

# Obesity is a Risk Factor for Prediabetes

Mukhamedova V. M., Nishanova M. S.

Andijan State Medical Institute, Andijan, Uzbekistan

**Abstract** Obesity is a disease that, unfortunately, is becoming more and more common. We can see obese patients on the street, at work, and even at home; our loved ones find themselves overweight. Obesity is a very insidious disease; it can begin to develop for reasons such as stress, poor lifestyle or hereditary predisposition. Obesity is necessarily accompanied by other diseases, such as, for example, diabetes mellitus, arterial hypertension, varicose veins, arthrosis, and atherosclerosis. If obesity is not treated promptly, people doom themselves to develop chronic diseases and even die.

**Keywords** Obesity, Overweight, Prediabetes, Glycated hemoglobin

## 1. Introduction

Prediabetes can progress to T2DM in 50% of cases within 5 years [3]. In this regard, prediabetes has received increasing attention in attempts to delay the onset of T2DM and prevent or delay microvascular and macrovascular complications [1,4].

However, information on the epidemiology of prediabetes and its associations with obesity is scarce and absent in the modern population of the Andijan region. This is the reason for late diagnosis of diabetes and its complications with all its serious consequences. For this reason, there are still no epidemiological diagnostic criteria for prediabetes, although risk factors for prediabetes and/or diabetes are formed or accumulate long before specific manifestations appear [2].

**Purpose of the study:** to study the effect of body mass index on the incidence of carbohydrate metabolism disorders.

## 2. Materials and Methods

Strictly according to the scenario of the epidemiological study, 2112 people (coverage - 100.0%), women - 83.1% and men - 16.9% were examined. All those examined were representatives of the indigenous population of the Markhamat district of the Andijan region. Involvement of the population in the survey was ensured through a written invitation and home visits. Work with the invitation was completed after the survey.

The following methods were used in the population survey: epidemiological, clinical, biochemical, instrumental and statistical. The population was examined using standardized and unified DiaHatar questionnaires to assess the risk of prediabetes and T2DM.

Risk factors were determined and assessed according to the criteria of the WHO, the Russian Association of Endocrinologists (2017), EASD and ADA (2015, 2018), Clinical recommendations for the management of patients with type 2 diabetes mellitus of the Republic of Uzbekistan (2 For a biochemical study before blood sampling, the fasting period was 10-12 hours The concentration of glucose in the blood plasma was determined using the Mindray A88 automatic analyzer. Determination of glycemia/glucose in the blood plasma. A fasting plasma glucose level of <6.1 mmol/l was taken as normoglycemia, and a range of plasma glucose concentrations was taken as impaired fasting glucose (IFG). from 6.1<7.0 mmol/l, for impaired glucose tolerance (IGT) ≥7.8<11.1 mmol/l, concentration equal to or exceeding 7.0 mmol/ (ADA criteria) - DM.

Glycated hemoglobin (HbA1c) was also selected as a diagnostic criterion for diabetes. The study of HbA1c in venous blood was carried out on a Mindray A88 analyzer using the Max-Planck-Ring21 65205 Wiesbaden Germany reagent, manufactured in Germany. This method for determining HbA1c is standardized in accordance with the requirements of NGSP/DCCT and IFCC.

The anthropometric study was carried out as follows: height was determined in the “standing” position with an accuracy of 0.5 cm (without shoes), and the heels, buttocks and shoulders of the subject should touch the measuring pole, the head should be positioned so that the connecting line was horizontal. Body weight was measured without shoes on standard scales, with an accuracy of 0.1 kg. To study overweight (BMI) and obesity, the following was carried out: calculation of body mass index (BMI) was carried out using the Quetelet index (QI) - the ratio of body weight in kg to the square of height in meters according to the formula, the level of obesity was calculated (Table 1).

$$BMI = \frac{\text{body weight (kg)}}{\text{height (sm}^2\text{)}} \pm$$

**Table 1.** Classification of obesity (WHO, 1997)

Body weight deficiency	Normal body weight	Overweight Obesity	1st degree Obesity	2nd degree Obesity	3rd degree
<18,5	18,5-24,9	25-29,9	30-34,9	35-39,9	≥40

### 3. Results and Their Discussions

**Table 2.** Epidemiological characteristics of BMI in the male and female population aged 18-65 years with various disorders of carbohydrate metabolism

Group of subjects	BMI indicators, kg/m <sup>2</sup>			
	With IGN	With IGN	With IGN + IGT	With T2DM
Male population 18-65 years old (n=357)	27,4+1,1	27,7+1,8	27,8+0,8*	27,9+1,5
Female population	28,2+0,8*	28,5+0,9	28,7+0,5*	28,5+2,5
General population	26,5+1,2	26,8+2,1*	26,8+1,2	27,2+1,8*

It turned out that all individuals with glycemic disorders have increased body weight (Table 2). Thus, BMI was noted in various disorders of body weight with the following

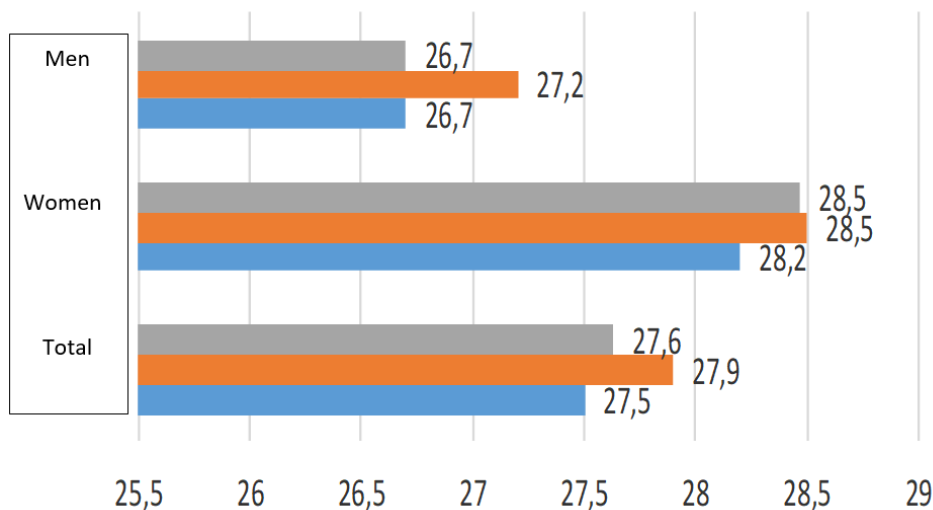
indicators: with NGN - 27.4 kg/m<sup>2</sup> (in women - 28.2 kg/m<sup>2</sup> and men - 26.5 kg/m<sup>2</sup>,  $P > 0.05$ ), with IGT - 27.7% (in women - 28.5 kg/m<sup>2</sup> and men - 26.8 kg/m<sup>2</sup>, with IGN + IGT - 27.8 kg/m<sup>2</sup> (in women - 28.7 kg/m<sup>2</sup> and in men - 26.8 kg/m<sup>2</sup>, ( $P > 0.05$ ) and with diabetes - 27.9 kg/m<sup>2</sup> (in women - 28.5 kg/m<sup>2</sup> and men - 27.2 kg/m<sup>2</sup>; ( $P > 0, 05$ )).

**In general, it is clear that BMI and obesity make a significant contribution to the development of prediabetes and T2DM, especially in the rural female population (Fig. 1)**

The noted indicators once again demonstrate the importance of more active preventive work among the population in relation to various types of glycemic disorders among the population. Data close to our results were obtained in countries near and far abroad [1]

The role of body weight in the prevalence of glycemic disorders in a healthy population aged 18–65 years is shown in Table 3.

The identified data indicate (Table 2) that excess weight significantly increases the incidence of glycemic disorders at all stages of prediabetes from IFG, IGT to T2DM. In addition, among persons without NDO, the prevalence of body weight disorders is also determined with an increase from 1.2% (normal body weight), 18.8% (I degree obesity), 12.7% (II degree obesity) and 4.7% (III degree obesity).

**Figure 1.** Risk of developing glycemic disorders depending on BMI in those examined**Table 3.** The role of body weight in the prevalence of glycemic disorders in a healthy population aged 18–65 years

Characteristics of body mass index (BMI) kg/m <sup>2</sup>	Groups of subjects with and without NDU									
	Ps NGN		Ps NTG		Ps NGN+NTG		Ps SD2		LbNUO	
	n	%	n	%	N	%	n	%	n	%
BMI 18.5-24.9 (normal body weight)	0	0,00	4	0,2	2	0,1	3	0,1	26	1,2
BMI 25-29.9 (overweight)	94	4,5**	98	4,6**	62	2,9**	36	1,7**	566	26,3***
BMI 30-34.9 (I degree obesity)	87	4,1**	79	3,7**	45	2,1**	26	1,2**	397	18,8***
BMI 35-39.9 (II degree obesity)	47	2,2**	61	2,9**	34	1,6*	17	0,8**	268	12,7***
BMI ≥ 40 (III degree obesity)	14	0,7*	25	1,2**	16	0,8*	5	0,2*	99	4,7**

Note: Ps IGN - population with impaired fasting glycemia, Ps IGT - population with impaired glucose tolerance, IGN + IG - population with impaired fasting glycemia and impaired glucose tolerance, PsDM2 - population with type 2 diabetes mellitus, PZL - population healthy people.

PsNGN at different levels of body weight is characterized by an increase in prevalence as follows: 4.5% (with BMI), 4.1% (with class I obesity), 2.2% (with class II obesity) and 0.7% (for III degree obesity). With normal body weight – not determined (0.00%).

The prevalence of IGT was: in a population with normal body weight – 0.2%, in a population with overweight – 4.6% ( $P<0.01$ ), in a population with stage I obesity – 3.7% ( $P<0.01$ ), in the population with II degree obesity – 1.2% ( $P<0.01$ ) and in the population with III degree obesity – 1.2% ( $P<0.01$ ). The frequency of detection of this type of carbohydrate metabolism disorder at different levels of body weight is determined with a difference of more than 4 times ( $P<0.01$ ).

Prediabetes is characterized by the following prevalence depending on the body mass index of the subjects: 0.1% (with a BMI of 18.5-24.9 kg/m<sup>2</sup>), 2.9% (with a BMI of 25-29.9 kg/m<sup>2</sup>), 2.1% (with BMI 30-34.9 kg/m<sup>2</sup>), 1.6% (with BMI 35-39 kg/m<sup>2</sup>) and 0.8% (with BMI  $\geq$  40 kg/m<sup>2</sup>).

A similar epidemiological trend is also observed in T2DM. Thus, its prevalence was: with normal body weight – 0.1%, BMI – 1.7% ( $P<0.01$ ), with class I obesity – 1.2% ( $P<0.01$ ), with obesity of the second degree - 0.8% ( $P<0.01$ ) and with

obesity of the third degree - 0.2% ( $P<0.05$ ). There is a statistically significant negative impact of body weight disorders on type 2 diabetes mellitus. Therefore, given the relatively high prevalence of T2DM, it is necessary to conduct active screening to identify disorders of carbohydrate metabolism in overweight individuals to modify their lifestyle and prevent the development of type 2 diabetes.

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