Childhood Obesity Through the Lens of Equity, Diversity, & Inclusion

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Disclosures

- Advisor- Novo Nordisk, Calibrate, GoodRx, Doximity
- Research- Amazon
## Objectives

<table>
<thead>
<tr>
<th>Discuss</th>
<th>Discuss racial and ethnic disparities in the prevalence, treatment, and pathophysiology of obesity.</th>
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<tbody>
<tr>
<td>Explore</td>
<td>Explore issues surrounding obesity and socioeconomic status, education level, and provider diagnosis in obesity.</td>
</tr>
<tr>
<td>Understand</td>
<td>Understand differences in response to treatment of racial and ethnic minorities with regards to pharmacotherapy and weight loss surgery.</td>
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</tbody>
</table>
# How is Obesity defined in Children and Adolescents?

<table>
<thead>
<tr>
<th>Weight Status Category</th>
<th>BMI Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 5&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Healthy Weight</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; Percentile - &lt;85&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Overweight</td>
<td>85&lt;sup&gt;th&lt;/sup&gt; Percentile - &lt;95&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Class I Obesity</td>
<td>≥ 95&lt;sup&gt;th&lt;/sup&gt; Percentile - &lt;120&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Class II Obesity</td>
<td>≥ 120&lt;sup&gt;th&lt;/sup&gt; Percentile - &lt;140&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Class III Obesity</td>
<td>≥ 140&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
</tbody>
</table>
Trends in obesity among adults **AND** children and adolescents aged 2-19, by sex, United States, 1999 through 2015-2016

Prevalence of obesity among boys and girls aged 12-19 years, by race and ethnicity: United States, 2015-2016

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey (NHANES), 2015-2016
Prevalence\(^{\dagger}\) of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2011

\(^{\dagger}\) Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) \(\geq\) 30%.
Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory

Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.


*Sample size < 50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2017

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Non-Hispanic White Adults, by State and Territory, BRFSS


*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Non-Hispanic White Adults, by State and Territory, BRFSS, 2015-2017

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Hispanic Adults, by State and Territory, BRFSS


*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Hispanic Adults, by State and Territory, BRFSS, 2015-2017

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Non-Hispanic Black Adults, by State and Territory, BRFSS


*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among Non-Hispanic Black Adults, by State and Territory, BRFSS, 2015-2017

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
• Age-adjusted Total Body Fat was greater in African Americans (P = 0.017) and females (P < 0.0001) compared with Whites and males, respectively.

• The demonstrated ethnic and sex differences are important confounders in the prevalence of obesity and in the assignment of disease risk in children and adolescents.

VAT: Visceral Adipose Tissue
SAT: Subcutaneous Adipose Tissue
Regulation of Food Intake

http://www.cellbiol.net/ste/alpobesity2.php
<table>
<thead>
<tr>
<th>Substance</th>
<th>Production Site</th>
<th>Effect (Relevant for Feeding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghrelin (grow)</td>
<td>• Stomach (fundus region, entero-endocrine cells) • Neurons in the hypothalamus</td>
<td>Appetite (orexigenic)</td>
</tr>
<tr>
<td>Anandamide (endocannabinoid, ananda; bliss, delight + amide)</td>
<td>Small intestine</td>
<td>Appetite (orexigenic)</td>
</tr>
<tr>
<td>Insulin (insula; island or islet)</td>
<td>Pancreas (β-cells in islets of Langerhans)</td>
<td>• Satiety (anorexigenic) • glycogen and lipid storage</td>
</tr>
<tr>
<td>Leptin (leptos, thin)</td>
<td>• Adipocytes (long term) • Stomach (short term)</td>
<td>Satiety (anorexigenic)</td>
</tr>
<tr>
<td>CCK (cholecystokinin, “move the bile-sac”)</td>
<td>Small intestine</td>
<td>• Early satiety (anorexigenic) • release of digestive enzymes from exocrine pancreas, bile from the gallbladder and H+ from parietal cells in stomach</td>
</tr>
<tr>
<td>PYY (peptide tyrosine tyrosine)</td>
<td>• Ileum • colon</td>
<td>Satiety (anorexigenic)</td>
</tr>
</tbody>
</table>

http://www.cellbiol.net/stel/apobesity4.php
Regulation of Food Intake
Central Nervous System regulates weight
Insulin, Estrogen, and Fat Mass in African-American vs. European American adolescent girls

**Fig. 1.** Comparison by age for A1Rg in AA (■) and EA (▲) girls. Multivariate linear regression modeling indicated significant age (P < 0.001) and race (P < 0.001) effects. Error bars, SEM. **, P < 0.01; ***, P < 0.001.

**Fig. 2.** Comparison in serum E2 concentration by age in AA (■) and EA (▲) girls. Multivariate linear regression modeling indicated significant age (P < 0.001) and race (P < 0.05) effects as well as age by race interaction (P < 0.001). Error bars, SEM. *, P < 0.05; **, P < 0.01; ***, P < 0.001.

Insulin, Estrogen, and Fat Mass in African-American vs. European American adolescent girls

FIG. 3. Racial differences in progression though puberty in AA (■) and EA (▲) girls. Error bars, SEM. *, P < 0.05.

FIG. 4. Comparison between increase in percent fat before and after menarche in AA (shaded bars) and EA (unshaded bars) girls.
BDNF Regulation and Obesity

Potential Reasons for Ethnic Disparities in Obesity

- ↑↑ Energy Intake
- ↓ Energy Expenditure
- ↑↑ Life Stressors
  - Racism
  - Lack of Career Options
  - Family Illness/Death
- Cultural Influences
- Genetics

Johnston DW et al. Demography 2011
Johnson P et al. ABNF 2012
Factors which affect access to weight loss surgery

Race
Age
Sex
SES
Location
Referral
Adjustment of BMI Scale for Race, Gender, and Obesity Related Diseases

<table>
<thead>
<tr>
<th>Obesity Co-morbidity</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Black</td>
<td>Hispanic</td>
</tr>
<tr>
<td>Hypertension</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Diabetes</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>≥2 risk factors</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Average</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

BMI = body mass index; ROC = receiver operating characteristic.
30 year old woman s/p RYGB

86% EBWL/41.5% TBWL

BMI: 48.5
BMI: 28
BMI: 32
86% EBWL/41.5% TBWL

Bupropion/Naltrexone
Summary

- Obesity is a Multi-factorial disease process
- Regulation of food intake is complex
- ↑ Prevalence of Obesity in Ethnic Minorities
- Persons vary with response to education level and obesity
- Health Care Providers are less likely to diagnose ethnic minorities with overweight/obesity
- Ethnic minorities have less pronounced response to weight loss surgery and pharmacotherapy
Action Items

- Steps should be taken to ascertain etiology of higher prevalence of obesity in ethnic minorities
- Health care providers should be more vigilant about giving appropriate diagnosis of overweight/obesity in ethnic minorities
- Strategies should be employed to address disparities in prevention and treatment of obesity in ethnic minorities
Reference for Physicians and Patients