The Obesity Epidemic & Opioid Crisis Threats to Mortality Improvement

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VP & Chief Medical Officer,
SCOR Global Life Americas
Topics for today

**Obesity**
Define the problem
Delve into the causes
Children and adolescents
Complications/Mortality
Discuss solutions

**Opioids**
The Problem
Overdoses and Mortality
Solutions
Step One

Calculate Body Mass Index (BMI)

- English – $703 \times \left(\frac{\text{weight in lbs}}{\text{height in inches}^2}\right)$
- Metric – weight in kg/(height in meters)$^2$
**Children Ages 2-20**

**BMI Classification – Children ages 2-20**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;5&lt;sup&gt;th&lt;/sup&gt; Percentile for Age and Sex</td>
</tr>
<tr>
<td>Normal weight</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;-85&lt;sup&gt;th&lt;/sup&gt; Percentile for Age and Sex</td>
</tr>
<tr>
<td>Overweight</td>
<td>&gt;85&lt;sup&gt;th&lt;/sup&gt; – 94.9&lt;sup&gt;th&lt;/sup&gt; Percentile for Age and Sex</td>
</tr>
<tr>
<td>Obese</td>
<td>&gt;95&lt;sup&gt;th&lt;/sup&gt; Percentile for Age and Sex</td>
</tr>
</tbody>
</table>

**Body mass index-for-age percentiles: Boys, 2 to 20 years**

- **Underweight**: A 10-year-old boy with a BMI of 23 would be in the obese category (95<sup>th</sup> percentile or greater).
- **Normal weight**: A 10-year-old boy with a BMI of 21 would be in the overweight category (85<sup>th</sup> to less than 95<sup>th</sup> percentile).
- **Overweight**: A 10-year-old boy with a BMI of 18 would be in the healthy weight category (5<sup>th</sup> percentile to less than 85<sup>th</sup> percentile).
- **Obese**: A 10-year-old boy with a BMI of 13 would be in the underweight category (less than 5<sup>th</sup> percentile).

Age in Years
## Adults

<table>
<thead>
<tr>
<th>Adult BMI Classification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.5</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 – 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥25 – 29.9</td>
</tr>
<tr>
<td>Overweight (Asian)</td>
<td>23 – 24.9</td>
</tr>
<tr>
<td>Obese</td>
<td>≥30</td>
</tr>
<tr>
<td>Obese Class I</td>
<td>30-34.9</td>
</tr>
<tr>
<td>Obese Class II</td>
<td>35.0-39.9</td>
</tr>
<tr>
<td>Obese Class III</td>
<td>≥40</td>
</tr>
</tbody>
</table>
Worldwide epidemic

- Worldwide obesity has more than doubled since 1980.
- In 2014, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 600 million were obese.
- 39% of adults aged 18 years and over were overweight in 2014, and 13% were obese.
- Most of the world's population live in countries where overweight and obesity kills more people than underweight.
- 41 million children under the age of 5 were overweight or obese in 2014.
Age-adjusted prevalence of obesity in adults

1994

2014
Etiology of Obesity

Diet

- Fast Food
- Food Insecurity (Food Banks)
- Sugary Drinks (Diet drinks?)
- Large Portions
- Lack of Supervision (Childhood)
Etiology of Obesity

- Lack of Activity
  - Screen time
    - TV (Double Effect)
    - Computers
    - Smart Phone
    - Video Games
    - Virtual Reality Headset
  - Urban Settings (Lack of Facilities, changing modes of transport)
Roughly three-quarters of internet users ages 65 and up say they go online daily

<table>
<thead>
<tr>
<th>Ages 18-29</th>
<th>About once a day</th>
<th>Several times a day</th>
<th>Almost constantly</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>47</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

| 30-49      | 7                | 50                  | 31               |

| 50-64      | 14               | 48                  | 19               |

| 65+        | 17               | 51                  | 8                |

| 65+ smartphone users | 14 | 65 | 12 |

Source: Survey conducted Mar. 7-April 4, 2016. “Tech Adoption Climbs Among Older Adults”

PEW RESEARCH CENTER

Source: @pewinternet, @josephncohen; Read full article
Etiology of Obesity

- **Shorter Sleep Duration**
  - Sleep deprivation (< 7 hours per night) has increased from 16% to 37% of the population over the past 40 years. Sleep deprivation is associated with increased appetite for calorie dense foods.
Etiology

- Associations ? Causality?
  - Gut microbiome
  - Toxins (Bisphenol A)
  - Viruses (Adenovirus 36)
Etiology

Genetics

- Genetic Syndromes associated with early obesity (rare) ie Bardet-Biedl, Prader-Willi
- Single gene defects, most common is Melanocortin 4 receptor (MC4R) which may be found in up to 4-6% of those with severe, early onset obesity, others rare.
- One variant of the FTO gene on chromosome 16 is thought to carry a 1.5 fold risk of obesity. It was found in ~ 16% of Europeans and may account for 22% of common obesity. It appears to act in increasing fat storage and reducing mitochondrial thermogenesis five fold.
Etiology

- Endocrine & Hypothalamic disorders
- Metabolic Influences and Programming
  - Small or Large for gestational Age
  - Mother’s pre-pregnancy weight and weight gain during pregnancy (bariatric surgery)
  - Famine during pregnancy, maternal diabetes or Pre-eclampsia
Adults & Obesity

- Most people become obese in adulthood and there are certain times weight gain tends to occur
  - Women
    - Pregnancy – excessive gestational gain increases the risk
    - Menopause – both increase in weight and fat mass are noted
  - Men
    - Transition to more sedentary lifestyle in the early 20s
    - Rise in body weight continues until ~ late 50s
    - Mid 60s weight may begin to decline
Etiology

- Energy expenditure
  - Small differences in moderately vigorous activity (5-10 mins per day) make a big difference in obesity risk
Energy intake balanced with energy expenditure

- 70% of energy expenditure is from basal metabolic activity: respiratory, cardiac, gastrointestinal, maintaining temperature, fidgeting, etc.
- 10% is used consuming, metabolizing, storing food
- The remaining 20% is due to exercise/activity
- 80% of the variation of energy expenditure between individuals is related to fat free mass (muscle burns more energy than fat)
Diet

- The body resists weight loss through diet by decreasing resting and total energy expenditure.
- In a formerly obese person 15 percent fewer calories need to be consumed to maintain weight loss than in a non-obese person.
- Hormonal stimulus to increase consumption can persist for 3-5 years after weight loss.
Treatment - Diet

- Goal – Total 5 to 7% loss of body weight is realistic
- Not accounting for exertion, 22 kcal/kg food energy daily is required to maintain body weight (9.98 kcal/lb) in adults. 200 lb man requires ~ 2000 kcal per day (basal metabolic rate). There is about a +/-20% variation due to age, metabolism, lean body mass, etc. There are calculators online that take into account the amount of activity ([http://www.calculators.org/health/weight-loss.php](http://www.calculators.org/health/weight-loss.php))
- Metabolic rate decreases ~2% per decade of age (100 cal/day)
- Roughly, a deficit of 500 kcal/day should result in about 1 lb weight loss per week.
Treatment - Diet

- Goal is to reduce the amount of calories consumed
- Types of diets – adherence is the most important determinate of weight loss
- Studies comparing low fat versus low carbohydrate show long term differences in weight loss are minimal
- Experts recommend balanced reduction in caloric intake
- Exercise benefits body composition, does not dramatically affect weight
Treatment - Diet

- Difficult to study diet in Humans in the long term
  - Balanced – smaller portions (many of the prepared diets)
    - Works, especially short term
    - Variety may be a long term issue
  - Mediterranean
    - Monounsaturated Fats, moderate alcohol (wine), lots of grain, fruits, beans, vegetables, moderate cheese, fish, low red meat
  - Low Fat with healthy carbohydrates
    - 30 gm or less of fat per 1000 calories
  - Low carbohydrate
    - Rapid weight loss
    - ? More side effects
Behavioral Modification

- Realistic Goals
- Education and diet planning
- Consider eating style & triggers (stress)
- Monitoring
- Modifying Stimuli
- Support
- Reinforcement
- Positive Attitude, Assertiveness
- Physical activity
Other Treatment

- **Drugs**
  - Mostly short term
  - Side effects
  - Usually gain weight back when stopped

- **Bariatric surgery**
  - US procedures plateaued ~ 200,000 per year
  - $\text{BMI} \geq 40$
  - $\text{BMI} 35-39.9$ plus serious comorbid illness
  - $\text{BMI} 30-34.9$ plus very serious comorbidity uncontrolled
Juvenile Obesity


NOTES: Obesity is defined as body mass index (BMI) greater than or equal to the 95th percentile from the sex-specific BMI-for-age 2000 CDC Growth Charts.


https://www.cdc.gov/nchs/data/hestat/obesity_child_13_14/obesity_child_13_14.htm#Figure
Obesity in children and adolescents

- Obesity is more common among native americans, blacks and Hispanics
- Having one parent who is obese increases the child’s risk two to threefold
- If both parents are obese the risk increases up to 15 fold.
CAD Risk factors and obesity in Kids

- Odds of low HDL
- Odds of high LDL
- Odds of abnormal glucose
- Odds of high systolic BP
- Odds of high diastolic BP
- Odds of elevated A1c

www.pediatrics.org/cgi/doi/10.1542/peds.2009-0179
doi:10.1542/peds.2009-0179
Obesity clearly linked to Type 2 DM in Juveniles

90% of T2 DM in Childhood have BMI in ≥95th percentile. Almost 50% are ≥99th percentile.

Percent T2DM for adjusted BMI percentile - children

Pediatric Diabetes 2015
doi: 10.1111/pedi.12281
Youth onset T2DM appears more lethal than T1DM
Juvenile Obesity

- Increased Risk of Liver Disease
- 1.2 million men age 17-19, conscripts in Sweden, 34 million person-years follow-up

Type 2 Diabetes Pathogenesis

Genetic susceptibility
Environmental Influences

Age
Weight
Exercise

Insulin Resistance
Insulin Secretion

Duration
Hyperglycemia
Different Ethnic Groups develop T2DM at lower BMI

East Asians have more visceral fat for the same BMI 3-5% higher compared to Caucasians
Age-Adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults

1994

Obesity (BMI≥30 kg/m²)

Diabetes

2014

Obesity (BMI≥30 kg/m²)

Diabetes


Age-Adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults
Obesity - Complications

**Environment**
- Exercise
- Diet
- Other

**Genetics**

Obesity

Type 2 Diabetes
- CAD
- CVA

HLD
- HBP

Cancer

Liver Disease

Respiratory Disease

Excess Mortality

**Abbreviations:**
- CAD – Coronary artery disease
- CVA – Cerebrovascular Accident (Stroke)
- CKD – Chronic Kidney Disease
- HLD – Hyperlipidemia
- HBP – Hypertension
Type 2 Diabetes - Complications

- Renal Disease
  - Albuminuria

- Vascular disease – Heart and peripheral
  - Higher risk for silent ischemia

- Retinopathy
  - Screening every 1-2 years

- Neuropathy
  - Prone to peripheral neuropathy – foot care needed
Estimated years of life lost due to diabetes

- 12 million person-years, > 123,000 deaths
- 97 prospective cohorts over 25 countries
- Individuals without known CV disease

<table>
<thead>
<tr>
<th>Age</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>6.3 yrs</td>
<td>200%</td>
</tr>
<tr>
<td>50</td>
<td>5.8</td>
<td>200%</td>
</tr>
<tr>
<td>60</td>
<td>4.5</td>
<td>200%</td>
</tr>
</tbody>
</table>

At age 50 the survival difference is attributable to 58% vascular, 9% cancer, and 30% other (renal, infectious, liver disease, etc.)
Obesity – Health Hazards

- For each 5 kg/m² increase in Obesity is associated with a corresponding increase in mortality from the following causes:
  - Diabetes – HR 2.16
  - Ischemic heart disease and stroke – HR 1.42
  - Cancer – HR 1.19
  - Respiratory disease – HR 1.38
  - Chronic kidney disease – HR 1.59

- 10,625,411 participants, 239 studies
  385,879 deaths, non-smokers, without chronic disease, followed median 13.7 years

The Lancet; Published online July 13, 2016
http://dx.doi.org/10.1016/S0140-6736(16)30175-1

Body-mass index and all-cause mortality: individual participant-data meta-analysis of 239 prospective studies in four continents
Fat and Fit?

**CENTRAL ILLUSTRATION:** Metabolically Healthy Obese and Incident Cardiovascular Disease

- **Normal Weight Metabolically Healthy**
  - BMI 18.50-24.99 kg/m²
  - No Dyslipidemia
  - No Hypertension
  - No Type 2 Diabetes

- **Obese Metabolically Healthy**
  - BMI ≥30.00 kg/m²
  - No Dyslipidemia
  - No Hypertension
  - No Type 2 Diabetes

- **Cardiovascular Disease**
  - 49% Increased Risk of Coronary Heart Disease
  - 7% Increased Risk of Cerebrovascular Disease
  - 96% Increased Risk of Heart Failure

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## Obesity and Cancer

<table>
<thead>
<tr>
<th>Cancer Site or Type</th>
<th>Relative Risk of the Highest BMI Category Evaluated versus Normal BMI (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophagus: adenocarcinoma</td>
<td>4.8 (3.0–7.7)</td>
</tr>
<tr>
<td>Gastric cardia</td>
<td>1.8 (1.3–2.5)</td>
</tr>
<tr>
<td>Colon and rectum</td>
<td>1.3 (1.3–1.4)</td>
</tr>
<tr>
<td>Liver</td>
<td>1.8 (1.6–2.1)</td>
</tr>
<tr>
<td>Gallbladder</td>
<td>1.3 (1.2–1.4)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>1.5 (1.2–1.8)</td>
</tr>
<tr>
<td>Breast: postmenopausal</td>
<td>1.1 (1.1–1.2)</td>
</tr>
<tr>
<td>Corpus uteri</td>
<td>7.1 (6.3–8.1)</td>
</tr>
<tr>
<td>Ovary</td>
<td>1.1 (1.1–1.2)</td>
</tr>
<tr>
<td>Kidney: renal-cell</td>
<td>1.8 (1.7–1.9)</td>
</tr>
<tr>
<td>Meningioma</td>
<td>1.5 (1.3–1.8)</td>
</tr>
<tr>
<td>Thyroid</td>
<td>1.1 (1.0–1.1)</td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td>1.5 (1.2–2.0)</td>
</tr>
</tbody>
</table>
Average annual percent change in incidence of overweight- and obesity-related cancers,* by quartile — United States, 2005–2014

Obesity associated Cancers:
Adenocarcinoma of the esophagus; cancers of the breast [in postmenopausal women], colon and rectum, endometrium, gallbladder, gastric cardia, kidney, liver, ovary, pancreas, and thyroid; meningioma; and multiple myeloma

* Except colorectal cancer.

Obesity – Health Hazards

- **Respiratory Disease**
  - Hypoventilation and Obstructive Sleep Apnea

- **Chronic Kidney Disease**
  - Association with HBP, Diabetes, and metabolic syndrome
  - Obesity-related glomerulonephropathy & proteinuria

- **Coronary artery disease**
  - HBP (~33%), HLD, Diabetes (together 50%)
  - Central obesity especially (for every SD increase in waist circumference there is an increased hazard ratio of 1.26 for CV disease)

- **Hypertension**
  - Association from the Framingham study overweight and obesity accounted for ~27% of the cases of hypertension
  - In the obese it is estimated that the BP falls 1 mm Hg for each Kg of weight loss
Mortality and obesity

10,625,411 participants, 239 studies
385,879 deaths, non-smokers, without chronic disease, followed median 13.7 years

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Obesity Solutions

They have solved the problem in the future

A scary sign? – Expectations are being reset.
Obesity Solutions

- Food Supply and Access
  - Fast Food restaurants near schools
  - Food banks with fresh foods
  - Coupons that make fresh foods cost less
  - Fresh vegetables in inner city neighborhoods (Minneapolis Staples Food Ordinance)
  - School lunches
  - Restricting Trans-fats
  - Taxing sugar sweetened beverages

- Education
  - Gap between services and knowledge about them
  - Home visitation programs
  - Multi-trained treatment teams

- Activity
  - Walkable communities
  - Bike trails and lanes
  - Programs for children

- Metabolic
  - Genetics and epigenetics in appetite
  - Modeling children's appetite and eating behavior

http://www.globalobesity.org/about-the-gopc/
Johns Hopkins Global Obesity Prevention Center
Solutions – Public Policy

Fig 1. Cumulative deaths prevented or postponed from 2015 to 2030 under each policy modelled, by sex. Error bars indicate 95% uncertainty intervals. DPPs, deaths prevented or postponed; F&V, fruit and vegetable; MMC, mass media campaign; SNAP, Supplemental Nutrition Assistance Program; SSB, sugar-sweetened beverage.

https://doi.org/10.1371/journal.pmed.1002311.g001
Obesity Solutions

Nauris Cinovics, from the Art Academy of Latvia

Questions?
rbraun@scor.com
Definitions - Opioids

- **Opium – from the opium poppy**
  - Codeine
  - Morphine
    - Heroin (diacetylmorphine)

- **Semisynthetic Opioids**
  - Oxycodone
  - Hydrocodone

- **Synthetic Opioids**
  - Methadone
  - Fentanyl
Epidemiology

- 2 million US Adults reported opioid use disorder in 2015
- 3.8 million reported misuse of a prescription pain medication
- 5.1 million US Adults have used heroin at some time
- 828 thousand reported heroin use in the past year
- A majority of people trying heroin will develop an opioid or heroin use disorder
Prescribed Opioids - 2015

US average MME
1999 – 180
2015 – 640

6X higher in highest counties

MME – Morphine milligram equivalents

SOURCE: CDC Vital Signs, July 2017
Heroin increased for 4 years, then held steady 2015-2016
Oxycodones declined 28% from 2012 to 2016.
Rate of Unintentional Drug Overdose Deaths, 1968-2015

Synthetic Opioid Overdose Death Rates

Age-adjusted deaths per 100,000 population for synthetic opioids (excluding methadone, including fentanyl and tramadol) from 2014 to 2015, by census region of residence

- **Northeast***
  - 5.6 deaths (3,071 Deaths in 2015)
- **Midwest***
  - 3.9 deaths (2,548 Deaths in 2015)
- **South***
  - 2.8 deaths (3,303 Deaths in 2015)
- **West***
  - 0.9 deaths (658 Deaths in 2015)
- **United States***
  - 3.1 deaths (9,580 Deaths in 2015)


* Statistically significant at p<0.05 level.
FIGURE. Age-adjusted rate* of drug overdose deaths,† by state — 2010 and 2015§

- West Virginia
- New Hampshire
- Kentucky
- Ohio
- Rhode Island
- Pennsylvania
- Massachusetts
- New Mexico
- Utah
- Tennessee
- Connecticut
- Delaware
- Maine
- Maryland
- Michigan
- Nevada
- Indiana
- Arizona
- Louisiana
- Oklahoma
- District of Columbia
- Missouri
- Vermont
- Wyoming
- New Jersey
- Florida
- Alaska
- North Carolina
- Alabama
- South Carolina
- Wisconsin
- Colorado
- Washington
- Idaho
- Illinois
- Arkansas
- Montana
- New York
- Georgia
- Virginia
- Mississippi
- Oregon
- Kansas
- California
- Hawaii
- Minnesota
- Iowa
- Texas
- North Dakota
- South Dakota
- Nebraska

Deaths per 100,000 population

- 2015 rate
- 2010 rate

MMWR / December 30, 2016 / Vol. 65 / Nos. 50 & 51
Figure 4: Number of Fentanyl Exhibits in NFLIS, 2004-2015

Source: DEA
1 kg Fentanyl costs $1700 - $3500
Potential revenue $6.6 million to $20 million
Figure. Contributions of Selected Causes of Death to the Change in Life Expectancy in the United States, 2000-2015

12 Leading causes of death (ranked highest to lowest according to No. of deaths in year 2015)
- Diseases of the heart
- Malignant neoplasms
- Chronic lower respiratory diseases
- Unintentional injuries
- Cerebrovascular diseases
- Alzheimer disease
- Diabetes mellitus
- Influenza and pneumonia
- Nephritis, nephrotic syndrome, and nephrosis
- Suicide
- Septicemia
- Chronic liver disease and cirrhosis
- Drug, opioid, and alcohol poisoning deaths
- Drug poisoning
- Opioid-involved poisoning
- Alcohol poisoning

\[ \text{Contribution to Change in Life Expectancy, } y \]

\[ -0.4 \quad -0.2 \quad 0 \quad 0.2 \quad 0.4 \quad 0.6 \quad 0.8 \quad 1.0 \quad 1.2 \]

\[ a \text{ In ranked cause-of-death classification, drug, opioid, and alcohol poisoning are not considered to be unique cause-of-death categories. Instead, poisoning deaths are classified as either accidental poisonings (which contribute to unintentional injuries), suicides, or homicides (ranked 16th in leading causes of death). Contributions from drug, opioid, and alcohol poisoning deaths overlap with both unintentional injury deaths and suicides and cannot be summed with these leading ranked causes of death.} \]
Sources of Prescription Opioids Among Past-Year Non-Medical Users

- Given by a friend or relative for free
- Prescribed by ≥1 physicians
- Stolen from a friend or relative
- Bought from a friend or relative
- Bought from a drug dealer or other stranger
- Other

Percent of Users

Number of Days of Past-Year Non-Medical Use

- Any
- 1-29
- 30-99
- 100-199
- 200-365

Solutions?

- Prescribing Guidelines
- Controlled drug databases
- Pharmacy oversight
- Accessibility of Naloxone
- Treatment programs
- Improve the economy
- Drug interdiction