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GLUCOSE AND INSULIN REFERENCE RANGES IN ORAL GLUCOSE TOLERANCE TEST

Science

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KEYWORDS:

Only D-glucose, known as dextrose, is biologically active. Its metabolism produces energy in the form of adenosine triphosphate. Its physiological function includes its role as: a) an energy source for all cells in the body; b) a participant in the production of proteins and lipids; c) a precursor for the synthesis of glycogen. Estimated blood glucose is a routine, widely used biomarker (1, 2, 3). Insulin is a peptide hormone that is synthesized as inactive proinsulin in the -cells of the islets of Langerhans in the pancreas. After a series of enzymatic reactions, the inactive proinsulin transforms into active insulin. It is built of A and B chains and binds to insulin receptors. The synthesized hormone accumulates in specialized secretory vesicles of the -cells in the pancreas. The insulin secretion in the bloodstream occurs after reception of specific signals, generated after the intake of nutrients. Plasma insulin has a half-life of 3 to 5 days (4, 5, 6, 7). It does not bind to plasma proteins. It is metabolized in about 60% in the kidneys and 40% in the liver. Its physiological effects are as follows: a) induces hypoglycemia; only this hormone has such an effect; b) increases lipid deposition in adipose tissues; c) reduces the level of free fatty acids; d) has a role in the degradation and synthesis of proteins; e) has a role in the glucose uptake in the liver and muscles; f) enables the conversion of glucose into glycogen; g) stimulates the replication of DNA; h) affects vascular tone (8, 9, 10). The most potent stimulus, causing the release of insulin in the bloodstream, is glucose. Membrane insulin receptors capture the insulin and activate the transport of glucose through the cell membrane. Insulin shows anabolic and anti-catabolic action. Glucose and insulin analysis are necessary for the diagnosis of insulin resistance (IR), pre-diabetes (PD), type 2 diabetes mellitus (DM2), impaired function of the -cells, metabolic syndrome, reactive hypoglycemia, acromegaly, etc. (8, 9, 10, 11). Studies have shown that the estimation of these two biomarkers in the fasting state is not sufficient. The data are significantly more informative if they are tracked dynamically after loading the body with a certain amount of glucose. Glucose may be administered parenterally (IGTT) or orally (OGTT). IGTT is used very rarely, because is labor-consuming and intolerable by the patients. Therefore, OGTT is preferred, whereby only blood glucose or glucose plus insulin can be tested for a more accurate diagnosis. OGTT may provide more physiological conditions for the assessment of -cell function. OGTT has a slightly higher sensitivity than fasting glucose to diagnose IR, PD and DM2 (1, 10, 12, 13). Worldwide, IR, PD and DM2 show a steady upward trend. This increases the use of glucose and insulin. Although introduced long ago, OGTT is still modified (2, 8, 9, 14). Many variations have been developed with regard to the amount of received glucose, the interval and duration of glucose and insulin follow-up. The classic OGTT is performed with fasting and multiple post-glucose measurements. Samples are taken at fasting and then at 30 minutes, 60 minutes, 120 minutes and 180 minutes after the intake of 75 g glucose as a solution. Glucose and insulin are measured at each time point and the results are plotted. Over the time, the number of measurements has been reduced. The current WHO recommendation for adults includes the intake of 75 g glucose and its analysis at fasting and 120 minutes (9, 12, 15, 16). There are cases, however, where the glucose level is within the reference range and the insulin level is not at the 2nd hour post dosing. Therefore, there are recommendations for using three versions: a) for 1 hour; b) for 2 hours; and c) for 3 hours (2, 6, 10, 15, 17, 18). The most common glucose and insulin reference values for adults in OGTT are presented below (Table 1 and Figure 1).

Table 1. Glucose and insulin reference values in OGTT (by 3, 5, 15, 18)

Parameter	Fasting state	30 min	60 min	120 min	180 min
Glucose (EDF)	<6.1	<11.1	<11.1	<7.8	<6.4
mmol/l (ADA)	3.3 - 5.5	<11.0	<10.0	<7.8	<6.0

Insulin					
mIU/L	<25 but >3	30-230	18-276	16-166	<25
pmol/L	<174 but >21	208-1597	125-1917	111-1153	<174

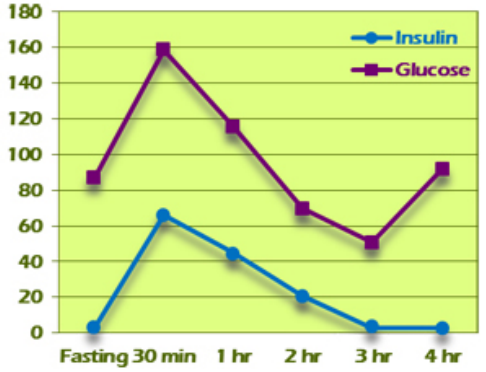

Figure 1. Graphical representation of glucose and insulin reference values in OGTT (15, 16, 18)

It should be noted that in adults, the average fasting glucose level increases with increasing of the age between the third and the sixth decade and then stops (Sacks, 2011). After glucose loading, the glucose level is higher in older individuals.

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