in order to draw physicians' attention to the condition, the American Medical
12 Association classified obesity as a disease ⁴.

13 Body mass index (BMI), which is calculated as weight/height squared (kg/m^2), is a common
14 and accepted measure that is used to report obesity rates. While BMI is not a true measure of
15 adiposity, it is simple to use in health screenings and epidemiological surveys ⁵. According to the
16 WHO, obesity is defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$, and overweight as a BMI of $[25-30) \text{ kg}/\text{m}^2$ ⁶. For
17 Chinese people, a $\text{BMI} \geq 28 \text{ kg}/\text{m}^2$ suggests obesity and a BMI of $[24-28) \text{ kg}/\text{m}^2$ indicates overweight
18 ⁷.

19 China is the largest developing country and has the largest population in the world. With rapid
20 economic growth and changes in lifestyle, such as dietary habits and physical activity ⁸, the
21 epidemiological data indicate that individuals with overweight and obesity have a higher prevalence
22 of traditional diseases, including dyslipidaemia, hypertension, cardiovascular disease, insulin
23 resistance or diabetes, fatty liver disease, and psychosocial complications and some cancers ^{5 9}.
24 Located in northwest China, Xinjiang is not only an autonomous minority ethnic region within the
25 People's Republic of China, but also one of the fastest developing regions in China. It is the largest
26 Chinese administrative division and spans over 1.66 million km^2 , which represents approximately
27 one-sixth of the country's territory. A few studies had reported the prevalence of overweight among
28 adults in Xinjiang ¹⁰. Nevertheless, the samples in the abovementioned studies were small, and those
29 results cannot accurately represent the status of overweight and obesity in the whole region of

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4 1 Xinjiang.

5 2 In the present study, we estimated the prevalence of overweight and obesity in Xinjiang,
6 3 northwestern part of China. Furthermore, we investigated the associated factors of overweight and
7 4 obesity, which will be regarded as a reference for policy makers to make informed decisions.

11 5 **Materials and Methods**

13 6 **Ethics approval**

15 7 This study was conducted according to the standards of the Declaration of Helsinki. Written
16 8 informed consent was acquired from each participant prior to enrolment. Ethics approval was
17 9 granted by the Ethics Committee of the First Affiliated Hospital of Xinjiang Medical University
18 10 (the approval ID: 20100116-01).

23 11 **Study design and population**

25 12 This survey is a population-based cross-sectional program and the Cardiovascular Risk Survey
26 13 (CRS) study was conducted in Xinjiang Province of China in 2010. Previously, several studies had
27 14 described in details ¹¹⁻¹⁴. The CRS was a prospective, multiple-ethnicity and community-based
28 15 observational study designed to investigate the prevalence and risk factors for cardiovascular disease
29 16 (CVD) in the Han, Uygur and Kazakh populations in Xinjiang Province ¹¹. All participants we
30 17 recruited had lived in Xinjiang for more than one year. In short, a total of 16,460 adults aged ≥ 35
31 18 years have been joined the CRS, 14,618 subjects (5,757 Han, 4,767 Uygur and 4,094 Kazakh
32 19 Chinese) of them completed the investigation. We adopt the method of multistage stratified
33 20 sampling to randomly select the representative sample from 6 different administrative regions,
34 21 including Urumqi, Yili, Hetian, Kalamayi, Fukang and Turpan.

44 22 **Data collection**

46 23 The standard survey mainly consisted of two aspects ¹⁵, one is the face-to-face interview, the
47 24 other is the physical examination. Before launching the regular survey, it is necessary to carry out a
48 25 pre-survey to ensure the accuracy and feasibility of the questionnaire. At the investigation stage,
49 26 two independent investigators ensured the validity of every survey questionnaire. In the
50 27 questionnaire processing stage, we used parallel double method to handle data, and carried out three
51 28 validations to verify the self-contradictory responses. The questionnaire provided demographics,
52 29 general personal information and medical histories ¹⁶. Height and weight were measured adopting

1 the standards. Height was measured to the nearest 0.1 cm, and weight was measured with a standard
2 scale in the upright position to the nearest 0.1 kg¹⁵. Smoking and drinking habits were self-reported.

3 Blood samples were collected in examination centres at local hospitals in the participants'
4 residential area. The collected and detected methods have also been described in detail previously
5^{13 14}. At the time of the in-person interview, a 5 mL fasting venous blood was collected into EDTA
6 tubes and separated to acquire plasma within 4 h. Finally, all samples after processing were stored
7 at -80°C immediately. We measured the biochemical markers in plasma using the equipment for
8 chemical analysis (Dimension AR/AVL Clinical Chemistry System, Newark, NJ, USA), operated
9 by the Clinical Laboratory Department of the First Affiliated Hospital of Xinjiang Medical
10 University. Relevant markers in plasma, which contained total cholesterol (TC), triglycerides (TG),
11 high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C),
12 were measured.

13 **Definition of variables**

14 Overweight and obesity were defined by the Chinese standards mentioned above. Obesity was
15 defined as BMI \geq 28 kg/m², and overweight was defined as a BMI of [24-28) kg/m².

16 Education was classified into four levels: primary school and below (including never having
17 attended school and elementary schooling only); junior middle school; senior middle school
18 (including secondary vocational schooling); undergraduate and above (including post-secondary
19 vocational schooling, master's degree and doctoral degree). The occupations consist of three parts:
20 manual labour (including farmers, production and service workers), white-collar occupations
21 (including office and other technical employment) and other occupations (including unemployed,
22 retiree, student and full-time homemaker)¹⁷. Smoking-status classifications included current
23 smokers (who had smoked at least one cigarette a day over the past 30 days) and never-smokers.
24 Drinking-status classifications included current drinkers (who had consumed more than one
25 alcoholic drink a week) and never-drinkers. Hypertension was defined as mean systolic BP \geq 140
26 mmHg, mean diastolic BP \geq 90 mmHg, and/or current use of antihypertensive medications^{14 18}.
27 Diabetes was defined as fasting plasma glucose \geq 126 mg/dL (\geq 7.0 mmol/L), self-reported history of
28 diabetes and/or current use of insulin or antidiabetic medications^{14 19}. Hypercholesterolemia was
29 defined as serum total cholesterol level $>$ 6.22 mmol/L (240 mg/dL), and hypertriglyceridemia was

1 defined as serum triglyceride level >2.26 mmol/L (200 mg/dL). A serum LDL-C level of >4.14
2 mmol/L (160 mg/dL) was defined as high LDL-C, and a serum HDL-C level of <1.04 mmol/L (40
3 mg/dL) was defined as low HDL-C. In total, dyslipidaemia was defined as the existence of at least
4 one of the four abnormal lipid concentrations mentioned above or self-reported use of lipid-lowering
5 drugs^{13 20}.

6 **Statistical analysis**

7 Data were entered and corrected by 2 staff members using EpiData 3.02 software (EpiData,
8 Association, Odense, Denmark). The subjects' continuous variables were expressed by frequency
9 distributions, meanwhile, the prevalence rates were shown through the percentage. Chi-square
10 testing (χ^2) was used to compare the prevalence of overweight and obesity in different groups. To
11 analyse the factors associated with obesity and adjust for potential confounding effects,
12 multivariable logistic regression analyses were carried out to explain independent factors associated
13 with overweight and obesity. ORs with 95% CIs were used for the risk analysis. All statistical
14 analyses were conducted using the complex sampling function of Social Sciences SPSS for
15 Windows version 22.0 (SPSS, Inc, Chicago, IL, USA), with a $P < 0.05$ indicating statistical
16 significance.

17 **Patient and public involvement**

18 This survey is a population-based cross-sectional program and the Cardiovascular Risk
19 Survey (CRS) study was conducted in Xinjiang Province of China in 2010. The study was
20 designed to investigate the prevalence of overweight and obesity among adult residents in
21 Xinjiang in northwest China. However, no patients or members of the public were included in the
22 design, recruitment or conduct of the study. The results were to be disseminated to participants
23 after the study was completed by the study team. The burden of intervention would not be
24 assessed by the patients themselves.

25 **Results**

26 In this survey, we interviewed 14618 residents aged 35 to 101 years (mean age: 50.8±12.6
27 years), including 6,819 (46.6%) men and 7,799 (53.4%) women. Among these participants, 5,757
28 (39.4%) were Han, with a mean age of 52.5±12.7 years; 4,767 (32.6%) were Uygur, with a mean
29 age of 50.7±13.0 years; and 4,094 (28.0%) were Kazakh, with a mean age of 48.6±11.7 years.

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4 1 According to the BMI classification for Chinese people, the overall prevalence of overweight was
5 2 36.5% (male 40.1%; female 33.4%), and the prevalence of obesity was 26.5% (male 27.2%; female
6 3 25.8%) in Xinjiang Province (**Table 1**). There were differences in age, area, race, occupation,
7 4 education, marriage, drinking habits, hypertension history and plasma levels of TG and TC between
8 5 the overweight and obesity groups, while there were no significant differences in sex, smoking,
9 6 diabetes history and the level of LDL-c and HDL-C between the 2 groups.

10 7 From the age-stratified and gender-stratified results in **Table 2**, for men, the prevalence of both
11 8 overweight and obesity peaked at 45-54 years, while a significant trend indicating an increase in the
12 9 prevalence of overweight with age was not demonstrated. For women, the prevalence of overweight
13 10 and obesity increased with age, peaking at 55-64 years, though there was a slight decrease at ≥ 65
14 11 years. In addition, a higher proportion of enrolled males were overweight than females. Interestingly,
15 12 the proportion of females who were obese was higher than that of males.

16 13 From the age-stratified and race-stratified results in **Table 3**, as a whole, obesity prevalence was
17 14 found to be the highest among the Kazakh participants and the lowest among Han participants. The
18 15 differences among the three ethnic groups were statistically significant ($P < 0.001$). Further,
19 16 overweight prevalence was also significantly different among the three ethnicities, with the highest
20 17 rate among Han participants and the lowest among Kazakh participants.

21 18 We divided the participants into two groups: normal weight and overweight/obese. **Table 1**
22 19 shows that the following factors all had a significant effect on overweight/obese: age, area, race,
23 20 education, marital status, occupation, drinking, hypertension and dyslipidaemia ($P < 0.05$). We
24 21 applied multivariable unconditional logistic regression analysis to all of the identified risk factors
25 22 and attempted to identify any existing differences in these risk factors that could explain the
26 23 difference in overweight and obesity prevalence. **Table 4** shows the results of logistic regression
27 24 models comparing the prevalence of the potential risk factors: sex, age, area, marriage status,
28 25 occupation, smoking, drinking, hypertension, diabetes and level of dyslipidaemia, including
29 26 hypercholesterolemia, hypertriglyceridemia and low HDL-C. The multivariable logistic regression
30 27 results reveal that female adults were more likely to become overweight and obese than male adults
31 28 (OR 0.8, 95% CI 0.7 to 0.8). We categorised age into four groups, which clearly showed that
32 29 increasing age was a risk factor for overweight/obesity, especially age 45-54 years (OR 1.5, 95%

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4 1 CI 1.3 to 1.6). Among the three ethnic groups, the Kazak participants (OR 1.7, 95% CI 1.5 to 1.8)
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6 2 and Uygur participants (OR 1.4, 95% CI 1.3 to 1.6) were at higher risk of becoming overweight and
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8 3 obese. Participants who were married (OR 1.8, 95% CI 1.4 to 2.5) or widowed (OR 1.8, 95% CI 1.3
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10 4 to 2.5) were more likely to be overweight/obese than those who were unmarried. In addition,
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12 5 smokers (OR 0.9, 95% CI 0.8 to 0.9) were less likely to become overweight and obese than non-
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14 6 smokers. Participants who drank were more likely to become overweight or obese than those who
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16 7 never or rarely drank (OR 1.5, 95% CI 1.3 to 1.6). Overweight and obesity were more common
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18 8 among those who had hypertension (OR 2.1, 95% CI 2.0 to 2.3) and diabetes (OR 1.3, 95% CI 1.1
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20 9 to 1.6) compared with those who had no hypertension and diabetes history. In the overweight and
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22 10 obese group, hypertriglyceridemia (OR 2.4, 95% CI 2.2 to 2.7), hypercholesterolemia (OR 1.2, 95%
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24 11 CI 1.1 to 1.3) and low HDL-C (OR 1.1, 95% CI 1.0 to 1.2) remained risk factors.

25 12 **Discussion**

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27 13 The epidemic of obesity is one of the most important health problems worldwide and is
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29 14 estimated to be the second leading cause of preventable death in developed countries, behind
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31 15 cigarette smoking ^{21 22}. The prevalence of overweight and obesity continues to increase around the
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33 16 world, as have associated comorbidities and healthcare costs ²³. In the US, the prevalence of obesity
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35 17 accounts for one-third of the general population, and another one-third is overweight ²⁴. The China
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37 18 Chronic Disease Survey conducted by the Chinese Centre for Disease Control and Prevention
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39 19 demonstrated that the prevalence of overweight among Chinese adults (age 18–64 years) in 2007
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41 20 and 2010 was 26.6% and 30.6%, respectively (males, 27.4% and 32.1%; females, 25.7% and 29.1%),
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43 21 and the prevalence of obesity was 7.7% and 12.1%, respectively (males, 6.7% and 12.5%; females,
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45 22 8.7% and 11.1%) ¹⁵. We found that the prevalence of both overweight and obesity was high. Our
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47 23 cross-sectional study indicates that the prevalence of overweight and obesity among adults in
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49 24 northwest China was 36.5% (males, 40.1%; females, 33.4%) and 26.5% (males, 27.2%; females,
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51 25 25.8%), respectively. In the Russian population ²⁵, the prevalence of overweight was 64.6% (males,
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53 26 42.3%; females, 28.7%), and approximately one-third of the participants (30.3%) were obese (males,
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55 27 27.5%; females, 31.4%). Contrary to what was observed in our research, the prevalence of
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57 28 overweight was higher than obesity in that study. This implies that overweight and obesity have a
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59 29 higher prevalence in both sexes and are more common in northwest China and Russia than in other
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4 1 areas, although effective actions might have been taken to control the upward trend ²⁶. The
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6 2 prevalence of underweight (according to Chinese standards, underweight reflects <18.5 kg/m²) was
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8 3 significantly different among the ethnic groups ($P<0.05$) (**Supplementary Table 1**). However, due
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10 4 to the special dietary habits (high-sugar and high-fat diet) and living habits in Xinjiang, the number
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12 5 of low-weight people was too small to reliably detect differences.

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14 6 In this study, we found that the prevalence of both overweight and obesity was high in middle
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16 7 age (45-64 years). Similarly, age gradients in the prevalence of obesity have been found in Russia
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18 8 ²⁶. It is worth noting that more than half of all women aged 55–64 years were obese, and nearly 80%
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20 9 of men in the group aged 45–54 years were overweight or obese, which is consistent with our age
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22 10 gradients. Chinese people are more likely to have positive perceptions of obesity because it is
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24 11 considered good fortune to become fat during middle age in traditional Chinese culture ²⁷. Moreover,
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26 12 a large segment of the middle-aged and older adult population will be living with overweight and
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28 13 obesity, which is associated with additional health impairments ²⁸.

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30 14 Through the present study, we found a very high prevalence of overweight and obesity in three
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32 15 ethnicities in Xinjiang, and there is no doubt that this result is similar to those observed in the
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34 16 previous study conducted in Xinjiang ¹⁰. In addition, the prevalence rate of obesity was significantly
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36 17 different among Han, Uygur and Kazak groups, as the prevalence in the Kazak group was
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38 18 significantly higher compared with the Han and Uygur groups. Overall, our findings indicate that
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40 19 16.3% of Han, 11.2% of Uygur, and 9.1% of Kazak people more than 35 years of age in Xinjiang
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42 20 were overweight and that 7.4% of Han, 9.3% of Uygur, and 9.8% of Kazak people were obese.
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44 21 Xinjiang is a multi-ethnic co-populated area in China. The national census showed that there are 47
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46 22 ethnicities in Xinjiang, and 13 of them are confirmed to be native ethnicities, such as the Uygur and
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48 23 Kazak. Explanations for this increase in prevalence are as follows: First, Kazak people live in the
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50 24 grasslands and forests, and their dietary habits are characterised by eating more animals and
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52 25 consuming fewer fresh vegetables. Second, the Kazak group is a nomadic ethnicity, the members of
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54 26 which usually live in hypoxic areas and at high altitude where the climate is cold and dry. Third,
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56 27 differences in genetic background may be an important factor underlying the differences in the
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58 28 prevalence of obesity ²⁹.

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60 29 Multivariable logistic regression analysis showed that the prevalence of overweight and obesity

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4 1 was related to several factors. A previous review revealed that various marital transitions are related
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6 2 with changes in body weight: transition into marriage appears to be associated with weight gain,
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8 3 whereas transition out of marriage is associated with weight loss³⁰. Our study found a similar result,
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10 4 namely, that marriage-related transitions, including marrying, divorcing and being widowed, are
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12 5 risk factors for becoming overweight and obese. A plausible explanation is that behaviours and
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14 6 lifestyles differ among married and unmarried individuals, but the exact mechanism underlying this
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16 7 association with marriage status is not clear. In our study, we also found that different educational
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18 8 levels, occupations and areas of residence are closely related to body weight. We observed that a
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20 9 low education level is a risk factor because of insufficient levels of cognition. Urban populations,
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22 10 especially the unemployed, retirees, students and full-time housewives, are more likely to become
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24 11 overweight and obese, which may be attributable to urban working conditions, for example, sitting
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26 12 in an office and living a fast-paced life as well as supermarket or fast-food restaurant availability³¹.

27 13 The 2015 Global Burden of Disease Study, representing 195 countries and territories, estimated
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29 14 that 25.0% of men and 5.4% of women worldwide smoked daily, which is the leading preventable
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31 15 cause of death worldwide³². In this study, we found a lower prevalence of overweight and obesity
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33 16 in smokers than in non-smokers, which is consistent with studies conducted in Switzerland, India
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35 17 and Jilin, China^{15 33 34}. In addition, reasonable explanations illustrate the issue based on two different
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37 18 criteria. Using tobacco is associated with the function of multiple systems, especially that of
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39 19 cardiovascular and digestive systems³⁵. In terms of the organism itself, smoking has been
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41 20 considered to be a method of relieving stress and anxiety. In northwest China in particular, it is
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43 21 generally believed that the more you drink, the more weight you gain. Wang et al¹⁵ found results
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45 22 consistent with this belief.

46 23 To the best of our knowledge, obesity is an independent risk factor for both CVD and death
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48 24³⁶⁻³⁸. We explored whether the prevalence of overweight and obesity is higher among subjects with
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50 25 hypertension or diabetes or dyslipidaemia. The results provide a compelling reason why the
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52 26 occurrence of obesity is combined with cardiovascular risk factors such as hypertension, diabetes
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54 27 and dyslipidaemia. Previous studies reported that the benefits of weight loss are well established,
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56 28 with a 5–10% reduction in weight associated with improvements in health and quality of life and a
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58 29 3% reduction being positive for health improvement when maintained³⁹.

1 Relevant departments should heed the high prevalence of overweight and obesity in Xinjiang
2 Province and provide effective guidelines to help to reverse the trend. The main strengths of our
3 study are its large sample size and precise physical measurements, which increase the validity of
4 our results. However, the present study has several limitations. First, the main limitation is the
5 cross-sectional design, which prohibits inferring a causal link between overweight and obesity and
6 risk factors. As in cross-sectional studies, data on exposure and outcome are gathered
7 simultaneously at a specific time point. Prospective studies are necessary to confirm our findings.
8 In addition, self-reported data and the nature of cross-sectional data may lead to recall and
9 reporting biases, which may be the reason for the non-significant difference in the causes of
10 obesity. Finally, other indicators of adiposity, such as body-fat percentage and waist
11 circumference, which many studies have noted reflect the prevalence of overweight, obesity and
12 body-fat distribution, were not obtained in our study^{40 41}.

13 **Conclusions**

14 In conclusion, the present study indicates that the prevalence of overweight and obesity
15 among adult residents in Xinjiang in northwest China has been very high during the past years.
16 Furthermore, the main influencing factors for overweight and obesity are sex, age, race, marital
17 status, education level, occupation, smoking, drinking, hypertension, diabetes and dyslipidaemia.
18 These data suggest that efforts related to the prevention and control of overweight and obesity
19 should be a public health priority in the northwest of China. These findings will be submitted to
20 relevant departments as a reference for efforts to reverse these trends.

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4 1 Contributed reagents/materials/analysis tools: Xiangmei Li, Guoli Du, Hui Zhai. Quality control the
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6 2 study and revision: Yining Yang, Xiaomei Li. Wrote the paper: Ning Song. All authors read and
7
8 3 approved the final manuscript.

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10 4 **Conflicts of Interest:** The authors declare no conflict of interest.

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12 5 **Ethics approval:** This study was carried out in accordance with the Declaration of Helsinki and
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14 6 the study protocol was approved by the Ethics Committee of the First Affiliated Hospital of
15
16 7 Xinjiang Medical University (Xinjiang, China) (approval ID:20100116-01).

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18 8 **Data availability statement:** All data relevant to the study are included in the article or uploaded
19
20 9 as supplementary information. No additional data are available.

21 10 **References**

- 22
23 11 1. De Luca M, Angrisani L, Himpens J, et al. Indications for Surgery for Obesity and Weight-
24
25 12 Related Diseases: Position Statements from the International Federation for the Surgery of Obesity
26
27 13 and Metabolic Disorders (IFSO). *Obesity surgery* 2016;26(8):1659-96 doi: 10.1007/s11695-016-
28
29 14 2271-4[published Online First: Epub Date]].
30
31 15 2. Collaboration NCDRF. Trends in adult body-mass index in 200 countries from 1975 to 2014: a
32
33 16 pooled analysis of 1698 population-based measurement studies with 19.2 million participants.
34
35 17 *Lancet* 2016;387(10026):1377-96 doi: 10.1016/S0140-6736(16)30054-X[published Online First:
36
37 18 Epub Date]].
38
39 19 3. Pineda E, Sanchez-Romero LM, Brown M, et al. Forecasting Future Trends in Obesity across
40
41 20 Europe: The Value of Improving Surveillance. *Obesity facts* 2018;11(5):360-71 doi:
42
43 21 10.1159/000492115[published Online First: Epub Date]].
44
45 22 4. Addo PN, Nyarko KM, Sackey SO, et al. Prevalence of obesity and overweight and associated
46
47 23 factors among financial institution workers in Accra Metropolis, Ghana: a cross sectional study.
48
49 24 *BMC research notes* 2015;8:599 doi: 10.1186/s13104-015-1590-1[published Online First: Epub
50
51 25 Date]].
52
53 26 5. Lee DH, Keum N, Hu FB, et al. Comparison of the association of predicted fat mass, body mass
54
55 27 index, and other obesity indicators with type 2 diabetes risk: two large prospective studies in US
56
57 28 men and women. *European journal of epidemiology* 2018;33(11):1113-23 doi: 10.1007/s10654-
58
59 29 018-0433-5[published Online First: Epub Date]].
60
30 6. Flegal KM, Kit BK, Orpana H, et al. Association of all-cause mortality with overweight and
31
32 31 obesity using standard body mass index categories: a systematic review and meta-analysis. *Jama*
33
34 32 2013;309(1):71-82 doi: 10.1001/jama.2012.113905[published Online First: Epub Date]].
35
36 33 7. Wang H, Zhai F. Programme and policy options for preventing obesity in China. *Obesity*
37
38 34 *reviews : an official journal of the International Association for the Study of Obesity* 2013;14
39
40 35 Suppl 2:134-40 doi: 10.1111/obr.12106[published Online First: Epub Date]].
41
42 36 8. Lao XQ, Ma WJ, Sobko T, et al. Dramatic escalation in metabolic syndrome and cardiovascular
43
44 37 risk in a Chinese population experiencing rapid economic development. *BMC public health*
45
46 38 2014;14:983 doi: 10.1186/1471-2458-14-983[published Online First: Epub Date]].
47
48 39 9. Ferretti F, Mariani M. Simple vs. Complex Carbohydrate Dietary Patterns and the Global
49
50
51
52
53
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59
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53
54
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56
57
58
59
60
- 1 Overweight and Obesity Pandemic. *International journal of environmental research and public health* 2017;14(10) doi: 10.3390/ijerph14101174[published Online First: Epub Date]].
 - 2
3 10. Lek N, Yan W, Zhang Y, et al. Indices of central and general obesity and cardiometabolic risk
4 among adolescents in three ethnic groups in north-west China. *Annals of human biology*
5 2016;43(1):18-24 doi: 10.3109/03014460.2015.1014418[published Online First: Epub Date]].
 - 6 11. Xie X, Ma YT, Yang YN, et al. Alcohol consumption and ankle-to-brachial index: results
7 from the Cardiovascular Risk Survey. *PloS one* 2010;5(12):e15181 doi:
8 10.1371/journal.pone.0015181[published Online First: Epub Date]].
 - 9 12. Xie X, Ma YT, Yang YN, et al. Polymorphisms in the SAA1/2 gene are associated with
10 carotid intima media thickness in healthy Han Chinese subjects: the Cardiovascular Risk Survey.
11 *PloS one* 2010;5(11):e13997. doi: 10.1371/journal.pone.0013997 [published Online First:
12 2010/11/26]
 - 13 13. Luo JY, Ma YT, Yu ZX, et al. Prevalence, awareness, treatment and control of dyslipidemia
14 among adults in northwestern China: the cardiovascular risk survey. *Lipids Health Dis* 2014;13:4.
15 doi: 10.1186/1476-511X-13-4 [published Online First: 2014/01/08]
 - 16 14. Liu F, Adi D, Xie X, et al. Prevalence of Isolated Diastolic Hypertension and Associated Risk
17 Factors among Different Ethnicity Groups in Xinjiang, China. *PloS one* 2015;10(12):e0145325.
18 doi: 10.1371/journal.pone.0145325
 - 19 15. Wang R, Zhang P, Gao C, et al. Prevalence of overweight and obesity and some associated
20 factors among adult residents of northeast China: a cross-sectional study. *BMJ open*
21 2016;6(7):e010828 doi: 10.1136/bmjopen-2015-010828[published Online First: Epub Date]].
 - 22 16. Awareness t, control of diabetes mellitus and the risk factors: survey results from northeast
23 China Kilpi, F., Webber L, Musaigner A, et al. Alarming predictions for obesity and non-
24 communicable diseases in the Middle East. *Public health nutrition* 2014;17(5):1078-86 doi:
25 10.1017/S1368980013000840[published Online First: Epub Date]].
 - 26 17. Wang C, Yu Y, Zhang X, et al. Awareness, treatment, control of diabetes mellitus and the risk
27 factors: survey results from northeast China. *PloS one* 2014;9(7):e103594 doi:
28 10.1371/journal.pone.0103594[published Online First: Epub Date]].
 - 29 18. McManus RJ, Caulfield M, Williams B, et al. NICE hypertension guideline 2011: evidence
30 based evolution. *Bmj* 2012;344:e181 doi: 10.1136/bmj.e181[published Online First: Epub Date]].
 - 31 19. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of Hyperglycemia in Type 2
32 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the
33 European Association for the Study of Diabetes (EASD). *Diabetes care* 2018;41(12):2669-701
34 doi: 10.2337/dci18-0033[published Online First: Epub Date]].
 - 35 20. Alshamiri M, Ghanaim MMA, Barter P, et al. Expert opinion on the applicability of
36 dyslipidemia guidelines in Asia and the Middle East. *International journal of general medicine*
37 2018;11:313-22 doi: 10.2147/IJGM.S160555[published Online First: Epub Date]].
 - 38 21. Lavie CJ, Arena R, Alpert MA, et al. Management of cardiovascular diseases in patients with
39 obesity. *Nature reviews Cardiology* 2018;15(1):45-56 doi: 10.1038/nrcardio.2017.108[published
40 Online First: Epub Date]].
 - 41 22. Rummo P, Kanchi R, Perlman S, et al. Correction to: Change in Obesity Prevalence among
42 New York City Adults: the NYC Health and Nutrition Examination Survey, 2004 and 2013-2014.
43 *Journal of urban health : bulletin of the New York Academy of Medicine* 2018;95(6):800 doi:
44 10.1007/s11524-018-0310-2[published Online First: Epub Date]].

- 1
2
3
4 1 23. Collaborators GBDO, Afshin A, Forouzanfar MH, et al. Health Effects of Overweight and
5 2 Obesity in 195 Countries over 25 Years. *The New England journal of medicine* 2017;377(1):13-27
6 3 doi: 10.1056/NEJMoa1614362[published Online First: Epub Date]].
7 4 24. Vogelzangs N, Kritchevsky SB, Beekman AT, et al. Obesity and onset of significant
8 5 depressive symptoms: results from a prospective community-based cohort study of older men and
9 6 women. *The Journal of clinical psychiatry* 2010;71(4):391-9 doi:
10 7 10.4088/JCP.08m04743blu[published Online First: Epub Date]].
11 8 25. Kontsevaya A, Shalnova S, Deev A, et al. Overweight and Obesity in the Russian Population:
12 9 Prevalence in Adults and Association with Socioeconomic Parameters and Cardiovascular Risk
13 10 Factors. *Obesity facts* 2019;12(1):103-14 doi: 10.1159/000493885[published Online First: Epub
14 11 Date]].
15 12 26. Catala-Lopez F, Genova-Maleras R. [Prevention and control of chronic non-communicable
16 13 diseases in Spain: A call to action]. *Medicina clinica* 2013;140(11):502-3 doi:
17 14 10.1016/j.medcli.2012.11.006[published Online First: Epub Date]].
18 15 27. Carroll DD, Blanck HM, Serdula MK, et al. Obesity, physical activity, and depressive
19 16 symptoms in a cohort of adults aged 51 to 61. *Journal of aging and health* 2010;22(3):384-98 doi:
20 17 10.1177/0898264309359421[published Online First: Epub Date]].
21 18 28. Mc Hugh S, O'Neill C, Browne J, et al. Body mass index and health service utilisation in the
22 19 older population: results from The Irish Longitudinal Study on Ageing. *Age and ageing*
23 20 2015;44(3):428-34 doi: 10.1093/ageing/afu177[published Online First: Epub Date]].
24 21 29. Wang YT, Adi D, Yu ZX, et al. The burden and correlates of hypertension among Chinese
25 22 rural population in Han, Uygur, and Kazak: a cross-sectional study. *Journal of the American*
26 23 *Society of Hypertension* : *JASH* 2017;11(11):737-45 e3 doi: 10.1016/j.jash.2017.09.010[published
27 24 Online First: Epub Date]].
28 25 30. Dinour L, Leung MM, Tripicchio G, et al. The Association between Marital Transitions, Body
29 26 Mass Index, and Weight: A Review of the Literature. *Journal of obesity* 2012;2012:294974 doi:
30 27 10.1155/2012/294974[published Online First: Epub Date]].
31 28 31. Saelens BE, Glanz K, Frank LD, et al. Two-Year Changes in Child Weight Status, Diet, and
32 29 Activity by Neighborhood Nutrition and Physical Activity Environment. *Obesity*
33 30 2018;26(8):1338-46 doi: 10.1002/oby.22247[published Online First: Epub Date]].
34 31 32. Collaborators GBDT. Smoking prevalence and attributable disease burden in 195 countries
35 32 and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015.
36 33 *Lancet* 2017;389(10082):1885-906 doi: 10.1016/S0140-6736(17)30819-X[published Online First:
37 34 Epub Date]].
38 35 33. Marques-Vidal P, Bochud M, Mooser V, et al. Prevalence of obesity and abdominal obesity in
39 36 the Lausanne population. *BMC public health* 2008;8:330 doi: 10.1186/1471-2458-8-
40 37 330[published Online First: Epub Date]].
41 38 34. Siddiquee T, Bhowmik B, Da Vale Moreira NC, et al. Prevalence of obesity in a rural Asian
42 39 Indian (Bangladeshi) population and its determinants. *BMC public health* 2015;15:860 doi:
43 40 10.1186/s12889-015-2193-4[published Online First: Epub Date]].
44 41 35. Torigian DA, Green-McKenzie J, Liu X, et al. A Study of the Feasibility of FDG-PET/CT to
45 42 Systematically Detect and Quantify Differential Metabolic Effects of Chronic Tobacco Use in
46 43 Organs of the Whole Body-A Prospective Pilot Study. *Academic radiology* 2017;24(8):930-40
47 44 doi: 10.1016/j.acra.2016.09.003[published Online First: Epub Date]].

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- 1 36. Global BMIMC, Di Angelantonio E, Bhupathiraju Sh N, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet* 2016;388(10046):776-86 doi: 10.1016/S0140-6736(16)30175-1[published Online First: Epub Date]].
- 2 37. Lassale C, Tzoulaki I, Moons KGM, et al. Separate and combined associations of obesity and metabolic health with coronary heart disease: a pan-European case-cohort analysis. *European heart journal* 2018;39(5):397-406 doi: 10.1093/eurheartj/ehx448[published Online First: Epub Date]].
- 3 38. Fan J, Song Y, Chen Y, et al. Combined effect of obesity and cardio-metabolic abnormality on the risk of cardiovascular disease: a meta-analysis of prospective cohort studies. *International journal of cardiology* 2013;168(5):4761-8 doi: 10.1016/j.ijcard.2013.07.230[published Online First: Epub Date]].
- 4 39. Espeland MA, Glick HA, Bertoni A, et al. Impact of an intensive lifestyle intervention on use and cost of medical services among overweight and obese adults with type 2 diabetes: the action for health in diabetes. *Diabetes care* 2014;37(9):2548-56 doi: 10.2337/dc14-0093[published Online First: Epub Date]].
- 5 40. Zeng Q, Dong SY, Sun XN, et al. Percent body fat is a better predictor of cardiovascular risk factors than body mass index. *Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas* 2012;45(7):591-600
- 6 41. Ramirez-Velez R, Correa-Bautista JE, Gonzalez-Ruiz K, et al. The Role of Body Adiposity Index in Determining Body Fat Percentage in Colombian Adults with Overweight or Obesity. *International journal of environmental research and public health* 2017;14(10) doi: 10.3390/ijerph14101093[published Online First: Epub Date]].

26 **Table 1 Prevalence of overweight and obesity according to demographic characteristics**

Characteristic	N	Overweight			Obesity		
		n (%)	χ^2	P	n (%)	χ^2	P
Sex							
Male	6819	2735(40.1)	71.1	<0.001*	1856 (27.2)	3.7	0.05
Female	7799	2603(33.4)			2013(25.8)		
Age (years)							
35-44	5425	1866(34.4)	20.3	<0.001*	1146(21.1)	149.8	<0.001*
45-54	3759	1441(38.3)			1153(30.7)		
55-64	2932	1067(36.4)			919(31.3)		
≥65	2502	964(38.5)			651(26.0)		

Area							
Urban	7974	3163(39.7)	75.1	<0.001*	1956(24.5)	33.9	<0.001*
Rural	6644	2175(32.7)			1913(28.8)		
Ethnicity							
Han	5757	2380(16.3)	99.1	<0.001*	1082(7.4)	331.9	<0.001*
Uyghur	4767	1635(11.2)			1361(9.3)		
Kazak	4094	1323(9.1)			1426(9.8)		
Occupation							
Manual labour	4583	1760(12.0)	12.1	0.002*	1095(7.5)	32.1	<0.001*
White collar	7751	2736(18.7)			2086(14.3)		
Other	2284	842(5.8)			688(4.7)		
Education							
Primary school and below	5805	1993(13.6)	26.9	<0.001*	1589(10.87)	21.2	<0.001*
Junior middle school	3094	1196(8.2)			844(5.8)		
Senior middle school	4556	1676(11.5)			1191(8.2)		
Undergraduate and above	1163	473(3.2)			245(1.7)		
Marriage							
Unmarried	192	59(0.4)	14.1	<0.001*	27(0.2)	23.1	<0.001*
Married	12988	4795(32.8)			3427(23.4)		
Divorced	201	53(0.4)			47(0.2)		
Widowed	1237	431(3.0)			368(2.5)		
Drinking							
Yes	4169	923(6.3)	44.5	<0.001*	663(4.5)	24.6	<0.001*
No	10449	4415(30.2)			3206(21.9)		
Smoking							
Yes	2151	1688(11.6)	39.7	<0.001*	1101(7.5)	0.01	0.92
No	12467	3650(25.0)			2768(18.9)		

Hypertension							
Yes	5701	2138(14.6)	3.9	0.05	2155(14.7)	616.8	<0.001*
No	8917	3200(21.9)			1714(11.7)		
Diabetes							
Yes	859	335(2.3)	2.4	0.1	317(2.2)	51.0	<0.001*
No	13759	5003(34.2)			3552(24.3)		
Dyslipidaemia							
Hypertriglyceridemia							
Yes	4113	1724(11.8)	72.0	<0.001*	1497(10.2)	289.9	<0.001*
No	10505	3614(24.7)			2372(16.2)		
Hypercholesterolemia							
Yes	3787	1469(10.1)	11.4	0.001*	1267(8.7)	128.3	<0.001*
No	10831	3869(26.5)			2602(17.8)		
High LDL-C							
Yes	5251	1921(13.1)	0.02	0.9	1334(9.1)	4.8	0.03*
No	9367	3417(23.4)			2535(17.3)		
Low HDL-C							
Yes	4437	1704(11.7)	9.8	0.002*	1215(8.3)	2.8	0.09
No	10831	3634(24.9)			2654(18.2)		

1 Categorical variables are presented as counts and percentages. HDL-c, high density lipoprotein-cholesterol; LDL-
2 c, low density lipoprotein-cholesterol.

3 Data were compared by χ^2 tests. * $P < 0.05$, Statistically significant.

4
5 **Table 2 Prevalence of overweight and obesity in men and women according to age group**

Age (years)	Overweight		<i>P</i>	Obesity		<i>P</i>
	Male(%)	female(%)		male(%)	female(%)	
35-44	994(40.2)	872(29.5)	<0.001	631(25.5)	515(17.4)	<0.001
45-54	735(43.1)	706(34.4)		517(30.3)	636(31.0)	
55-64	476(35.8)	591(36.8)		389(29.3)	531(33.0)	
≥65	530(40.3)	434(36.5)		319(24.3)	332(27.9)	

1 Date were compared by χ^2 tests. * P <0.05, Statistically significant.

2
3 **Table 3 Prevalence of overweight and obesity in Han, Uyghur and Kazak according to age**

4 **group**

Age (years)	Overweight			P	Obesity			P
	Han(%)	Uyghur(%)	Kazak(%)		Han(%)	Uyghur(%)	Kazak(%)	
35-44	712(35.0)	573(34.6)	581(33.6)	<0.001	273(13.4)	422(25.5)	451(26.1)	<0.001
45-54	599(43.9)	481(38.1)	361(31.9)		246(18.0)	436(34.5)	471(41.6)	
55-64	497(45.9)	354(32.6)	216(28.3)		268(24.7)	318(29.3)	333(43.6)	
≥65	572(45.0)	227(29.9)	165(35.1)		295(23.2)	185(24.3)	171(36.4)	

5 Date were compared by χ^2 tests. * P <0.05, Statistically significant.

6
7 **Table 4 Multivariable regression analysis of correlates of overweight and obesity in residents**
8 **of Xinjiang Province**

Characteristic	B	S.E.	Wald	df	P	OR	95%CI
Area	-0.1	0.04	10.4	1	0.001*	0.9	0.8-0.9
Sex	-0.3	0.05	32.5	1	<0.001*	0.8	0.7-0.8
Ethnicity			94.4	2	<0.001*		
Han	-	-	-	-	-	1	-
Uygur	0.4	0.05	50.0	1	<0.001*	1.4	1.3-1.6
Kazakh	0.50	0.05	86.2	1	<0.001*	1.7	1.5-1.8
Age (years)			71.2	3	<0.001*		
35-44	-	-	-	-	-	1	-
45-54	0.4	0.05	62.8	1	<0.001*	1.5	1.3-1.6
55-64	0.3	0.05	24.6	1	<0.001*	1.3	1.2-1.5
≥65	0.1	0.06	3.1	1	0.08	1.11	1.0-1.3
Education			17.9	3	<0.001*		
Primary school and below	-	-	-	-	-	1	-
Junior middle school	0.2	0.05	15.6	1	<0.001*	1.2	1.1-1.4
Senior middle school	0.2	0.06	7.0	1	0.008*	1.2	1.0-1.3

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Undergraduate and above	0.2	0.08	6.8	1	0.009*	1.3	1.1-1.5
Occupation			10.4	2	0.006*		
Manual labour	-	-	-	-	-	1	-
White collar	0.01	0.05	0.04	1	0.8	1.0	0.9-1.1
Other	0.2	0.06	7.9	1	0.005*	1.2	1.1-1.4
Marriage			26.5	3	<0.001		
Unmarried	-	-	-	-	-	1	-
Married	0.6	0.2	15.5	1	<0.001*	1.8	1.4-2.5
Divorced	0.1	0.2	0.2	1	0.7	1.1	0.7-1.7
Widowed	0.6	0.2	12.4	1	<0.001*	1.8	1.3-2.5
Smoking	-0.2	0.05	9.0	1	0.003*	0.9	0.8-0.9
Drinking	0.4	0.06	34.8	1	<0.001*	1.5	1.3-1.6
Hypertension	0.8	0.04	340.4	1	<0.001*	2.1	2.0-2.3
Diabetes	0.3	0.09	10.4	1	0.001*	1.3	1.1-1.6
Dyslipidaemia							
Hypertriglyceridemia	0.9	0.05	371.4	1	<0.001*	2.4	2.2-2.7
Hypercholesterolemia	0.2	0.05	20.9	1	<0.001*	1.2	1.1-1.3
Low HDL-C	0.1	0.04	6.4	1	0.01*	1.1	1.0-1.2
High LDL-C	0.02	0.04	0.16	1	0.69	1.0	0.9-1.1
Constant	-1.0	0.2	35.3	1	<0.001	-	-

1 * $P < 0.05$, Statistically significant.

Supplementary Table 1 Prevalence of underweight

Characteristic	N	Underweight	
		n (%)	P
Sex			
Male	6819	71(1.04)	<0.001
Female	7799	219(2.81)	

* $P < 0.05$, Statistically significant.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (On page 1, line 1) (b) Provide in the abstract an informative and balanced summary of what was done and what was found (On page 2)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (On page 2, line 2-5)
Objectives	3	State specific objectives, including any prespecified hypotheses (On page 2, line 2-5)
Methods		
Study design	4	Present key elements of study design early in the paper (On page 4, line 9)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (On page 2, line 7)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (On page 4, line 9-20) (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (On page 5,6)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (On page 4,5)
Bias	9	Describe any efforts to address potential sources of bias (On page 11, line 1-3)
Study size	10	Explain how the study size was arrived at (On page 4, line 15-16)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (On page 4,5)
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (On page 6) (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (On page 6) (e) Describe any sensitivity analyses

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (On page 4, line 15-16) (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (On page 14, Table1) (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures (On page 6-7)
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (On page 6,7) (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (On page 6,7)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (On page 6,7)
Discussion		
Key results	18	Summarise key results with reference to study objectives (On page 8)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (On page 10,11)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (On page 11)
Generalisability	21	Discuss the generalisability (external validity) of the study results (On page 11)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (On page 11)

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.