Human Health and Insulin Resistance

Aeysha Sultan,[1] Hira Sultan,[2] Bukhtawar Sultan,[3] Irum Shahzadi,[4] Sumaira Shamshad,[5] Maryam Zahra,[1] Roberto Acevedo[6*]

Department of Chemistry, Division of Science & Technology, University of Education, Lahore, Pakistan
MFMG, Physics Division, PINSTECH, Nilore, 44000, Islamabad, Pakistan
Government Special Education Center Sillanwali, Pakistan
Sargodha Medical College, Sargodha, Pakistan
Facultad de Ingeniería, Arquitectura y Diseno, ˜ Universidad San Sebastian, ´ Bellavista 7, Santiago, 8420524, Chile

Corresponding author: roberto.acevedo.llanos@gmail.com

Abstract

The insulin resistance is often associated with diabetes, inflammation and diabetes. Insulin resistance is linked with increased free fatty acids, glycerol, hormones, and pro-inflammatory cytokines in blood plasma which lead to inflammation, oxidative stress, lipodystrophy and mitochondrial diseases. This review aims to give a basic understanding of insulin resistance and factors which promote and possible remedies which may help alleviate this condition.

Keywords: Insulin resistance, obesity, diabetes, inflammation, oxidative stress

Introduction

Insulin is a pancreatic hormone which is responsible for metabolism of carbohydrates, proteins, and fats by mediating the absorption of plasma glucose into liver, adipose tissue, skeletal muscles. Increased intake of carbohydrates stimulates production of insulin which in turn binds with cellular receptors of liver, adipose tissue and skeletal muscles to promote intake of glucose from blood into the cells. the spike of insulin causes abrupt decrease in plasma glucose due to uptake of glucose by the cells. The sudden decrease in blood glucose is usually followed by intake of carbohydrate which again leads to insulin spike and this vicious cycle continues.[1]

Extensive intake of carbohydrate leads to buildup of too much insulin in the blood which in turn leads to a condition called the insulin resistance. An extreme adipose tissue expansion due to an increase in nutrients intake and insufficient energetic expenditure is considered as **obesity**, a condition which has been suspected to cause chronic low-grade systemic and local inflammation.[2] Obesity increases reactive oxygen species formation in fat cells, shortens telomeres (a reason of infertility), and eventually results in inactivation of the p53 tumor suppressor, inflammation, and the elevation of insulin resistance.[3] Obesity has a very close and well established link with diabetes.[2,4]

Insulin resistance is a condition in which the body's cells become resistant to the effects of insulin. When cells become insulin resistant, they are less able to use glucose (sugar) from the bloodstream

for energy, leading to higher blood sugar levels. To compensate, the pancreas produces more insulin, however, increased level of plasma insulin results in:

1. Stimulation of appetite, leading to overeating.
2. Stimulation of body to store more fat, particularly in the abdominal area leading to increased visceral fat.
3. interference with the body's ability to burn fat for energy
4. Hormonal imbalances, specially elevation of levels of cortisol, a stress hormone that can cause weight gain.[5]

Insulin resistance also causes inflammation, both local as well as systemic. As described earlier, increased carbohydrate intake stimulate insulin production and insulin promotes fat storage. The increased fat buildup causes increased production of proinflammatory agents that are drained into the portal vein and from here the process of insulin resistance is initiated.[6,7] therefore, insulin resistance causes fat buildup and increased fat build up causes insulin resistance. It is worth mentioning here that in addition to increased intake of carbohydrates, the intake of saturated fatty acids and a compromised gut microbiota have also been linked with inflammation.[8,9] Hence these foods are also responsible for insulin resistance.

Apoptosis is a natural cleaning process of body whereby the human body removes damaged cells and toxins from the body. The increased adipose tissue to due insulin mediated fat buildup stimulates over production of macrophage-derived apoptosis inhibitor to prevent lipolysis in adipose tissue thus leading to obesity.[10,11]

Mitochondira are power house of cell and are responsible for energy production. A lack of energy production from mitochondria in your cells causes mitochondrial disease. Mitochondrial dysfunction occurs when mitochondria don't work as well as they should due to another disease or condition. Many conditions can lead to secondary mitochondrial dysfunction.[5] Insulin resistance results in increased build up of triglycerides in muscle and liver subjects, especially the older population. The increased triglyceride level causes decline in mitochondrial biogenesis as well as mitochondrial function that leads to a decrease in both mitochondrial oxidative activity and ATP synthesis.[12] This results in decreased energy production and the subject experiences lethargy, compromised organ functioning and brain fog.

The current medical strategies in managing blood glucose mostly involve managing insulin levels. Often a person who is already insulin resistant is given insulin shots to maintain blood glucose levels. However, it is a well established fact that for every agonist there is always an antagonist in the human body. For insulin, the antagonist is glucagon. The insulin promotes accumulation of glucose as fats whereas glucagon is responsible for burning fats for generating energy. It has been reported that after a spike of insulin, when the glucose level falls, the immediate intake of food, specially carbohydrates, does more harm than good. Instead of intaking carbohydrate at that time, if the subject gets involved in some form of physical activity, the glucagon is activated which stimulates burning of fats firstly from liver cells and later from adipose tissue. This natural antagonist if managed properly can lead to effective management of insulin resistance. adipose-

specific cytokines and inflammatory cytokines and interleukin-6 (IL-6) are secreted by visceral adipocytes.

Different studies have indicated that any drugs or food supplement that suppress inflammation improve insulin sensitivity[13,14] and also leads to the reduction of oxidative stress of mitochondria in visceral fat, and improves insulin resistance.[15] Insulin resistance has also been reported to be cured by means of increasing intake of fiber, cruciferous vegetables, apple cidar vinegar and by means of fasting.[16] Fiber, cruciferous vegetables and apple cidar vinegar are well established for improving gut health by promoting healthy microbiome.[17]

As mentioned earlier, the increased obesity causes inflammation which is described as elevated levels of pro-inflammatory cytokines or an increased number of white blood cells in the blood or tissue. Overstimulation of inflammatory process frequently leads to various abnormalities such as organ dysfunction and tissue injury.[18] an improved insulin sensitivity is a possible and promising remedy for curing/ managing disorders associated with insulin disorder.

Conclusion:

Insulin resistance is a disorder associated with current modern life style that involves increased food, both in quantity and frequency, and no or very little physical activity. Insulin resistance is not only linked with increased blood glucose levels but is also associated with a number of physiological disorder. The role of glucagon, an antagonist of insulin, needs to be explored for managing insulin resistance as well as diabetes. The role of anti-inflammatory food supplements is also a field worth exploring in search towards remedy for insulin, obesity as well as diabetes.

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