

# Excess Sugar Boosts Teens' CVD Risk Factors

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FROM CIRCULATION

Intake of added sugars by adolescents is associated with multiple measures known to increase cardiovascular disease risk, including decreased HDL cholesterol levels, and increased LDL cholesterol levels and geometric mean triglyceride levels, according to data from the National Health and Nutrition Ex-

amination Survey (NHANES) 1999-2004.

In 2,157 adolescents who participated in the survey, the daily consumption of added sugars – defined as refined calorie-containing sweeteners added to food and beverages during processing or preparation – averaged 118.9 g (28.3 tsp. or 476 calories), representing an average of 21.4% of total energy. Among those with the highest level of added sugar intake (at least 30% of total energy) and

the lowest level of added sugar intake (less than 10% of total energy), respectively, the HDL cholesterol levels were 1.28 and 1.40 mmol/L, LDL cholesterol levels were 2.44 and 2.24 mmol/L, and triglycerides were 0.89 and 0.81 mmol/L, Jean A. Welsh of Emory University, Atlanta, and her colleagues reported.

No differences were noted in daily added sugar consumption based on demographic factors including age, sex,

race/ethnicity, poverty, or educational level, but in adolescents with at least 85th percentile of body mass index and thus considered overweight/obese, added sugar intake was positively correlated with the homeostasis model assessment (HOMA-IR), which is an estimate of insulin resistance derived from fasting glucose and insulin levels, the investigators found (Circulation 2011 [doi:10.1161/CIRCULATIONAHA.110972166]).

Adjusted mean HOMA-IR (fasting insulin [pmol/L] times fasting glucose [mmol/L]/22.5) in overweight adolescents was 4.61 in those with the highest added sugar consumption, compared with 3.49 in those with the lowest consumption.

The findings contribute to a growing body of evidence linking carbohydrate and sugar intake with increased cardiovascular disease risk and are particularly important given that consumption of added sugars has increased substantially in recent decades. In 1977-1978, daily consumption of added sugars in adolescents was 62-84 g, compared with the nearly 119 g seen in this study, representing an increase of 42%-92%, the investigators said.

Mechanisms that might explain the dysmetabolic effects of carbohydrates, and specifically sugars, include the insulin response to the metabolism of high-glycemic index foods, the increased de novo lipogenesis that results when high levels of fructose are metabolized by the liver, and the increased hepatic triglyceride synthesis combined with increased secretion and/or decreased clearance of very low-density lipoproteins, the investigators wrote.

“Modification of the effect of added sugars on measures of glucose metabolism by weight status could be explained by the decreased insulin sensitivity known to result from increased adiposity,” they added.

Adolescents in this study were U.S. residents aged 12-18 years who were randomly selected to provide a fasting blood sample for NHANES 1999-2004 and who provided dietary intake information. Those with unreliable or implausible dietary data were excluded, as were those who were pregnant, those who had extreme triglyceride levels, those with previously diagnosed diabetes mellitus, and those with missing covariate data. Dietary information was merged with U.S. Department of Agriculture MyPyramid equivalents databases to determine added sugar content.

Dr. Miriam Vos, an author on the study, disclosed receiving financial support in the form of a career award from the National Institutes of Diabetes and Digestive and Kidney Diseases and also receiving support from the Children's Digestive Health and Nutrition Foundation. Dr. Vos also is the author of “The No-Diet Obesity Solution for Kids,” (Bethesda, Md.: AGA Institute Press, 2009) for which she receives royalties. The remaining authors report no relevant financial conflicts of interest. ■

## • *Insulin initiation and intensification of glucose control*

Intensification or rapid improvement in glucose control has been associated with a transitory, reversible ophthalmologic refraction disorder, worsening of diabetic retinopathy, and acute painful peripheral neuropathy. However, long-term glycemic control decreases the risk of diabetic retinopathy and neuropathy.

## • *Lipodystrophy*

Long-term use of insulin, including LANTUS, can cause lipodystrophy at the site of repeated insulin injections. Lipodystrophy includes lipohypertrophy (thickening of adipose tissue) and lipatrophy (thinning of adipose tissue), and may affect insulin absorption. Rotate insulin injection or infusion sites within the same region to reduce the risk of lipodystrophy. [See *Dosage and Administration* (2.1)].

## • *Weight gain*

Weight gain can occur with insulin therapy, including LANTUS, and has been attributed to the anabolic effects of insulin and the decrease in glucosuria.

## • *Peripheral Edema*

Insulin, including LANTUS, may cause sodium retention and edema, particularly if previously poor metabolic control is improved by intensified insulin therapy.

## • *Allergic Reactions*

### *Local Allergy*

As with any insulin therapy, patients taking LANTUS may experience injection site reactions, including redness, pain, itching, urticaria, edema, and inflammation. In clinical studies in adult patients, there was a higher incidence of treatment-emergent injection site pain in LANTUS-treated patients (2.7%) compared to NPH insulin-treated patients (0.7%). The reports of pain at the injection site did not result in discontinuation of therapy.

Rotation of the injection site within a given area from one injection to the next may help to reduce or prevent these reactions. In some instances, these reactions may be related to factors other than insulin, such as irritants in a skin cleansing agent or poor injection technique. Most minor reactions to insulin usually resolve in a few days to a few weeks.

### *Systemic Allergy*

Severe, life-threatening, generalized allergy, including anaphylaxis, generalized skin reactions, angioedema, bronchospasm, hypotension, and shock may occur with any insulin, including LANTUS and may be life threatening.

## • *Antibody production*

All insulin products can elicit the formation of insulin antibodies. The presence of such insulin antibodies may increase or decrease the efficacy of insulin and may require adjustment of the insulin dose. In phase 3 clinical trials of LANTUS, increases in titers of antibodies to insulin were observed in NPH insulin and insulin glargine treatment groups with similar incidences.

## 6.2 Postmarketing experience

The following adverse reactions have been identified during post-approval use of LANTUS.

Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to estimate reliably their frequency or establish a causal relationship to drug exposure.

Medication errors have been reported in which other insulins, particularly short-acting insulins, have been accidentally administered instead of LANTUS [See *Patient Counseling Information* (17) in the full prescribing information]. To avoid medication errors between LANTUS and other insulins, patients should be instructed to always verify the insulin label before each injection.

## 7. DRUG INTERACTIONS

A number of drugs affect glucose metabolism and may require insulin dose adjustment and particularly close monitoring.

The following are examples of drugs that may increase the blood-glucose-lowering effect of insulins including LANTUS and, therefore, increase the susceptibility to hypoglycemia: oral anti-diabetic products, pramlintide, angiotensin converting enzyme (ACE) inhibitors, disopyramide, fibrates, fluoxetine, monoamine oxidase inhibitors, propoxyphene, pentoxifylline, salicylates, somatostatin analogs, and sulfonamide antibiotics.

The following are examples of drugs that may reduce the blood-glucose-lowering effect of insulins including LANTUS: corticosteroids, niacin, danazol, diuretics, sympathomimetic agents (e.g., epinephrine, albuterol, terbutaline), glucagon, isoniazid, phenothiazine derivatives, somatropin, thyroid hormones, estrogens, progestogens (e.g., in oral contraceptives), protease inhibitors and atypical antipsychotic medications (e.g. olanzapine and clozapine).

Beta-blockers, clonidine, lithium salts, and alcohol may either potentiate or weaken the blood-glucose-lowering effect of insulin. Pentamidine may cause hypoglycemia, which may sometimes be followed by hyperglycemia.

The signs of hypoglycemia may be reduced or absent in patients taking sympatholytic drugs such as beta-blockers, clonidine, guanethidine, and reserpine.

## 8. USE IN SPECIFIC POPULATIONS

### 8.1 Pregnancy

Pregnancy Category C: Subcutaneous reproduction and teratology studies have been performed with insulin glargine and regular human insulin in rats and Himalayan rabbits. Insulin glargine was given to female rats before mating, during mating, and throughout pregnancy at doses up to 0.36 mg/kg/day, which is approximately 7 times the recommended human subcutaneous starting dose of 10 Units/day (0.008 mg/kg/day), based on mg/m<sup>2</sup>. In rabbits, doses of 0.072 mg/kg/day, which is approximately 2 times the recommended human subcutaneous starting dose of 10 Units/day (0.008 mg/kg/day), based on mg/m<sup>2</sup>, were administered during

## LANTUS® (insulin glargine [rDNA origin] injection) solution for subcutaneous injection

organogenesis. The effects of insulin glargine did not generally differ from those observed with regular human insulin in rats or rabbits. However, in rabbits, five fetuses from two litters of the high-dose group exhibited dilation of the cerebral ventricles. Fertility and early embryonic development appeared normal.

There are no well-controlled clinical studies of the use of LANTUS in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. It is essential for patients with diabetes or a history of gestational diabetes to maintain good metabolic control before conception and throughout pregnancy. Insulin requirements may decrease during the first trimester, generally increase during the second and third trimesters, and rapidly decline after delivery. Careful monitoring of glucose control is essential in these patients.

### 8.3 Nursing Mothers

It is unknown whether insulin glargine is excreted in human milk. Because many drugs, including human insulin, are excreted in human milk, caution should be exercised when LANTUS is administered to a nursing woman. Use of LANTUS is compatible with breastfeeding, but women with diabetes who are lactating may require adjustments of their insulin doses.

### 8.4 Pediatric Use

The safety and effectiveness of subcutaneous injections of LANTUS have been established in pediatric patients (age 6 to 15 years) with type 1 diabetes [see *Clinical Studies* (14) in the full prescribing information]. LANTUS has not been studied in pediatric patients younger than 6 years of age with type 1 diabetes. LANTUS has not been studied in pediatric patients with type 2 diabetes.

Based on the results of a study in pediatric patients, the dose recommendation when switching to LANTUS is the same as that described for adults [see *Dosage and Administration* (2.3) and *Clinical Studies* (14) in the full prescribing information]. As in adults, the dosage of LANTUS must be individualized in pediatric patients based on metabolic needs and frequent monitoring of blood glucose.

### 8.5 Geriatric Use

In controlled clinical studies comparing LANTUS to NPH insulin, 593 of 3890 patients (15%) with type 1 and type 2 diabetes were ≥65 years of age and 80 (2%) patients were ≥75 years of age. The only difference in safety or effectiveness in the subpopulation of patients ≥65 years of age compared to the entire study population was a higher incidence of cardiovascular events typically seen in an older population in both LANTUS and NPH insulin-treated patients.

Nevertheless, caution should be exercised when LANTUS is administered to geriatric patients. In elderly patients with diabetes, the initial dosing, dose increments, and maintenance dosage should be conservative to avoid hypoglycemic reactions. Hypoglycemia may be difficult to recognize in the elderly [See *Warnings and Precautions* (5.3)].

## 10. OVERDOSAGE

An excess of insulin relative to food intake, energy expenditure, or both may lead to severe and sometimes prolonged and life-threatening hypoglycemia. Mild episodes of hypoglycemia can usually be treated with oral carbohydrates. Adjustments in drug dosage, meal patterns, or exercise may be needed.

More severe episodes of hypoglycemia with coma, seizure, or neurologic impairment may be treated with intramuscular/subcutaneous glucagon or concentrated intravenous glucose. After apparent clinical recovery from hypoglycemia, continued observation and additional carbohydrate intake may be necessary to avoid recurrence of hypoglycemia.

Rev. September 2009  
sanofi-aventis U.S. LLC  
Bridgewater, NJ 08807  
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GLA-BPLR-SA-SEP09