

## Pancreas Fat and Diabetes

Rie Murakami<sup>1</sup>, Yoshifumi Saisho<sup>1\*</sup>

<sup>1</sup>Department of Internal Medicine, Keio University School of Medicine, Tokyo, Japan.

**Corresponding Author:** Yoshifumi Saisho, Department of Internal Medicine, Keio University School of Medicine, Tokyo, Japan,

**Tel:** +81-3-3353-1211; **Email:** ysaisho@keio.jp

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Obesity is an important factor for the development of diabetes. When excess of calorie intake continues for a long time, fat supply exceeds the capacity of subcutaneous fat storage in the body. Then spillover of fat leads to ectopic fat deposits in various tissues such as the liver, heart, skeletal muscle, and pancreas as well [1].

In Zucker Diabetic Fatty (ZDF) rats, beta cell dysfunction and apoptosis were accompanied by excess lipid accumulation in islets [2], suggesting that beta cell apoptosis is induced by ectopic fat deposits in the pancreas, so called lipotoxicity hypothesis. However, clinical meaning of pancreas fat in humans remains unclear. In humans, many reports regarding pancreas fat have been published, but results are inconsistent. We suppose that one of the reasons for these inconsistent results is due to the intricate structure of the pancreas, since it is difficult to distinguish intra-pancreas fat from fat tissue outside the pancreas by computed tomography (CT) or magnetic resonance imaging (MRI) studies.

Previous reports including imaging and histological assessments showed that pancreatic fat content is significantly increased with obesity [3-5] and age [5, 6]. But recent systematic review by Singh et al. showed conflicting results that presence of non-alcoholic fatty pancreas is independent of age and BMI [7].

It is also controversial whether pancreas fat is associated with diabetes. First, Tushuizen et al. reported that pancreatic fat content was associated with decreased beta cell function in non-diabetic subjects by using magnetic resonance spectroscopy (MRS) [8]. Whereas recent systematic review showed that pancreas fat was associated with risks of diabetes and metabolic syndrome [7], there was no significant difference in pancreas fat between subjects with and without diabetes in our previous report using CT imaging [6]. A recent study in which pancreatic intralobular fat was measured carefully by using-

MRI/MRS also showed no association between pancreatic fat and diabetes [9].

Aimed at accurate measurement of intra-pancreas fat, we recently reported the intra-pancreas fat content assessed by using autopsy and surgical specimens [10]. Our study was a relatively large-scale study including autopsy from 72 Japanese non-diabetic adults and pancreas samples from 99 diabetic and non-diabetic adults who underwent pancreatic surgery. We reported that pancreas fat was significantly associated with age and BMI. And there was no significant difference in intra-pancreas fat between subjects with and without diabetes. No correlation was found between the pancreas fat and beta cell mass.

Our findings suggest that pancreatic fat deposits have little effects on beta cell mass and development of diabetes in humans. Although there have been a number of reports regarding pancreas fat in humans assessed by CT or MRI/MRS imaging, more careful and accurate measurement of the pancreas fat will be warranted in future studies.

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