# Fasting Plasma Glucose and 2-hour Postprandial Plasma Glucose Characteristics in a Large Multi-ethnic Chinese Population

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**Short title:** PPG less than FPG in China

**Highlights**

A quarter (26.04%) of participants in a Chinese population had plasma glucose levels following a 75g glucose load that were equal to or less than their fasting plasma glucose value.

Low Post Load was associated with a beneficial cardiometabolic profile with a lower BMI, lower blood pressure, and favourable lipid profile.

IFG occurred more frequently in participants without hypoglycaemia (12.54% vs 1.25%, p=0.004).

The relationship between this phenomenon and high post load glucose and the progression to prediabetes, diabetes and 'hard' cardiovascular outcomes in a Chinese population requires further longitudinal investigation.

**Abstract**

Introduction

During an oral glucose tolerance test (OGTT), typically fasting plasma glucose is lower than 2-hour postprandial plasma glucose (2-h). However, postprandial plasma glucose (PPG) levels lower than fasting plasma glucose (FPG) levels may also occur. This study aims to describe the prevalence, clinical characteristics, and contributing risk factors for PPG≤FPG in a large diverse Chinese population.

Materials and Methods

We conducted a cross-sectional analysis of baseline data from a nationwide cohort study conducted in China. In addition to sociodemographic and anthropometric data collection, individuals had OGTT, and blood chemistry tests. We determined the prevalence of PPG≤FPG ('Low Post Load' group) and PPG>FPG ('High Post Load' group) and used logistic regression to evaluate the association of risk factors with the occurrence of Low Post Load .

Results

The prevalence of Low Post Load was 26.04% (n=3,773) and High Post Load was 73.96% (n=10,714). Low Post Load was found to be related to younger age, male, lower BMI, lower blood pressure, higher HDL cholesterol levels and lower triglycerides levels. Compared with participants in the High Post Load group, participants in Low Post Load group had lower PPG (4.59±0.83mmol/L vs 7.15±1.41mmol/L) and HbA1c (5.30±0.43% vs 5.39±0.45%). People in Low Post Load group were more likely to have hypoglycaemic episodes(2.12% vs 0.01%) and impaired fasting glucose (12.30% vs 4.81%) compared with people with High Post Load, All P<0.001.

Conclusions

We found a high prevalence of people with Low Post Load glucose (26.04%) in a Chinese population cohort. The relationship between Low Post Load and the progression to or protection from

diabetes and related complications, and future incidence of cardiovascular disease needs further exploration in longitudinal analyses.

**Keywords**: Fasting Plasma Glucose, Diabetes, OGTT, Glucose Tolerance, Cross-sectional Study

**Introduction**

The oral glucose tolerance test (OGTT) is a test commonly used to diagnose diabetes or prediabetes, in which plasma glucose is tested after an overnight fast and again 2 hours following ingestion of a 75-gram glucose solution. The 2-hour post glucose load plasma glucose measure [hereafter referred to as postprandial plasma glucose (PPG)] is usually found to be higher than the fasting plasma glucose levels(FPG). A PPG result higher than 7.8 mmol/l and less than 11.1 mmol/L indicates impaired glucose tolerance (IGT), which is a well-established risk factor for type 2 diabetes(1). The relationship between the PPG and FPG is thought to be related to the risk of developing type 2 diabetes as subjects whose PPG levels return to fasting levels more quickly have demonstrated a lower risk for the development of type 2 diabetes(2).

PPG levels that are lower than or equal to FPG levels 2 hours after a glucose load has been described in people with and without diabetes(3). Several factors have been associated with this phenomenon including abnormal liver function, pancreatic dysfunction, late dumping syndrome and patients who have had gastrectomy or bariatric surgery(4-10). In some cases, PPG levels can fall low enough to cause hypoglycaemia, referred to as reactive hypoglycaemia. Plasma glucose levels are maintained within a narrow normal range by the coordinated physiological responses of multiple organs(11). The liver maintains plasma glucose level in the fasted state via activation of metabolic pathways like gluconeogenesis and glycogenolysis, and the pancreas releases insulin to promote uptake of glucose into the tissues (12-16). PPG lower than FPG has been observed in some patients with liver disease(17, 18) and pancreatic dysfunction such as high insulin sensitivity, over-reaction of glucagon-like peptide 1, and deficiencies of counter-regulatory hormones which can lead to PPG being lower than FPG (19-22). In addition to antidiabetic medications, vigorous activity before sampling and insufficient food intake, late dumping syndrome, related to a rapid rate of gastric emptying, results in the exposure of the distal gut to more carbohydrates and leads to postprandial hyperglycaemia, which stimulates the pancreas resulting in hyperinsulinaemia, leading to late hypoglycaemia or reactive hypoglycaemia(23, 24). Reactive hypoglycaemia has been associated with a number of linked insulin resistance-related conditions such type 2 diabetes, non-alcoholic fatty liver disease, polycystic ovarian syndrome and

hypertriglyceridaemia(17, 25). In fact, postprandial hyperinsulinemia which is a key physiological mechanism in Low Post Load, and is reported to be independently associated with coronary artery disease(26).

Although the relationship between PPG and FPG and the risks of developing diabetes have been described in research settings, no studies have reported the population prevalence of PPG≤FPG. In this study, we used an FPG value and a PPG value measured 2-hours after a 75 grams OGTT to define 'Low Post Load'(PPG≤FPG) and 'High Post Load'(PPG>FPG) groups. We aimed to evaluate the population prevalence of 'Low Post Load' and the clinical characteristics of people with 'Low Post Load'.

**Materials and methods**

Study population

All subjects were participants of the Study on Evaluation of Innovative Screening tools and determination of optimal diagnostic cut-off points for type 2 diabetes in Chinese multi-ethnic population (SENSIBLE) and SENSIBLE-Addition studies[The National Key R&D Program of China (2016YFC1305700)](27, 28). It was conducted in 8 provinces from different regions of China across several ethnic groups(27, 28). A multi-stage cluster and simple randomization method was used to invite subjects aged 20 to 70 years who had been living in their residence for 5 years to participate. Participants enrolled in the baseline study between November 2016 to June 2017. After providing written informed consent participants completed a questionnaire, anthropometric examination and laboratory evaluation. Individuals who refused to sign the informed consent, were pregnant, had a significant psychiatric illness e.g. mild depression was not an exclusion or any other diseases that cannot complete the investigation procedures were excluded from the study. In this paper, we use the baseline data of the cohort to conduct a cross-sectional analysis.

A total of 17,629 participants were recruited into this study. We excluded participants with missing data on sociodemographic information (e.g. age, gender, ethnicities, family history of diabetes) and plasma glucose value (fasting plasma glucose and/or 2-hour plasma glucose), the outliers (>99.9 percentile or<0.1 percentile, including anthropometric examination characteristics (BMI<15.605 kg/$m^2$

or BMI>48.423 kg/$m^2$, waist<55cm or waist>126cm), and participants with self-reported diabetes or who had been diagnosed with diabetes by the baseline OGTT.

Data collection

Eligible participants were invited to attend a study day and advised to maintain their usual lifestyle/physical activity for at least 3 days prior and maintain an overnight fast of at least 10 hours. On the study day the following assessments were conducted: 1. heart rate and blood pressure were measured using electronic sphygmomanometers (YE680E, Jiangsu Yuyue Medical Equipment Inc., Nanjing, Jiangsu, China); 2. fasting plasma glucose; 3. blood chemistry tests and biochemistry examination; 4. a standard 75-gram glucose solution for an oral glucose tolerance test (OGTT) was given and plasma glucose measure taken 120 mins later; 5. completion of a face-to-face structured questionnaire and anthropometric examination using standardized procedures(29).

Blood sample collection and analysis

All blood samples were centrifuged on-site within 30 min after collection. For the serum and the whole blood samples, they were shipped at 4 °C by air to the central laboratory in Nanjing Adicon Clinical Laboratories. All the blood specimens were analysed immediately after arrival using an automatic chemistry analyser (Synchron LX-20, Beckman Coulter Inc., CA, USA). HbA1c was measured with high-performance liquid chromatography (HPLC; D-10™ Haemoglobin Analyzer, Bio-Rad Inc., CA, USA).

Questionnaire

The questionnaire was designed to collect demographic characteristics (age, gender, educational level), lifestyle behaviour (smoking status, drinking status, regular physical activity) and health-related characteristics. This standardized questionnaire was administered by trained interviewers to all enrolled participants.

Occupations were categorized into two groups [Professional occupations including researcher, doctor, teacher, administrative leader and office staff), and manual workers (including commerce or service man, farmer, fisherman, soldier and workman) or student]. Lifestyle and behaviour questions, i.e., smoking, alcohol, exercise, and diet information were categorical variables, scored on several points scales or classified as 'yes' or 'no'.

Health-related characteristics were self-reported by participants, and included medical conditions (the start time, control time or end time and severity level) and medication use (the start time and end time).

Definitions of Diabetes and Type 2 Diabetes

Diabetes mellitus, impaired glucose tolerance(IGT), impaired fasting glucose(IFG), and normal glucose tolerance(NGT) were defined using the Chinese Guideline 2020 edition (based on WHO 1999 diagnostic criteria)(30). The fasting plasma glucose (FPG) of normoglycaemia people has been set at 3.9–6.1 mmol/L and the 2h-postprandial plasma glucose at 7.8 mmol/L or less; impaired fasting glucose(IFG) was defined as an FPG of greater than or equal to 6.1 mmol/L and less than 7.0 mmol/L, and PPG at 120 min after oral glucose load less than 7.8 mmol/L; impaired glucose tolerance(IGT) was defined as an FPG of less than 6.1 mmol/L, and PPG at 120 min after oral glucose loading of equal or greater than 7.8 mmol/L and less than 11.1 mmol/L. Diabetes was defined as FPG≥7.0 mmol/L or 2h-postprandial blood≥11.1 mmol/L, the diagnostic criteria for hypoglycaemia were plasma glucose <2.8 mmol/L.

Statistical analyses

Continuous variables were described as means (± SD) or median (interquartile range) and categorical data are presented as number and percentage. Statistical differences in continuous data were determined using Student's t-test and Welch's t-test. Categorical data were compared using the chi-squared test or Fisher's exact test.

A multivariate logistic regression was used to identify factors associated with Low Post Load. All variables with significant differences at univariate logistic regression analysis (P<0.05) were included in multivariate logistic regression analysis, and the odds ratio (OR) and 95%CI were calculated for each factor. We further divided into those with and without hypoglycaemia and used logistic regression model to compare respondent characteristics .

All statistical analyses were performed with SAS version 9.4 (SAS Institute Inc). Results were considered significant when the P-value was less than 0.05 at two-sided test.

**Results**

In total, 17,629 people participated in the original study. A total of 14,487 participants (Figure 1) were included in this analysis after exclusion of 93 subjects without FPG, 1281 subjects without PPG, 4 subjects without HbA1c, 49 subjects without sociodemographic information, 67 subjects without BMI information, 17 outliers in BMI, 2 subjects lacking diet information and 68 subjects who self-reported with diabetes and 1,561 subjects who were found to have diabetes in the OGTT.

Table 1 shows data on clinical, socio-economic, and behavioural characteristics of high and low post load groups. The mean age of participants was 49.34±11.92 years and 9,702 (66.97%) were female. There were 3,773 participants (26.04%) in the Low Post Load group and 10,714 participants (73.96%) in the High Post Load group. Participants in the Low Post Load group were significantly younger, were more likely to be male, non-Han ethnicity, had lower BMI, heart rate less than 100 beats/min, higher HDL, and lower TG levels, and were more likely to drink alcohol and exercise regularly compared with participants in the High Post Load group.

Figure 2 shows Number of plasma values in Low Post Load group and High Post Load group. Compared with participants in High Post Load group, participants in Low Post Load group had lower PPG (4.59±0.83 vs 7.15±1.41) and HbA1c(5.30±0.43 vs 5.39±0.45), with higher hypoglycaemia incidence (all P<0.001). In the Low Post Load group, 87.70% (n=3,309) had normal glucose tolerance compared with 66.18% (n=7,090) in the High Post Load group. There were no participants in the Low Post Load group with IGT and 464(12.30%) participants had IFG. In the High Post Load group 515(4.81%)

participants had IFG, 2,313(21.59%) participants had IGT, and 796(7.43%) participants had both IFG and IGT(P<0.001).

In Table 2, an adjusted logistic regression model indicated that most of the evaluated factors had significant and independent positive or negative associations with Low Post Load. For the phenomenon of Low Post Load, the significant factors were age<44 years; male; people of Uyghur or Zhuang ethnicity; BMI<24kg/$m^2$; normal blood pressure; heart rate<100 beats/min; status as never or former drinker; HDL cholesterol≥1.55 mmol/L; triglycerides<1.70 mmol/L, all P<0.001.

Within the low post load group, a small number of participants (n=80/3,773; 2.12%) had hypoglycaemia, defined as a blood glucose of <2.8 mmol/L in the OGTT.

As shown in Table 3, for participants in the Low Post Load group, the following variables had a significant association with hypoglycaemia: age<44 years old, male, non-Han population, Manual-worker, BMI<24kg/m2 and cigarette smoking. Although participants with hypoglycaemia has lower FPG (5.13±0.53 vs 5.44±0.56, p<0.001) and PPG(2.49±0.30 vs 4.64±0.78, p<0.001), there was no difference in HbA1c compared with participants without hypoglycaemia.

**Discussion**

In this analysis we found a quarter (26.04%) of participants in a Chinese population had plasma glucose levels following a 75g glucose load that were equal to or less than their fasting plasma glucose values. Although this phenomenon that we have called Low post Load has been described in individuals with specific clinical conditions, it can occur without any precipitating factors and until now there is a lack of published data that provide estimates of the prevalence of this phenomenon in the general population. This large cohort study now establishes the prevalence in a multi-ethnic Chinese population.

In our study, people with Low Post Load were more likely to be younger, have lower BMI, and to have a number of characteristics such as lower triglycerides, LDL, blood pressure and higher HDL suggesting that Low Post Load has a beneficial cardiometabolic profile. People with high post load were more likely to have prediabetes. The Low post load group had a higher proportion of people with normal glucose tolerance than the high post load group (87.7% vs 66.2%), 464 (11.93%) participants had IFG and no

participants had IGT, while in the High Post Load group, there was a lower proportion with IFG (4.21%), higher proportions with IGT (18.92%) and both IFG and IGT(6.51%). Prediabetes is an intermediate hyperglycaemic state between normal glucose tolerance and overt diabetes. Over a lifetime follow-up, about 70% of people with prediabetes develop type 2 diabetes, with the risk of developing diabetes 2-fold higher in those with IFG and IGT than those with isolated IFG or isolated IGT(31-33). IGT is associated with more severe insulin resistance and beta-cell dysfunction(34-36). The San Antonio Heart Study demonstrated that participants with normal glucose tolerance and High Post Load had 2.33-fold odds of developing type 2 diabetes when compared with normal glucose tolerance participants with Low Post Load, during 7 to 8 years of follow-up(2). In 20 years of follow up in the CARDIA (Coronary Artery Risk Development in Young Adults) study normal glucose tolerance participants with Low Post Load had a lower risk of developing type 2 diabetes(37).

We defined 'Low Post Load" as 2-hour post-load plasma glucose lower than fasting plasma glucose. Using this definition, there are two sub-categories of people: 1) those with adequate insulin reserve who are able to quickly normalise their plasma glucose after an oral load, and 2) those with over-correction of their plasma glucose with post-load plasma glucose in the hypoglycaemic range, ie. reactive hypoglycaemia. We found that IFG occurred less frequently in participants with hypoglycaemia (1.25% vs 12.54%, p=0.004). This might due to the higher insulin secretion or insulin response and a different metabolic trajectory in participants with hypoglycaemia. We will follow these participants in subsequent cohort studies to find if they are more prone to diabetes progression.

Smoking, caffeine intake, insufficient food intake, antidiabetic medications and heavy exercise have been demonstrated as pre-analytical factors that affect plasma glucose levels(39, 40). We excluded participants with diabetes (self-reported or diagnosed by OGTT). Use of glucose lowering agents could affect glucose levels during OGTT. Also, people with diabetes have insulin resistance and relative insulin insufficiency resulting in raised fasting and post-load glucose by definition. We found that current drinking and vigorous exercise were related to hypoglycaemia after adjustment for age, gender and BMI in our study.

The study has several limitations. About 70% of the study participants were women. This study was

conducted in areas where there is a lot of mobility of young men who travel to urban areas for work, leaving predominantly women to be sampled in the study areas. In this study, there were 294(2.03%) participants with liver disease, 3(0.02%) participants with pancreatic disease and 114(0.79%) participants with upper digestive tract disease. These conditions have been associated with the occurrence of Low post Load, however as the prevalence was limited and derived from self-reporting by subjects in questionnaires, they may be underestimated, and we were not able to fully examine the contribution of these conditions to the occurrence of Low Post Load. Fasting or postprandial insulin was not measured in this study, and we could not investigate the association between insulin secretion, insulin resistance and low or high post load. Additionally, there were missing data on waist-hip ratio, and we were unable to examine the relationship between central obesity and this phenomenon.

In conclusion, we found a significant prevalence of people with Low Post Load glucose (26.04%) in population-based baseline data of a cohort in China. Low Post Load was associated with a beneficial cardiometabolic profile with a lower BMI, lower blood pressure, and favourable lipid profile. The relationship between this phenomenon and high post load glucose and the progression to prediabetes, diabetes and 'hard' cardiovascular outcomes in a Chinese population requires further longitudinal investigation.

**Acknowledgements**

This research was funded by the Key Research and Development Program in Jiangsu Province (grant number BE2022828) and the National Key R&D Program of China (grant number 2016YFC1305700). X. XU. is supported by China Scholarship Council (CSC).

**Disclosure**

The authors declare no conflict of interest.

**Approval of the research protocol**

The study was conducted in accordance with the Declaration of Helsinki, and this study protocol was

reviewed and approved by the Human Research Ethics Committee of Zhongda Hospital, Southeast University, approval number: 2016ZDSYLL092-P01. The name of the institutions indicated in the Ethical approval listed in the supplement.

**Informed Consent**

Written informed consent has been obtained from the patients to publish this paper.

**Approval date of Registry and the Registration No. of the study/trial:**

N/A

**Animal Studies**

N/A

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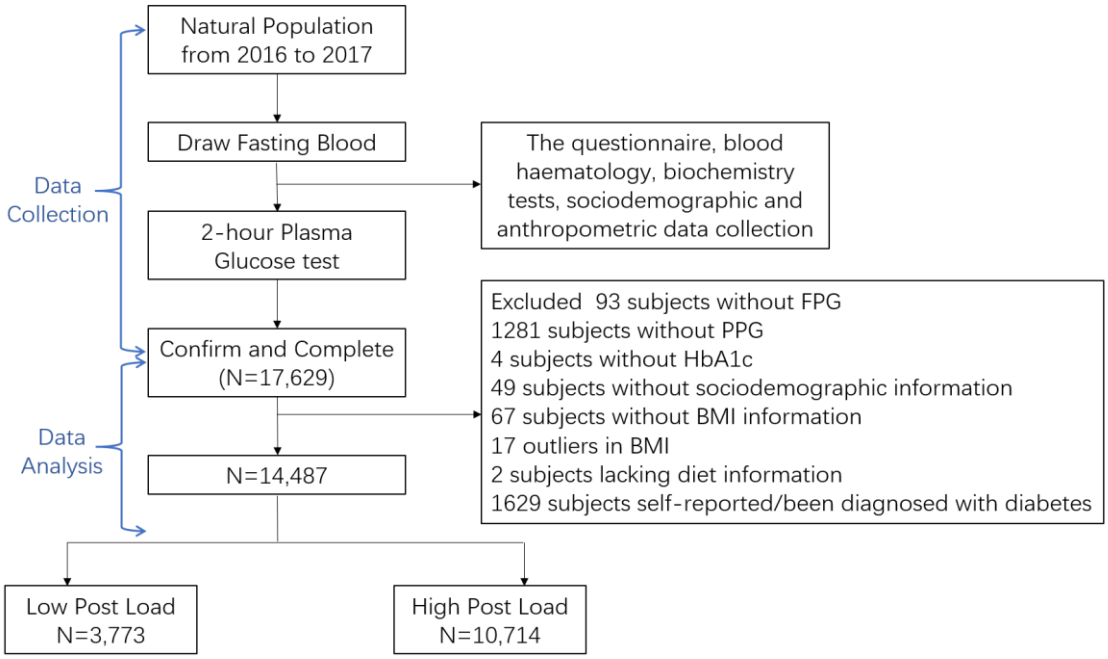


**Figure 1. Flow chart of this research**

**Table 1. Baseline information of participants by Low/High Post Load**

| | All N=14,487 | Low Post Load N=3,773(26.04%) | High Post Load N=10,714(73.96%) | P-value |
|---|---|---|---|---|
| | Mean ± SD / N(%) | Mean ± SD / N(%) | Mean ± SD / N(%) | |
| **Age(years)** | 49.34(11.92) | 46.60(12.69) | 50.31(11.48) | <0.001 |
| **Gender(Female)** | 9,702(66.97%) | 2,136(56.61%) | 7,566(70.62%) | <0.001 |
| **Ethnicity(Han)** | 7,056(48.71%) | 1,590(42.14%) | 5,466(51.02%) | <0.001 |
| **Education Levels(illiteracy)** | 1,415(9.77%) | 274(7.26%) | 1,141(10.65%) | <0.001 |
| **Occupation Type** | | | | <0.001 |
| Professional | 2,364(16.32%) | 711(18.84%) | 1,653(15.43%) | |
| Manual-worker | 12,011(82.91%) | 3,004(79.62%) | 9,007(84.07%) | |
| Student | 112(0.77%) | 58(1.54%) | 54(0.50%) | |
| **Body mass index(kg/m$^2$)** | 24.87(3.79) | 24.17(3.65) | 25.12(3.80) | <0.001 |
| **SBP (mmHg)** | 130.8(20.45) | 128.0(19.87) | 131.7(20.57) | <0.001 |
| **DBP (mmHg)** | 80.86(12.14) | 79.47(12.05) | 81.34(12.14) | <0.001 |
| **Heart rate (beats/min)** | 78.55(11.38) | 77.27(11.18) | 79.00(11.42) | <0.001 |
| **Total cholesterol(mmol/L)** | 5.03(1.09) | 4.92(1.11) | 5.06(1.08) | <0.001 |
| **HDL cholesterol(mmol/L)** | 1.57(0.39) | 1.61(0.41) | 1.55(1.54) | <0.001 |
| **LDL cholesterol(mmol/L)** | 2.84(0.81) | 2.77(0.82) | 2.87(0.80) | <0.001 |
| **Triglycerides(mmol/L)** | 1.55(1.53) | 1.35(1.47) | 1.62(1.54) | <0.001 |
| **Smoking** | | | | <0.001 |

| | | | | |
|---|---|---|---|---|
| Never | 11,764(81.20%) | 2,873(76.15%) | 8,891(82.98%) | |
| Former | 453(3.13%) | 135(3.58%) | 318(2.97%) | |
| Current | 2,270(15.67%) | 765(20.28%) | 1,505(14.05%) | |
| **Alcohol** | | | | <0.001 |
| Never | 10,991(75.87%) | 2,721(72.12%) | 8,270(77.19%) | |
| Former | 534(3.69%) | 168(4.45%) | 366(3.42%) | |
| Current | 2,962(20.45%) | 884(23.43%) | 2,078(19.40%) | |
| **Vigorous Exercise** | 5,259(36.30%) | 1,420(37.64%) | 3,839(35.83%) | 0.047 |
| **Regular meals** | 10,992(75.87%) | 2,784(73.79%) | 8,208(76.61%) | <0.001 |
| **Family History of diabetes** | 2,021(13.95%) | 496(13.15%) | 1,525(14.23%) | 0.097 |
| **Hypoglycaemic drugs use** | 16(0.11%) | 4(0.11%) | 12(0.11%) | 1.000 |
| **Self-report liver disease** | 294(2.03%) | 65(1.72%) | 229(2.14%) | 0.120 |
| **Self-report pancreatic disease** | 3(0.02%) | 1(0.03%) | 2(0.02%) | 1.000 |
| **Self-report upper digestive track disease** | 114(0.79%) | 32(0.85%) | 82(0.77%) | 0.621 |
| **FPG(mmol/L)** | 5.43(0.57) | 5.44(0.56) | 5.43(0.58) | 0.317 |
| **PPG(mmol/L)** | 6.49(1.71) | 4.59(0.83) | 7.15(1.41) | <0.001 |
| **Hypoglycaemia** | 81(0.56%) | 80(2.12%) | 1(0.01%) | <0.001 |
| **Difference(2hPPG-FPG)** | 1.06(1.59) | -0.85(0.70) | 1.73(1.24) | <0.001 |
| **HbA1c(%)** | 5.37(0.45) | 5.30(0.43) | 5.39(0.45) | <0.001 |
| **Status (WHO1999)** | | | | <0.001 |
| NGT | 10,399(71.78%) | 3,309(87.70%) | 7,090(66.18%) | |
| IFG | 979(6.76%) | 464(12.30%) | 515(4.81%) | |
| IGT | 2,313(15.97%) | 0(0.00%) | 2,313(21.59%) | |
| IFG+IGT | 796(5.49%) | 0(0.00%) | 796(7.43%) | |

Data are presented as n, n(%), mean±SD or median(IQR).

Occupation type: Professional occupation: researcher, doctor, teacher, administrative leader and office staff; manual worker: commerce or serviceman, farmer, fisherman, soldier and workman; student: current student.

BMI: body mass index.

SBP: systolic blood pressure.

HDL: high-density lipoprotein.

LDL: low-density lipoprotein.

FPG: fasting plasma glucose.

PPG: postprandial plasma glucose.

HbA1c: haemoglobin A1C.

Significance of differences at p-value < 0.05.

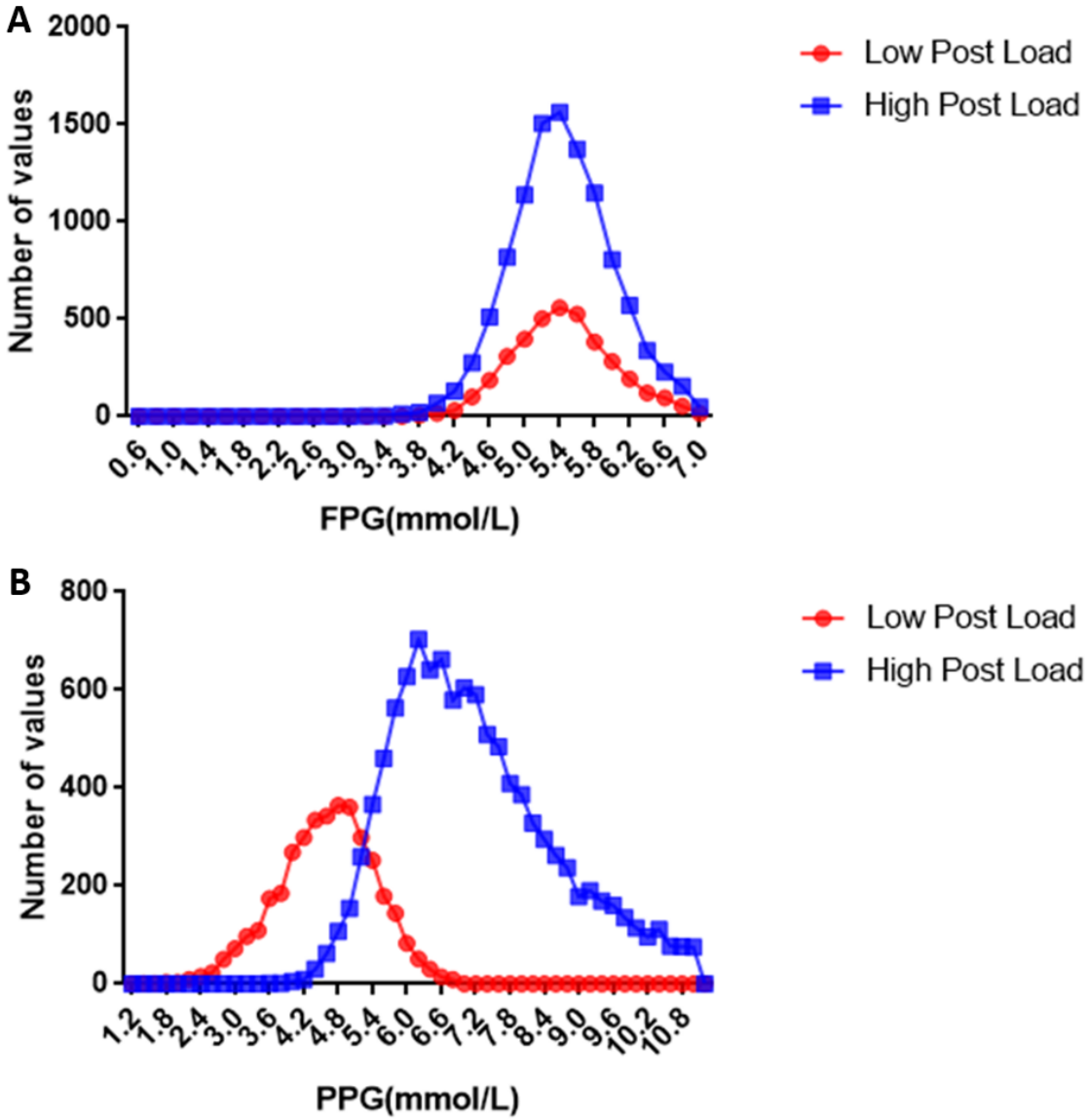


**Figure 2. Distribution of blood glucose values in Low Post Load group and High Post Load group**

**Table 2. Effects of respondent characteristics on Low Post Load in a sample of 14,487 Chinese population**

| Characteristics | OR (95%CI) | P-value |
|---|---|---|
| **Age** | | |
| Young age (<44 years) | 1.000 | |
| Middle age (44-59 years) | 0.629(0.567,0.697) | <0.001 |
| Older adults (60-74 years) | 0.478(0.420,0.545) | <0.001 |
| Elderly (≥75 years) | 0.225(0.073,0.697) | 0.010 |
| **Gender** | | |
| Female | 1.000 | |

| | | |
|---|---|---|
| Male | 2.007(1.819,2.215) | <0.001 |
| **Ethnicity** | | |
| Han | 1.000 | |
| Dai | 0.842(0.721,0.982) | 0.029 |
| Kazakh | 1.136(0.921,1.401) | 0.234 |
| Korean | 1.057(0.889,1.257) | 0.528 |
| Uyghur | 1.900(1.639,2.203) | <0.001 |
| Zhuang | 1.655(1.436,1.906) | <0.001 |
| Other | 1.822(0.816,4.070) | 0.144 |
| **Education levels** | | |
| Illiteracy | 1.000 | |
| Primary school | 1.000(0.840,1.189) | 0.996 |
| Middle School | 1.025(0.865,1.215) | 0.774 |
| High school | 1.088(0.904,1.311) | 0.372 |
| Junior college, Undergraduate and above | 1.228(1.018,1.482) | 0.032 |
| **Occupation** | | |
| Professional occupation | 1.000 | |
| Manual-worker | 0.825(0.727,0.935) | 0.003 |
| Student | 1.494(0.915,2.442) | 0.108 |
| **BMI** | | |
| Underweight (<18.5kg/$m^2$) | 1.000 | |
| Normal range (18.5-23.9kg/m2) | 0.826(0.620,1.102) | 0.194 |
| Overweight (24-27.9kg/m2) | 0.537(0.401,0.718) | <0.001 |
| Obese(≥28kg/m2) | 0.425(0.314,0.576) | <0.001 |
| **Blood Pressure** | | |
| Normal | 1.000 | |
| High Normal | 0.865(0.773,0.967) | 0.011 |
| Grade 1 Hypertension | 0.898(0.789,1.022) | 0.102 |
| Grade 2 Hypertension | 0.738(0.623,0.872) | <0.001 |
| Grade 3 Hypertension | 0.781(0.607,1.005) | 0.054 |
| Isolated systolic hypertension | 0.940(0.825,1.072) | 0.356 |
| No Data | 0.768(0.272,2.164) | 0.617 |
| **Heart rate(beats/min)** | | |
| <60 | 1.000 | |
| 60-100 | 0.811(0.630,1.043) | 0.102 |
| >100 | 0.518(0.363,0.738) | <0.001 |
| No Data | 1.177(0.558,2.484) | 0.668 |
| **Total cholesterol(mmol/L)** | | |
| <5.17 | 1.000 | |
| 5.17-6.46 | 0.981(0.892,1.078) | 0.689 |
| ≥6.47 | 0.982(0.841,1.146) | 0.815 |
| **HDL cholesterol(mmol/L)** | | |
| <0.91 | 1.000 | |
| 0.91-1.54 | 1.276(0.945,1.722) | 0.112 |
| ≥1.55 | 1.694(1.251,2.292) | <0.001 |
| **LDL cholesterol(mmol/L)** | | |
| <3.37 | 1.000 | |

| | | |
|---|---|---|
| 3.37-4.13 | 0.930(0.833,1.038) | 0.196 |
| ≥4.14 | 1.018(0.863,1.202) | 0.828 |
| **Triglycerides(mmol/L)** | | |
| <1.70 | 1.000 | |
| 1.70-2.25 | 0.667(0.584,0.762) | <0.001 |
| ≥2.26 | 0.552(0.483,0.630) | <0.001 |
| **Smoking** | | |
| Never | 1.000 | |
| Former | 0.938(0.737,1.195) | 0.605 |
| Current | 0.949(0.830,1.085) | 0.444 |
| **Alcohol** | | |
| Never | 1.000 | |
| Former | 1.031(0.801,1.327) | 0.813 |
| Current | 0.839(0.733,0.959) | 0.010 |
| **Vigorous Exercise‡** | 0.894(0.823,0.972) | 0.009 |
| **Regular meals ‡** | 1.070(0.971,1.179) | 0.171 |
| **Family history of diabetes ‡** | 1.117(0.982,1.271) | 0.092 |

Occupation type: Professional occupation: researcher, doctor, teacher, administrative leader and office staff; manual worker: commerce or serviceman, farmer, fisherman, soldier and workman; student: current student.

BMI: body mass index.

Blood Pressure (mmHg): SBP: systolic blood pressure; DBP: diastolic blood pressure; Normal: SBP<130, DBP<85; High Normal: 130≤SBP<140, 85≤DBP<90; Grade 1 Hypertension: 140≤SBP<160, 90≤DBP<100; Grade 2 Hypertension: 160≤SBP<180, 100≤DBP<110; Grade 3 Hypertension: SBP≥180, DBP≥110; Isolated systolic hypertension: SBP≥140, DBP<90(41).

HDL: high-density lipoprotein.

LDL: low-density lipoprotein.

‡p-value for comparison between No Data or No VS Yes.

Adjusted by continuous age variable, gender and BMI, the significance of differences at p-value < 0.05.

**Table 3. Participants with/without hypoglycaemia in Low Post Load group**

| | With hypoglycaemia N=80(2.12%) | Without hypoglycaemia N=3,693(97.88%) | P-value |
|---|---|---|---|
| | Mean ± SD / N(%) | Mean ± SD / N(%) | |
| **Age(years)** | 42.68(14.42) | 46.68(12.64) | 0.016 |
| **Gender(Female)** | 27(33.75%) | 2,109(57.11%) | <0.001 |
| **Ethnicity(Han)** | 11(13.75%) | 1,579(42.76%) | <0.001 |

| | | | |
|---|---|---|---|
| **Education Levels(illiteracy)** | 3(3.75%) | 271(7.34%) | 0.315 |
| **Occupation Type** | | | <0.001 |
| Professional | 3(3.75%) | 708(19.17%) | |
| Manual-worker | 73(91.25%) | 2,931(79.37%) | |
| Student | 4(5.00%) | 54(1.46%) | |
| **Body mass index(kg/m$^2$)** | 23.47(3.04) | 24.18(3.66) | 0.041 |
| **SBP (mmHg)** | 125.8(17.75) | 128.1(19.91) | 0.304 |
| **DBP (mmHg)** | 76.49(11.56) | 79.54(12.05) | 0.025 |
| **Heart rate (beats/min)** | 76.43(12.15) | 77.29(11.15) | 0.492 |
| **Total cholesterol(mmol/L)** | 5.00(1.17) | 4.92(1.11) | 0.515 |
| **HDL cholesterol(mmol/L)** | 1.69(0.48) | 1.61(0.40) | 0.148 |
| **LDL cholesterol(mmol/L)** | 2.83(0.85) | 2.76(0.82) | 0.510 |
| **Triglycerides(mmol/L)** | 1.15(0.90) | 1.35(1.48) | 0.053 |
| **Smoking** | | | 0.009 |
| Never | 50(62.50%) | 2,823(76.44%) | |
| Former | 3(3.75%) | 132(3.57%) | |
| Current | 27(33.75%) | 738(19.98%) | |
| **Alcohol** | | | 0.200 |
| Never | 53(66.25%) | 2,668(72.24%) | |
| Former | 2(2.50%) | 166(4.49%) | |
| Current | 25(31.25%) | 859(23.26%) | |
| **Vigorous Exercise** | 34(42.50%) | 1,386(37.53%) | 0.364 |
| **Regular meals** | 60(75.00%) | 2,724(73.76%) | 0.803 |
| **Family History of diabetes** | 10(12.50%) | 486(13.16%) | 0.863 |
| **Hypoglycaemic drugs use** | 0(0.00%) | 4(0.11%) | 1.000 |
| **Self-report liver disease** | 1(1.25%) | 64(1.73%) | 1.000 |
| **Self-report pancreatic disease** | 0(0.00%) | 1(0.03%) | 1.000 |
| **Self-report upper digestive track disease** | 0(0.00%) | 32(0.87%) | 1.000 |
| **FPG(mmol/L)** | 5.13(0.53) | 5.44(0.56) | <0.001 |
| **PPG(mmol/L)** | 2.49(0.30) | 4.64(0.78) | <0.001 |
| **Difference(2hPPG-FPG)** | -2.64(0.70) | -0.81(0.65) | <0.001 |
| **HbA1c(%)** | 5.22(0.54) | 5.31(0.42) | 0.171 |
| **Status (WHO1999)** | | | 0.004 |
| NGT | 79(98.75%) | 3,230(87.46%) | |
| IFG | 1(1.25%) | 463(12.54%) | |
| IGT | 0(0.00%) | 0(0.00%) | |
| IFG+IGT | 0(0.00%) | 0(0.00%) | |

Data are presented as n, n(%), mean±SD or median(IQR).

Occupation type: Professional occupation: researcher, doctor, teacher, administrative leader and office staff; manual worker: commerce or serviceman, farmer, fisherman, soldier and workman; student: current student.

BMI: body mass index.

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438 HDL: high-density lipoprotein.

439 LDL: low-density lipoprotein.

440 FPG: fasting plasma glucose.

441 PPG: postprandial plasma glucose.

442 HbA1c: haemoglobin A1C.

443 Significance of differences at p-value < 0.05.