Hyperinsulinism, Obesity and Type 2 Diabetes
Reversing the Trend

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Kids Are also Overweight/Obese
Only Half of NYC’s Elementary School Children Are at a Healthy Weight

More than 4 in 10 are overweight or obese in Grades K-5

- Underweight: 4%
- Obese: 24%
- Overweight: 19%
- Normal Weight: 53%
PEDIATRIC OBESITY: An Increasing Problem

Clinical manifestation of Insulin resistance

Skin
- Acanthosis nigricans
- Skin tags

Cartilage
- Pseudoacromegaly

Fat
- Obesity
- Dyslipidemia

Liver
- Fatty liver

Heart
- Atherosclerosis
- Hypertension

Pancreas
- Diabetes

Ovary
- Hyperandrogenism
- PCO
- Infertility

Muscle
- Muscle cramps
TYPE 2 IS ON THE RISE IN KIDS

- Cincinnati—incidence of type 2 diabetes in 10- to 19-year-olds increased from 0.7 per 100,000 in 1982 to 7.2 per 100,000 in 1994.
- Pima Indians show a statistical increase from 1967 to 1996 for those aged 10-19 years.
- Between 1988 and 1996, the Indian Health Service also documented a 54% increase in reported diabetes in 15- to 19-year-old adolescents.
- Other, multicenter observational databases show increasing percentage of diagnosed type II diabetes, with fewer than 4% reported before the 1990s and up to 45% in recent studies.
Table 4—Testing for type 2 diabetes in children

**Criteria***
- Overweight (BMI >85th percentile for age and sex, weight for height >85th percentile, or weight >120% of ideal for height)
- Plus
- Any two of the following risk factors:
  - Family history of type 2 diabetes in first- or second-degree relative
  - Race/ethnicity (American Indian, African-American, Hispanic, Asian/Pacific Islander)
  - Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, PCOS)
- Age of initiation: age 10 years or at onset of puberty if puberty occurs at a younger age
- Frequency: every 2 years
- Test: FPG preferred

*Clinical judgment should be used to test for diabetes in high-risk patients who do not meet these criteria.
SPECIAL ISSUES UNIQUE TO OUR KIDS AND ADULTS WITH TURNER SYNDROME
Abnormalities of insulin and carbohydrate metabolism*

- Impaired glucose tolerance: 106/326 patients (32%)
- Defects of insulin action/CHO metabolism in up to 40%
- Hyperglycemia in response to standard glucose load
- Normoglycemia with hyperinsulinemia
- Defect in glucose handling develops early

Insulin resistance/hyperinsulinemia

No correlation found with:
- Muscle mass
- Degree of adiposity

* 1991 review of the literature, Holl and Heinze
Insulin resistance: an early metabolic defect of Turner's syndrome

Individuals with Turner syndrome have twice the risk of the general population for developing this disease. It appears that the muscles of many persons with Turner syndrome fail to utilize glucose efficiently, and this may contribute to the development of high blood sugar (diabetes).

Cardiac Malformations and Hypertension, But Not Metabolic Risk Factors, Are Common in Turner Syndrome

KERSTIN LANDIN-WILHELMSEN, INGER BRYMAN, AND LARS WILHELMSEN

Research Center for Endocrinology and Metabolism (K.L.W.), Department of Gynecology (I.B.), and Section of Preventive Cardiology (L.W.), Sahlgrenska University Hospital, Göteborg, Sweden

### TABLE 2.
Diabetes, hypertension, blood pressure (BP), and fasting concentrations of blood glucose, plasma insulin, blood lipids, fibrinogen, and hormones in women with Turner syndrome (n = 71) matched with controls from a random population sample of women (the WHO MONICA Project, Göteborg, n = 213)

<table>
<thead>
<tr>
<th></th>
<th>Turner</th>
<th>Controls</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes (%)</td>
<td>3</td>
<td>2</td>
<td>NS</td>
</tr>
<tr>
<td>Treated hypertension (%)</td>
<td>22</td>
<td>3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>125 ± 14</td>
<td>117 ± 12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>76 ± 10</td>
<td>76 ± 8</td>
<td>NS</td>
</tr>
<tr>
<td>Fasting blood glucose (mmol/liter)</td>
<td>4.3 ± 0.9</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>Fasting plasma insulin (mU/liter)</td>
<td>10.4 ± 6.0</td>
<td>8.7 ± 5.0</td>
<td>NS</td>
</tr>
<tr>
<td>Total cholesterol (mmol/liter)</td>
<td>5.2 ± 1.1</td>
<td>5.2 ± 1.1</td>
<td>NS</td>
</tr>
<tr>
<td>LDL-cholesterol (mmol/liter)</td>
<td>3.0 ± 0.8</td>
<td>2.8 ± 0.9</td>
<td>NS</td>
</tr>
<tr>
<td>HDL-cholesterol (mmol/liter)</td>
<td>1.6 ± 0.4</td>
<td>1.5 ± 0.4</td>
<td>NS</td>
</tr>
<tr>
<td>Triglycerides (mmol/liter)</td>
<td>1.30 ± 1.5</td>
<td>1.30 ± 0.8</td>
<td>NS</td>
</tr>
<tr>
<td>Lipoprotein(a) (mg/liter)</td>
<td>215 ± 254</td>
<td>182 ± 209</td>
<td>NS</td>
</tr>
<tr>
<td>Fibrinogen (g/liter)</td>
<td>2.7 ± 0.6</td>
<td>2.7 ± 0.5</td>
<td>NS</td>
</tr>
<tr>
<td>PAI-1 antigen (mU/liter)</td>
<td>29.0 ± 29.0</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>Estradiol (nmol/liter)</td>
<td>0.31 ± 0.20</td>
<td>0.26 ± 0.28</td>
<td>NS</td>
</tr>
<tr>
<td>T (nmol/liter)</td>
<td>0.95 ± 0.6</td>
<td>1.1 ± 0.5</td>
<td>NS</td>
</tr>
<tr>
<td>SHBG (nmol/liter)</td>
<td>50.6 ± 39</td>
<td>67.4 ± 47</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Means ± sd. ND, Not determined; SHBG, sex hormone binding globuline; NS, not significant.
THE IMPACT OF OBESITY ON CARDIOVASCULAR RISK FACTORS IN TURNER'S SYNDROME

- Ninety-one women with Turner's syndrome attending a dedicated adult Turner's syndrome clinic and 22 control subjects were studied.
  - Women with Turner's syndrome were more:
    - Obese
    - Hypertensive
    - Had higher serum triglyceride concentrations

Morbidity in Turner Syndrome

The study period was from January 1, 1984 to December 31, 1993, including all women living in Denmark. Danish Cytogenetic Central Register and the Danish National Registry was used.

Marked Increase of:
- NIDDM and IDDM
- Ischemic heart disease
- Hypertension
- Stroke
- Our data suggest that patients with Turner syndrome are extraordinarily prone to abnormalities constituting the metabolic syndrome (e.g., hypertension, dyslipidaemia, NIDDM, obesity, hyperinsulinemia and hyperuricemia).

Claus Højbjerg Gravholt, Svend Juul, Rune Weis Naeraa and Jan Hansen Aarhus, Denmark
Muscle fiber composition and capillary density in Turner syndrome: evidence of increased muscle fiber size related to insulin resistance

- Healthy women with Turner syndrome are characterized by:
  - impaired glucose tolerance
  - insulin resistance
  - low physical capacity
  - enlarged type IIa muscle fibers, indicating diminished oxygen and substrate supply for metabolic processes.

These findings could be indicative of a prediabetic state.

Diabetes

- Women with Turner syndrome are at a moderately increased risk of developing type 1 diabetes in childhood and a substantially increased risk of developing type 2 diabetes by adult years. The risk of developing type 2 diabetes can be substantially reduced by maintaining a normal weight.
- The reason for the high risk of diabetes amongst individuals with Turner syndrome is unknown.
- Diabetes type II can be controlled through careful monitoring of blood-sugar levels, diet, exercise, regular doctor visits and sometimes medication.
- The incidence is not increased by treatment with GH.
The 3Yr cumulative incidence of diabetes in 3234 adults with IGT

NEJM 2002; 346: 393-403
Impaired insulin secretion is not secondary to obesity or hypogonadism in TS, but it is a distinct entity characterized by decreased insulin secretion, suggesting that haploinsufficiency for X-chromosome gene(s) impairs -cell function and predisposes to diabetes mellitus in TS.
“Hypertension is more common in patients with TS than in the general population. Blood pressure should therefore be monitored routinely and hypertension treated vigorously with reference to age-specific normal ranges. Dyslipidemia should be treated with specific lipid-lowering drugs.”
WHAT TO DO?

• RECOGNIZE IT’S NOT YOUR FAULT
• JUST DO IT
Relationship Between Energy Balance, Behavior and Targets of Behavior Therapy

\[ \text{Weight Change} = \text{Total energy intake} - \text{Total energy expenditure} \]

- Eating
- Activity
- Basal energy

Targets of behavior therapy
Health

Why should I take time to become healthy?

• Your body works better
• You can accomplish more
• You can feel better
• You are less likely to get certain illnesses
OBESITY TREATMENT GOALS

- Focus on health rather than appearance
- Encourage preference for healthful foods, awareness of hunger and satiety
- Emphasize physical activity
- Teach behavior change techniques
- Use social support
- Improve parent-child interaction
Basic Tenets of Treatment

• Nutrition
  • Stoplight Approach (Epstein, 1994)

• Activity Level

• Behavioral Techniques
  • Self-Monitoring
  • Stimulus Control
  • Contracting

• Hunger and Satiety
  Head Hunger versus Stomach Hunger
BASIC BEHAVIORAL TECHNIQUES

- Self-monitoring*
- Stimulus control*
- Contingency management
  - Goal-setting
  - Reinforcement (praise)
- Contracting*

- Modeling/social skills training
- Cognitive Skills
  - Reframing
  - Self efficacy
  - Problem-solving
- Relapse prevention
**STIMULUS CONTROL TECHNIQUES**

- Eat each meals at approximately same time/place.
- Eat while seated at table.
- Eliminate distractions.
- Place foods on small plate.
- Slow pace of eating by placing utensil(s) on table between bites.
- Pause at the end of meal to evaluate satiety level.
- Serve foods in small quantities.
- Avoid purchasing problematic foods or buy single portions.
BEHAVIORAL CONTRACTING

• Specify clearly defined behavioral goals.
• Specify time frame for achieving behavioral goals.
• Gradually change habits to achieve final target.
• Set realistic goals.
• Establish contract for behavior change, not weight change.
Oh please, scale, say that I'm down to 110, so I'll look really good and I'll meet someone, and we'll fall in love and get married and I'll be happy for the rest of my life...
The first part of our equation is activity

Get moving, find something you enjoy
**Physical Activity Pyramid**

**Cut down on**
- Watching TV
- Playing video and computer games

**2-3 Times/wk**
- **Leisure/Play**
  - Swinging
  - Tumbling
  - Canoeing
- **Strength/Flexibility**
  - Pull-ups/Push-ups
  - Rope climbing
  - Ballet
  - Yoga

**3-5 Times/wk**
- **Aerobic**
  - Biking
  - Running
  - Swimming
  - Skateboarding
  - Inline Skating
  - Jumping Rope
- **Recreational**
  - Basketball
  - Soccer
  - Skiing
  - Relay Races
  - Volleyball

**Every Day**
- Play Outside
- Ride your bike to the store
- Chores around the house
- Take the stairs instead of the elevator
- Take your dog for a walk
EXERCISE

• LOOK FOR EXCUSES TO INCREASE WORK LOAD
  - STAIRS INSTEAD OF ELEVATOR
  - PARKING A FEW BLOCKS AWAY FROM DESTINATION
  - WALKING WITH FAMILY AFTER DINNER
  - “FIDGET”
YOU CAN LOSE WEIGHT IF YOU WRITE DOWN ALL OF YOUR MEALS IN A JOURNAL.

THAT'S ALL I NEED TO DO?

YES, IF YOU USE OUR PATENTED WEIGHT-LOSS PENCIL.
The second part of the equation is nutrition.
Your body needs the right fuel to help it work well.
Stoplight Approach (Epstein et. al.)

Traffic Light Diet

Red: High in fat/simple carbohydrates
Low in nutrient density

Yellow: Staples of diet
Provides basic nutrition

Green: Lower than 20KCAL/average serving
Represented in fruits/vegetables
Carbohydrates

• Understanding the difference between complex (high fiber) carbohydrates and simple (processed) carbohydrates
• Benefits & types of complex carbohydrates
• Emphasizing portion control
• Incorporating into balanced realistic meal plan
Protein

• Focus on lean choices and low fat preparation as part of, (not center of) a balanced meal
• Understanding what a serving is and how many servings are needed per day
• Knowing the risks of too much or too little protein
• Overeating anything will make you gain weight
What About Fats?

- Fats:
  - Important part of our cells and the “messengers in our brain”
  - Needed for absorption of Vitamins “A,D,E,K”
  - Helps us keep our body temperature normal and insulates our organs
  - Largest form of stored energy
  - There are three basic categories of fats (saturated, polyunsaturated, and monounsaturated)

- **Monounsaturated fats** are the “good for you” fats found in nuts, avocado, canola oil, olives, olive oil, natural peanut butter, and fish. **Monounsaturated fats** help lower bad cholesterol, raise good cholesterol (HDL) and have important vitamins, minerals, and brain “helpers”
MORE FAT !?!

- **Polyunsaturated fats** are found in vegetable oils and can help lower total cholesterol.
- **Saturated fats** are found in butter, fat on red meat, and in full fat cheese and dairy.
- **Saturated fats** also include **Trans-fatty acids** a.k.a. hydrogenated fats - these are found in fried food, most margarine, packaged and processed cakes, cookies, and crackers.
- These “bad” fats can raise our cholesterol and other fats in our blood.

These bad fats can also lead to heart disease and certain types of cancer.
Practical Tips for a Healthy Lifestyle

• Healthy eating and home environment
• Low fat methods of food preparation
• Use of low fat food products
• Label reading/identification
• Portion Control
• Increasing Fruit & Vegetable Intake
• Beverages Count
BEVERAGES COUNT

• "Natural" does not mean it is good for you. Be aware of juices, smoothies, koolaid, sodas, flavored waters, and iced teas.

• Encourage water, seltzer, crystal lite, diluted juice, and diet beverages.

• Try homemade teas, lemonades, vegetable juices, juice iced cubes.

• Try low-calorie smoothies for a snack (do not add to a meal).
Why Breakfast?!?!

- Breakfast gives the body energy for the whole day
- Breakfast eaters do better at school (and work)
- Breakfast eaters have lower cholesterol levels, lower BMI’s, and are sick less often
- Breakfast eaters meet their nutritional needs
FAST & EASY BREAKFASTS

• Low fat grilled cheese on whole wheat and sliced tomato
• Breakfast smoothie: milk, yogurt or silken tofu, and fruit
• Oatmeal with nuts, raisins, & cinnamon
• Whole wheat toast with peanut butter

Whole grain waffles w/ sliced fruit
LABEL READING & PORTION SIZING

• Reading labels can help us learn what a serving is - this is an important part of weight management

• Check the label for the serving size and servings per container

• Buy single serving / mini-sized snacks

• Measuring cups and standardized spoons are a great tool to help control portions
Bottom Line Information

• Do Not skip meals, Breakfast is especially important !!
• Beverages count - drink water, seltzer, diet beverages etc. (avoid juice/soda)
• Avoid/Limit processed & fast food
• Choose whole grains & high fiber foods
• Focus on Moderation not Elimination
• Increase physical activity