Research Paper

Vitamin D deficiency is a risk factor for obesity and diabetes type 2 in women at late reproductive age

Grineva EN[1], Karonova T[1,2], Micheeva E[2], Belyaeva O[2], and Nikitina IL[1]

[1] *Almazov's Centre of Heart, Blood and Endocrinology, Petersburg, 197134, Russia*
[2] *I. P. Pavlov St Petersburg State Medical University, St. Petersburg, 197022, Russia*

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Correspondence to: *Karonova T, MD/PhD;* ***E-mail:*** *karonova@mail.ru*

Abstract: It was suggested that glucose metabolism and body fat content depend on serum levels of 25-hydroxyvitamin D [25(OH)D]. We studied 320 healthy women at late reproductive age of 40 to 52 years old (mean age 46.1±4.5) from St. Petersburg (North-West region of Russia). 25(OH)D levels were from 19.4 to 134.0 nMol/L (mean 52.9±22.7). Vitamin D deficiency (lower than 50 nMol/L) and insufficiency (50-75 nMol/L) was revealed in 59.1% and 27.8% of women, respectively. The study showed that low 25(OH)D levels were associated with obesity (r=-0.35, p<0.01), increased plasma glucose levels after OGTT (r=-0.31, p<0.01) and decreased insulin sensitivity index (r=-0.28, p<0.01). We found that 25(OH)D levels below 50 nMol/L were associated with obesity risk (OR 2.25[1.05-3.95], CI 95%) but not with risk of impaired glucose metabolism (1.07[0.54-2.12],CI95%). Our results showed that vitamin D insufficiency is highly prevalent in the population of healthy women. Low 25(OH)D levels correlated with high body fat, glucose levels and decreased insulin sensitivity. We conclude that vitamin D deficiency is a potential risk factor for obesity and development of insulin resistance leading to diabetes type 2.

INTRODUCTION

Approximately 1 billion people worldwide suffer from vitamin D deficiency [1-4], which may result from limited exposure to sunlight, long-term wearing of covering clothes, use of sunscreen, age as well as low consumption of food containing ergocalciferol, and malabsorption syndrome [5-6]. The vitamin D receptors (VDR) and the 1α-hydroxylase enzyme, which catalyzes the conversion of calcidiol [25-hydroxyvitamin D, 25(OH)D] to calcitriol [1,25-dihydroxyvitamin D, 1,25$(OH)_2$D], were found in more than 40 human cell types [1-8], indicating its potential role in the regulation of numerous metabolic processes. According to recent data, there may be a connection between vitamin D levels and cardiometabolic diseases: obesity; impaired glucose tolerance and diabetes mellitus type 2; arterial hypertension; and atherogenic dyslipidemia. Although the mechanisms are still unclear, vitamin D deficiency is associated with a greater risk of these pathological conditions [4,6,10-14]. Furthermore, an increased body fat and obesity is associated with low circulating 25(OH)D level [9,14-19].

Numerous studies investigated the relationship between 25(OH)D and insulin levels. Vitamin D receptors found in pancreatic ß-cells launched studies on the possible effects of calcitriol on regulation of insulin production [14,15]. It is well known that Vitamin D treatment of animals with induced diabetes mellitus type 1 slows the progression of diabetes, and that high doses of vitamin D in food consumed by risk-group children are able to reduce the incidence of diabetes [20-23]. In addition, while assessing carbohydrate metabolism, it was determined that the lack of vitamin D may cause a greater level of glycemia and a higher risk of diabetes mellitus type 2 [2,4,5,14,15,22,24]. There is a link between 25(OH)D levels and insulin responsiveness of tissues as well as between glucose levels and glycosylated hemoglobin in people without diabetes mellitus type 2 [15,21]. However, data from other

authors controvert the relation of vitamin D deficiency and metabolic syndrome factors [20,25]. Given these contradicting data, we sought to determine whether serum 25(OH)D concentration in late reproductive age healthy women is associated with body composition and glucose metabolism.

RESULTS

The mean age of women followed up was 46.1±4.5 years (from 40 to 52), BMI – 30.2±6.1 kg/m^2 (from 21.2 to 53.1). Depending on their BMI the participants were divided into groups of normal weight, overweight, and obese. Distribution between the groups was done according to waist circumference values: over or equal to 80 cm or less than 80 cm, as recommended by International Diabetes Federation [26].

The results of the study showed that 78% of women were overweight or obese, with WC more than 80 cm in 83.6%. DEXA confirmed increased fat mass in 87.7% of study population. ROC-analysis showed correlation between BMI and FMI (rang correlation coefficient R_γ=+0.98).

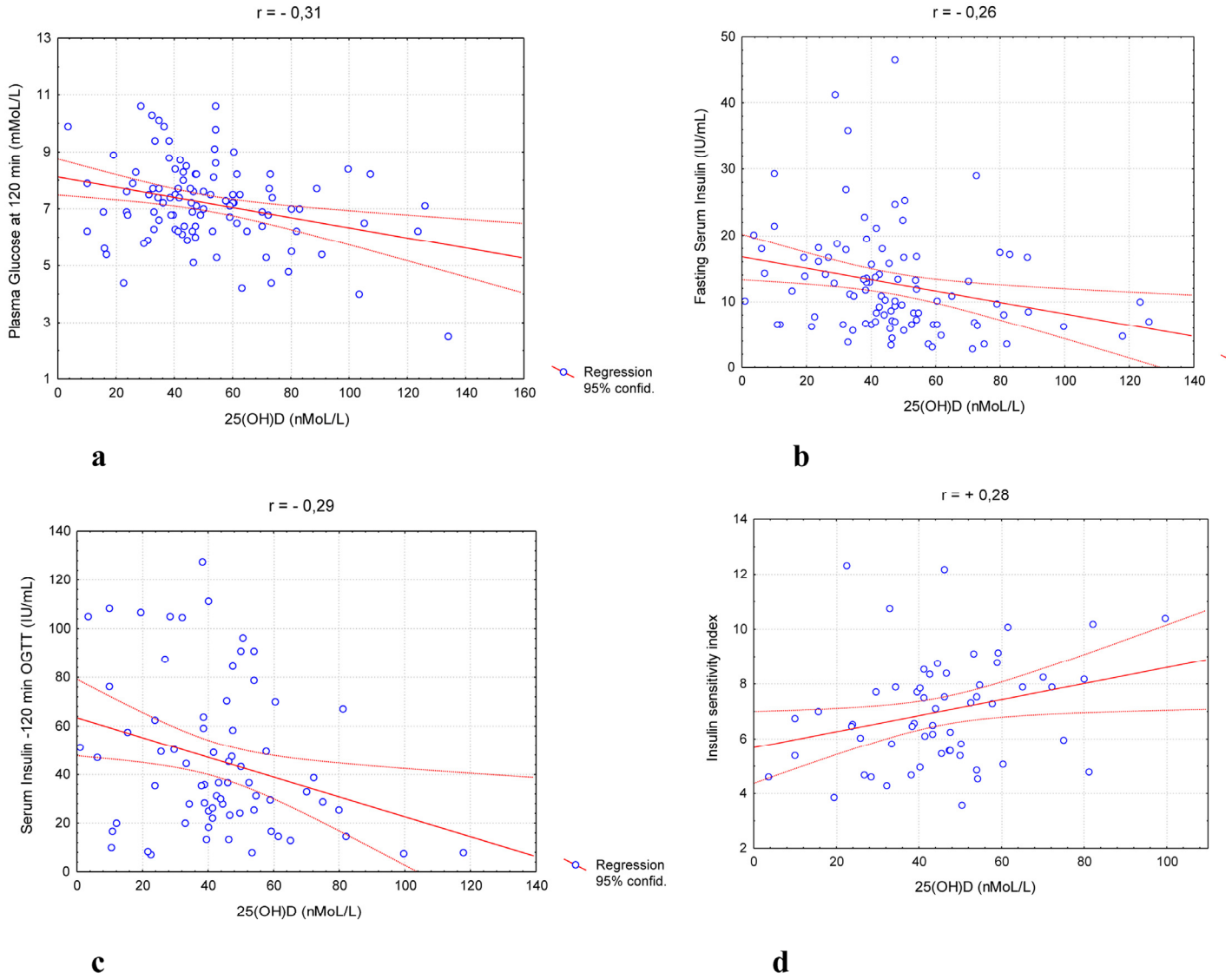

Figure 1. Distribution stimulated glucose (**a**), fasting (**b**) and stimulated (**c**) Insulin levels and ISI (0,120) parameters (**d**) in overweight/obese population.