Disclosures

- No conflicts of interest
- Off label use of medications will be discussed
Obesity in the U.S.

- 34.9% of adults are considered obese as of 2011–2012*
  - Unchanged 2003–2004 to the present

- 6.4% of adults (>20 yrs of age)* are considered extremely obese (a four-fold increase from 1976–1980)**
  - Extreme obesity=BMI≥40kg/m2


Child & Adolescent Obesity in US

- 16.9% of 2 to 19 yr olds are obese (BMI≥95%)
- 20.5% of adolescents (12 to 19 yrs old) are considered obese (BMI≥95%) in 2011–2012.*
- 4% of adolescents considered to have extreme obesity (≥99%ile)**
- Morbidly obese adolescents** are at a higher risk of:
  - Remaining obese as adults
  - developing obesity related co-morbidities in young adulthood and beyond

*Ogden CL, et. al. JAMA 2014; 311(8)): 806–814.
BMI-for-age and Risk Factors


Cutoff Points for Severe Obesity: Adolescent

a. Girls

b. Boys

BMI curves from CDC reference growth charts associated with the newly proposed definition for severe obesity for boys (A) and girls (B).

Obesity Classification–Adult

- Overweight – BMI = 25.00 to 29.99 kg/m²
- Class 1 Obesity – BMI = 30.00 to 34.99
- Class 2 Obesity – BMI = 35.00 to 39.99
- Class 3 Obesity – BMI ≥ 40.00 kg/m²

Classification Obesity – Child

- Overweight
  - BMI ≥ 85th to 95th
- Obese
  - BMI ≥ 95th to 99th
- Severe obesity
  - BMI ≥ 99th percentile
  - Or
  - BMI ≥ 1.2 x 95th centile = Class 2 (BMI ≥ 35 to 39.99)

Prevalence of Cardiovascular risk by obesity classification


Oxidized low-density lipoprotein (LDL; A), C-reactive protein (B), and interleukin-6 (C) in normal weight (NW), overweight (OW), obesity (OB), and extreme obesity (EO; body mass index [BMI] ≥120% of the 95th percentile or BMI ≥35 kg/m2).


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Relation of childhood BMI to adult obesity

<table>
<thead>
<tr>
<th>N</th>
<th>Childhood</th>
<th>Adulthood (mean age=27 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BMI%ile</td>
<td>Age</td>
</tr>
<tr>
<td>1161</td>
<td>0-49</td>
<td>13 ± 2</td>
</tr>
<tr>
<td>832</td>
<td>50-84</td>
<td>12 ± 2</td>
</tr>
<tr>
<td>130</td>
<td>85-89</td>
<td>13 ± 2</td>
</tr>
<tr>
<td>121</td>
<td>90-94</td>
<td>12 ± 2</td>
</tr>
<tr>
<td>122</td>
<td>95-98</td>
<td>13 ± 2</td>
</tr>
<tr>
<td>26</td>
<td>≥99</td>
<td>12 ± 3</td>
</tr>
</tbody>
</table>

Values are mean ± SD.


Bariatric Surgery Adults (Mean age=46): Risk of Comorbidities at time of surgery by BMI status at age 18 yrs

<table>
<thead>
<tr>
<th>CoMorbidity</th>
<th>Overweight</th>
<th>Class 1</th>
<th>Class 2/3</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venous edema</td>
<td>2.20</td>
<td>3.02</td>
<td>5.35</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Severe Walking limitation</td>
<td>2.16</td>
<td>1.60</td>
<td>4.21</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Abnormal Kidney function</td>
<td>1.49</td>
<td>1.83</td>
<td>4.02</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.07</td>
<td>1.37</td>
<td>1.42</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>1.05</td>
<td>1.20</td>
<td>1.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>1.12</td>
<td>1.42</td>
<td>1.02</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Women</td>
<td>1.07</td>
<td>1.16</td>
<td>1.25</td>
<td>.04</td>
</tr>
</tbody>
</table>

**Medical complications of Obesity in Childhood : Insulin Resistance**

- Abnormal Glucose metabolism‡ and Type 2 diabetes *
- Hypertension‡
- Metabolic Syndrome‡
- Hyperlipidemia‡
- Nonalcoholic fatty liver disease*
- Polycystic ovarian syndrome

*Major comorbid indication for bariatric surgery
‡ Relative comorbid indication for bariatric surgery

---

**Outcome of IGT**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IGT-&gt;NGT N=15</th>
<th>IGT-&gt;T2DM N=8</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity (C/AA/H)</td>
<td>8/3/4</td>
<td>1/7/0</td>
<td>0.007</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>12.4±2.5</td>
<td>11.9±3.2</td>
<td>0.78</td>
</tr>
<tr>
<td>BMI(kg/m²)/BMI-z</td>
<td>33.1±6.9/2.27±0.39</td>
<td>44.8±9/2.76±0.21</td>
<td>0.01</td>
</tr>
<tr>
<td>Wgt. Change(kg)</td>
<td>6.1±8.4</td>
<td>27.3±23.1</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Weiss et al Diabetes Care 28(4): 902, 2005
**Prevalence Systolic Hypertension by BMI, Age 12–16yrs (N=2640)**

![Graph showing prevalence of systolic hypertension by BMI](image)

Sorof, J and Daniels S. Hypertension 40:441-447, 2002

---

**Metabolic Syndrome**

- **Definition**
  - Cardiovascular risk factors associated with insulin resistance
    - Hypertension
    - Dyslipidemia
    - Visceral Adiposity

*Reaven, GM. Diabetes 37:1595-1607, 1988*
**ATPIII criteria and criteria modified for age–NHANESIII**

**ANY 3 OF THE FOLLOWING:**

<table>
<thead>
<tr>
<th>AGE Group</th>
<th>ATPIII</th>
<th>deFerranti, SD et al., 2004*</th>
<th>Cook, S et al, 2003**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>12 to 19yrs</td>
<td>≥150</td>
<td>≥100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≥110</td>
</tr>
<tr>
<td>Triglyceride (mg/dl)</td>
<td>≥150</td>
<td>≥100</td>
<td>≥110</td>
</tr>
<tr>
<td>Low HDL (mg/dl)</td>
<td>Males</td>
<td>&lt;40</td>
<td>&lt;50 except 15-19yr=&lt;45</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>&lt;50</td>
<td>≤40</td>
</tr>
<tr>
<td>FBS (mg/dl)</td>
<td>≥110</td>
<td>≥110</td>
<td>≥110</td>
</tr>
<tr>
<td>Waist circ (cm)</td>
<td>Males</td>
<td>&gt;102cm</td>
<td>&gt;75%ile for age and gender</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>&gt;88cm</td>
<td>&gt;75%ile for age and gender</td>
</tr>
<tr>
<td>BP (mmHg)</td>
<td>≥130/85</td>
<td>&gt;90%ile for age, gender and height</td>
<td>≥90%ile</td>
</tr>
</tbody>
</table>

*deFerranti, SD et al. Circulation 110:2494-2497, 2004

**Prevalence Metabolic Syndrome: Adolescents (12–19yrs), NHANESIII**

![BMI%ile graph](attachment:image.png)

- **Overall**
- **Elevated BMI**

DeFerranti N=1960
Cook N=2340

**GOAL:**
Prevent development of complications of obesity in childhood or as adults; Avoidance of adverse effects, particularly the compromise of growth

**Interventions**

- **Life–Style changes**
  - Dietary changes
  - Increased physical activity
- **Prescription weight–loss medication**
  - (eg. Orlistat)
- **Weight–loss surgery (WLS)**
  - (eg. Roux–en–y gastric bypass)

**Treatment Options**
Diet (1)

- Balanced Hypocaloric* (30–40% reduction in intake)
  - Low fat (25–30% of calories)
  - High complex carbohydrate (50–55% of calories)
  - Adequate protein (20–25% of calories)
  * Considered safe with normal growth expected\(^1,2\)

\(^1\)Williams CL et al. Ann NY Acad Sci 699:207, 1993

Diet (2)

- Protein sparing modified fast*
  - Low calorie (600–800 / day)
  - Much water
  - Multivitamin/mineral supplement
  - Increased intake of low-starch vegetables

*Considered experimental/high risk\(^1\)

- Complications: nitrogen loss, orthostatic hypotension, cardiac arrhythmias, impaired growth, hair loss, gallstones

Diet (3)

- Low Glycemic Index (GI)
  - 45% to 50% Carbohydrates
  - 30% to 35% Fat

- Increased non-starchy vegetables, legumes, fruits, nuts
- Decreased bread, potatoes, rice, refined flour and sugar

<table>
<thead>
<tr>
<th>Food</th>
<th>Glycemic Index†</th>
<th>Glycemic Load‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant rice</td>
<td>91</td>
<td>24.8 (110 g)</td>
</tr>
<tr>
<td>Baked potato</td>
<td>85</td>
<td>20.3 (110 g)</td>
</tr>
<tr>
<td>Corn flakes</td>
<td>84</td>
<td>21.0 (225 mL)</td>
</tr>
<tr>
<td>Carrot</td>
<td>71</td>
<td>3.8 (55 g)</td>
</tr>
<tr>
<td>White bread</td>
<td>70</td>
<td>21.0 (2 slices)</td>
</tr>
<tr>
<td>Rye bread</td>
<td>65</td>
<td>19.5 (2 slices)</td>
</tr>
<tr>
<td>Muesli</td>
<td>56</td>
<td>16.8 (110 mL)</td>
</tr>
<tr>
<td>Banana</td>
<td>53</td>
<td>13.3 (170 g)</td>
</tr>
<tr>
<td>Spaghetti</td>
<td>41</td>
<td>16.4 (55 g)</td>
</tr>
<tr>
<td>Apple</td>
<td>36</td>
<td>8.1 (170 g)</td>
</tr>
<tr>
<td>Lentil beans</td>
<td>29</td>
<td>5.7 (110 mL)</td>
</tr>
<tr>
<td>Milk</td>
<td>27</td>
<td>3.2 (225 mL)</td>
</tr>
<tr>
<td>Peanuts</td>
<td>14</td>
<td>0.7 (30 g)</td>
</tr>
<tr>
<td>Broccoli</td>
<td>. .</td>
<td>. .</td>
</tr>
</tbody>
</table>
Weighted mean differences in weight loss after 6 (A) and 12 (B) months of follow-up
LOW Carb vs LOW Fat Diet

![Graph showing weighted mean differences in weight loss](image)


Impact of weight loss and maintenance with ad libitum diets varying in protein and glycemic index content on metabolic syndrome

![Graph showing impact of weight loss and maintenance](image)

Fig. 2 Prevalence of metabolic syndrome after the low-calorie diet and 6 mo later, at post-intervention (n = 434). HGI, high glycemic index; HP, high protein; LCD, low-calorie diet; LGI, low glycemic index; LP, low protein; MetSyn, metabolic syndrome. Bars( ) indicate 95% confidence intervals. Within-group changes in prevalence were examined by using McNemar tests; no significance was found.


http://dx.doi.org/10.1016/j.nut.2013.09.001
Outcome: Structured Weight Loss Programs with Adults

80 Studies, N=26,455 with 18,199 completers (69%)

- Mean Weight Loss of 5 to 8.5kg (5% to 9%) at 6 months, after which:
  - Weight loss plateaus.

- Programs continuing for 48 months saw a 3 to 6kg (3% to 6%) weight loss maintenance


Effect of Low Fat vs Low Glyemic diet on BMI

Means (± SDs) for imputed BMI (A) and completers BMI (B) for the entire study period for the LGD (closed circles) and LFD (open circles).

7 to 15yr old (n=113) Hispanic Children

Impact at 6 months of intervention (N=4 studies)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Diet only</th>
<th>Exercise only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Change BMI</td>
<td>-0.8 to -2.7 kg/m²</td>
<td>-0.3 to -1.0 kg/m²</td>
</tr>
<tr>
<td>Mean Change Waist circ.</td>
<td>-1.1 to -3.8 cm</td>
<td>-0.7 to -3.9 cm</td>
</tr>
</tbody>
</table>

Follow-up 6 to 9 months post-intervention

3 studies 1 with sustained effect: Younger children Parents only nutrition education

CAST indicates aerobic and strength training; IV, inverse variance; and ST, strength training. Body mass index is calculated as weight in kilograms divided by height in meters squared.
## LDL-C

<table>
<thead>
<tr>
<th>Diet + Exercise</th>
<th>Diet Only</th>
<th>Mean Difference</th>
<th>Mean Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato, L. 2013.</td>
<td>0.64</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Bicep L. 2013.</td>
<td>0.61</td>
<td>1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Subtotal (L.2013)</td>
<td>1.25</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>High-intensity (LL.2013)</td>
<td>1.25</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Total (S.D.)</td>
<td>1.25</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

## HDL-C

<table>
<thead>
<tr>
<th>Diet + Exercise</th>
<th>Diet Only</th>
<th>Mean Difference</th>
<th>Mean Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato, L. 2013.</td>
<td>0.28</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Bicep L. 2013.</td>
<td>0.28</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Subtotal (L.2013)</td>
<td>0.28</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>High-intensity (LL.2013)</td>
<td>0.28</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Total (S.D.)</td>
<td>0.28</td>
<td>0.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>
From: Impact of Dietary and Exercise Interventions on Weight Change and Metabolic Outcomes in Obese Children and Adolescents: A Systematic Review and Meta-analysis of Randomized Trials


Triglycerides

<table>
<thead>
<tr>
<th>Triglycerides</th>
<th>Diet-Exercise</th>
<th>Diet-Body</th>
<th>Mean Difference % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet-exercise training</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Diet-exercise training</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Diet-exercise training</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Diet-exercise training</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Diet-exercise training</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Pharmacotherapy

Outcomes
<table>
<thead>
<tr>
<th>Drug</th>
<th>Mechanism of Action</th>
<th>Approval Status</th>
<th>Side-effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orlistat</td>
<td>Inhibition of gastric and pancreatic lipases</td>
<td>Approved age ≥ 12 yrs</td>
<td>Flatus, incontinence, loose stools, bowel urgency</td>
</tr>
</tbody>
</table>
| Lorcaserin            | Serotonin type 2C receptor agonist            | Approved age ≥ 18 yrs | • Interaction with serotonin reuptake inhibitors (antidepressants)  
|                       |                                               |                  | • Risk of teratogenicity  
|                       |                                               |                  | • Serotonergic effects (blurred vision, dizziness, headache, GI effects & nausea, somnolence) |
| Topiramate/Phentermine| Unknown/increase in synaptic noradrenaline, dopamine, serotonin | • Approved age ≥ 18 yrs  
|                       |                                               | • Not approved in Europe | • Dizziness, paraesthesias, attention deficit/ Dry mouth, palpitations, insomnia, constipation  
|                       |                                               |                  | • Teratogenicity  
|                       |                                               |                  | • Acute myopia & 2ndary angle closure glaucoma  
|                       |                                               |                  | • Cognitive dysfunction (difficulty with words and memory)  
|                       |                                               |                  | • Contraindicated with MAO inhibitors |
| Liraglutide           | GLP–1 agonist                                 | Treatment of T2DM age ≥ 18 | Mild to moderate nausea and vomiting  
|                       |                                               |                  | Concern re: pancreatitis and pancreatic CA |
Placebo subtracted weight reduction (kg) with orlistat, Adults

From Medical Letter. JAMA 2016; 315(11):1161-1162
Yanovsk SZ, Yanovski JA. JAMA 2014; 311(1):74-76.
Effectiveness Current Pharmacotherapy

Proportion of Patient achieving ≥5% weight loss

Yanovski SZ, Yanovski JA. JAMA 2014; 311(1):74-76.
Apovian CM et al. Obesity 2015; 23(2): S1-S26

Average Wgt Loss (Adult) Compared to Advice Only or Reduced energy diet

80 studies, N=26,455; 18,199 completers (69%)


Bariatric Surgery

- Adjustable Gastric Band
- Vertical Sleeve Gastrectomy
- Roux-en-Y Gastric Bypass

Bariatric surgery

- Bariatrics: a branch of medicine that deals with the treatment of obesity.

Malabsorptive procedures
- Restriction of absorption in GI tract
- Rarely used due to lifelong management and complications
- Biliopancreatic diversion with Duodenal switch

Restrictive procedures
- Restriction of food intake
- Vertical banded Gastroplasty (Stomach Stapling)
- Sleeve Gastrectomy

Combination procedures
- Weight loss both through restriction of intake and absorption
- Roux-en-Y Gastric Bypass

Malabsorptive procedures:
- http://www.homerton.nhs.uk/uploaded_files/Our_services/dudena_switch_blus.jpg

Restrictive procedures:
- http://www.overcomingobesity.net/images/vertical-banded-gastroplast.jpg
Restrictive procedure
Weight loss through restriction of food intake
http://www.overcomingobesity.net/adjustable-gastric-banding.cfm
Effect of Bariatric Procedures on Weight Loss


Outcome Adolescent Bariatric Surgery

### Metabolic Outcomes after LAGB

<table>
<thead>
<tr>
<th>Variable</th>
<th>Timepoint</th>
<th>P†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>48.8 ± 1.4 (35.9–65.4)</td>
<td>42.9 ± 1.5 (27.7–65.8)</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>135.0 ± 5.2 (94.5–198.4)</td>
<td>120.2 ± 5.2 (68.4–167.6)</td>
</tr>
<tr>
<td><strong>WC (cm)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>135.4 ± 3.6* (109.5–168)</td>
<td>123.5 ± 3.5 (87–165)</td>
</tr>
<tr>
<td><strong>SBP (%)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>71.1 ± 5.0 (6–98)</td>
<td>58.1 ± 5.1 (5–100)</td>
</tr>
<tr>
<td><strong>DBP (%)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>71.7 ± 3.9 (25–100)</td>
<td>68.0 ± 4.0 (16–98)</td>
</tr>
<tr>
<td><strong>TG (mg/dl)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>114.9 ± 11.5 (44–279)</td>
<td>108.4 ± 11.6* (36–388)</td>
</tr>
<tr>
<td><strong>FBS (mg/dl)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>86.5 ± 1.9 (71–134)</td>
<td>84.0 ± 1.9 (73–111)</td>
</tr>
<tr>
<td><strong>HDL (mg/dl)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>42.3 ± 1.8 (30–64)</td>
<td>46.0 ± 1.8* (28–65)</td>
</tr>
<tr>
<td><strong>CRP (mg/L)</strong></td>
<td><strong>Baseline</strong></td>
<td><strong>12 m post–LAGB</strong></td>
</tr>
<tr>
<td></td>
<td>8.1 ± 1.2* (0.73–27)</td>
<td>5.6 ± 1.2* (0.22–23.3)</td>
</tr>
</tbody>
</table>

Weight Changes and Prevalence of Dyslipidemia during the 3-Year Period after Bariatric Surgery.


Evidenced Based Recommendations re: WLS in Adolescents

- **A:** There is good evidence to support the recommendation. (e.g. Randomized controlled trials)
- **B:** There is fair evidence to support the recommendation.
- **C:** There is insufficient evidence to recommend for or against the inclusion.
- **D:** There is fair evidence to support the recommendation be excluded or derives only from expert opinion.

Recommendation for WLS: Adolescents (1)

- When combination procedures are used in adolescents, physical maturity should be documented
  - Completion of 95% of adult stature based on radiographic study. (category D).

- Psychological maturity—assessed prior to WLS
  - Demonstrated by understanding of the surgery, mature motivations for the operation, and compliance with preoperative therapy—(category D).

- BMI criteria in children and adolescents should be:
  - ≥35 with major comorbidities (i.e., type 2 diabetes mellitus, moderate–to–severe sleep apnea (AH1 > 15), pseudotumor cerebri, or severe NASH
  - Or, ≥40 with other comorbidities (e.g., HTN, insulin resistance, glucose intolerance, substantially impaired QOL or activities of daily living, dyslipidemia, sleep apnea with AH1 5) (categories B and C).

Pratt JSA, et. al. Obesity 2009; 17(5): 901-910
Michalsky, M et. al. SOARD 2012; 8:1-7

Recommendation for WLS: Adolescents (2)

- Children and adolescents should demonstrate the ability to comply with treatment regimens and medical monitoring before WLS.
  - For example, consistent attendance in a prolonged weight management program will provide important assurance of postoperative compliance (category D)
  - Individuals with mental retardation vary in their capacity to demonstrate knowledge, motivation, and compliance; they should, therefore, be evaluated for WLS on a case–by–case basis.
    - For these children, we suggest including an ethicist on the multidisciplinary evaluation team (category D).

Pratt JSA, et. al. Obesity 2009; 17(5): 901-910
Recommendation for WLS: Adolescents (3)

- Patients with syndromic obesity, endocrine disorders, obesity that appears to be related to the use of weight-promoting medications, and those in whom obesity cannot be controlled through medical interventions and/or carefully designed environmental and behavioral management should be considered for surgery on a case–by–case basis (category D).

- Patients with uncontrolled psychosis (presence of hallucinations and delusions), bipolar disorder (extreme mood lability), or substance use disorders can be considered for WLS on a case–by–case basis after they have been in remission for 1 year (category C).

Pratt JSA, et. al. Obesity 2009; 17(5): 901-910
Prevention (BMI 5 to 85th %ile)

- Dietary Intake
  - Limit consumption of sugar sweetened beverages
  - Encourage 5–a–day fruits and vegetables

- Physical Activity
  - Limit screen time to 1–2hrs/day starting age 5yrs
  - No TV/computer screens in bedroom
  - Encourage 60min moderate to vigorous physical activity/day

- Eating Behaviors
  - Daily breakfast
  - Limit restaurant eating
  - Encourage family meals
  - Limit portion size

Stage 1: Prevention + Protocol (BMI ≥ 85th %ile)

- Same as prevention (5th to 85th %ile), plus
  - Monthly follow-up
  - Target: weight maintenance with decreasing BMI as height increases
  - If no improvement in 3 to 6months, start a structured weight management program.
Stage 2: Structured weight management program (BMI ≥ 85th%ile)

- Balanced macronutrient diet emphasizing low amounts of energy dense foods
- Structured meals
- Supervised active play for 60min/day
- Screen time ≤ 1hr/day
- Increased monitoring of screen time, physical activity, meal logs by patient, family, provider

**Target:** Wgt loss = 1lb/month 2–11 yrs or 2lbs/week in older obese/overweight children and adolescents
- If no improvement in 3 to 6 months, move to Stage 3

Stage 3: Comprehensive Multidisciplinary Protocol (BMI ≥ 85th%ile)

- Eating and activity goals same as stage 2
- Structured behavioral modification program
  - Food and activity monitoring
  - Setting of short-term diet and activity goals
  - Involvement of primary care givers for children under 12yrs of age, and training of care givers for all children

**Target:** Weight maintenance or gradual weight loss till BMI ≤ 85th%ile not to exceed 1lb/month in children 2–5yrs or 2lbs/week in older obese children/adolescents
- For children unsuccessful with BMI ≥ 95th%ile and with significant comorbidities or with BMI ≥ 99th%ile, go to Stage 4.
Stage 4: Tertiary Care Protocol

- Referral to pediatric tertiary care center with expertise in pediatric obesity which operates under a designed protocol
  - Diet and activity counseling
  - Consideration to:
    - Meal replacement
    - Very low calorie diets
    - Medication
    - Surgery

Summary

- Morbid obesity in adolescence has little chance of remission
- Morbid obesity in childhood/adolescence is associated with both increased co-morbidities as a child and as an adult
- Diet and exercise interventions have modest impact on weight loss and comorbidities in children and pharmacotherapy is essentially absent
- Bariatric surgery has significant impact on weight loss and comorbidities in adults with less clear documentation with regard to comorbidities in adolescence though evidence is increasing
Conclusion

- There is an absence of pharmacotherapy alternatives for the pediatric population.
- BMI greater than the 99th percentile in adolescence represents a reasonable time to consider bariatric surgery as an option.
- We are still missing very long-term data to document the durability as well as safety of these procedures, though recent 3 year data is impressive.