How to lose weight

by doing

“Absolutely Nothing”
Sleep “is the most sedentary activity” yet it protects us from gaining weight!
“Sleep is not a luxury – it’s a necessity – and should be thought of as a ‘vital sign’ of good health”

www.cdc.gov/sleep
“Ignorance is the worst Sleep Disorder of them all”

Dr. William Dement in his book *The Promise of Sleep*

Dr. Dement was among the first to draw attention to the fact that *sleep* is as important, *if not more so*, than diet and exercise when it comes to wellbeing.
Sleep Restores the Brain and the Body

- **Brain**
  - Learning
  - Memory consolidation
  - Brain development

- **Body**
  - Restoration
  - Muscle building
  - Cellular repair
  - Hormonal secretion control
  - Immune system support
What happens if you do not get Quality Sleep?

- One of the most important functions of sleep is the re-organization of neural networks in the brain. A body with a sleep deprived brain starts to malfunction presenting with:
  - Problems with heat or cold regulation
  - Decline in immune function
  - An increase in cortisol, catecholamine's, and other stress hormones.
  - Increased levels of inflammatory hormones such as interleukin and C-reactive protein
  - **Imbalances in appetite and blood sugar regulation hormones.**
What happens if you do not get Quality Sleep?

• Not getting quality sleep can cause hormonal imbalance and inflammation as the Hypothalamic-Pituitary-Adrenal axis need’s quality sleep to re-balance after wake during the day.

• During quality sleep there is an increase in growth hormone and testosterone, the two crucial muscle repairing hormones.
  – This is why your body takes longer time to repair and recovery from physical exercise if you are not getting quality sleep.
How much sleep is needed

• Sleep is a **behavioral state** that is a natural part of life, we should spend about one-third of our life sleeping.

• Sleep is a **required activity** and is important for a healthy life. The National Sleep Foundation recommends 7-9 hours of sleep every 24 hours for individuals age 24-64 years old. (6)

• How much sleep is needed depends on:
  – Individual sensitivity to sleep loss (7,8)
  – Daily activities and exercise
  – Sleep Quality
  – Age
Sleep Loss – Sleep Deprivation

• Behavioral Sleep Deprivation (BSD)
  - Cultural, 24/7 lifestyle
  - Circadian rhythm disorders

• Pathological Sleep Deprivation
  - Obstructive Sleep Apnea
  - Restless Legs Syndrome
  - Insomnia
    - Pain syndromes
    - Other medical conditions
Worldwide obesity prevalence has doubled since 1980 (9).
This is paralleled by reduced sleep duration (10).

In 1998 35% American adults got 8 hours of sleep (11,12).
In 2005 26% American adults got 8 hours of sleep (11,12).

In 1998 obesity prevalence in USA was 18% (11,12).
In 2005 obesity prevalence in USA was 24% (11,12).
Regulation of feeding
Sleep / Wake cycles

- Control of sleep/wake cycles and feeding is by:
  - Hypothalamic-pituitary-Adrenal axis
  - Autonomic nervous system

- **Good Quality Sleep generally** (13,14)
  - decreases sympathetic activity
  - increases parasympathetic activity

- **Poor Quality Sleep generally** (13,14)
  - increases sympathetic activity
  - decreases parasympathetic activity
Quality Sleep & Endocrine Organs

- Endocrine organs are sensitive to changes in the autonomic nervous system
  - Increased secretion of inflammatory biomarkers
  - Changes in hormonal secretion
Sleep deprivation
Inflammatory biomarkers

- Increase in inflammatory biomarkers contributes to Metabolic Syndrome (15,16,17)

- Increases IL-6 during the day, causing somnolence and fatigue (18)

- Causes shift of IL-6 and TNF from nighttime to daytime combined with hyper secretion of cortisol, causing fatigue and difficulty in falling asleep (20,21)

- Increases C-reactive protein (16)
Sleep Deprivation
Changes in Hormonal balance

- **Insulin**
  - Sleep deprivation leads to changes in circadian rhythm of insulin secretion. Increased sympathetic activity affects insulin secretion and promotes **insulin resistance** (22,23)

- **Cortisol**
  - Sleep deprivation leads to increased levels (cortisol release is inhibited during good sleep) likely to promote development of **insulin resistance** (24)

- **Growth Hormones**
  - During sleep deprivation tissues are exposed to high levels for an extended period of time and GH anti-insulin effects promote development of **insulin resistance** (25,26)
Sleep Deprivation
Changes in Hormonal balance

- **Leptin**
  - Hormone released by fat cells dependent on sleep duration and decreased by sleep deprivation, signals release of fat reserves and the thyroid to upregulate thyroid function.
  - Increases energy expenditure and signals satiety to the brain
  - Decreases with sleep deprivation lowering the metabolic rate and will likely lead to increased calorie intake (27,28)

- **Ghrelin**
  - Secreted by the stomach, stimulates appetite and is elevated by sleep deprivation causing hunger and increased calorie intake (27,28)

- **Thyroid Hormone**
  - Decreased levels caused by sleep deprivation, lowers the basal metabolic rate (5)
Sleep Deprivation
Chronic Diseases

- **Obesity** \(^{(30,31)}\)
- Diabetes
- Heart diseases, high blood pressure and stroke
- Alzheimer
- Decreased mental performance and higher risk of depression
- Fatigue/accidents
The Sleep Deprived Brain

- The tired brain *craves things to wake it up*

- Coffee
- Nicotine
- Drugs
- **FOOD** spurs some less-than ideal food choices, including larger food portions and craving for junk food \(^{(32)}\)
Sleep Deprivation & Obesity

- Obesity is an important risk factor in the pathogenesis of various diseases (33,34)
  - Obstructive Sleep Apnea
  - Diabetes mellitus 2
  - Metabolic syndrome
Sleep Deprivation & Obesity

- Higher BMI is associated with compromised sleep quality (35)
- Obesity is associated with sleep disturbances that may predispose to accumulate sleep debt (36)
- This may contribute to
  - Increased appetite and more time to eat
  - Limit drive for physical activity
  - Changes in hormonal secretion influencing weight gain
Sleep Duration and Risk of Obesity

- Interpersonal differences exist in the sensitivity to sleep loss (37)

- U-shaped relationship with BMI, both short sleepers (<6 hrs) and long sleepers (>9 hrs) are more likely to be obese (37)

- Stronger correlation between sleep duration and obesity risk has been found in younger cohorts, suggesting that age-related factors other than sleep disturbances may play a more important role in the development of obesity later in life (38,39)
Sleep Duration and Risk of Obesity

- Significant association between short sleep (<6 hrs) and increased obesity risk (40,41,42,43)

- 6% increase in the probability of obesity with less than 7 hours slept (44)

- Study of 1597 individuals showed that every additional hour of sleep (6<x>9hrs) decreased incidence of obesity by 30% (45)
Obstructive Sleep Apnea (OSA) Obesity

- Estimated prevalence of OSA in US adult population (43,44,45)
  - Men 24%-58% (severe obesity 93%) (45)
  - Women 9%-37% (severe obesity 73%) (45)

Symptomatic OSA present in 4% of middle age men and 2% of women (46)

- Obesity is a risk factor for OSA
  - About 70% of those with OSA are obese (45)
  - Losing weight improves OSA (45)
  - OSA recurred in 50% after 4 years, regardless of weight gain (46)
Obstructive Sleep Apnea (OSA) Obesity

- OSA itself may cause weight gain (49)

- Frequent micro/macro arousals in OSA lead to repeated surges in sympathetic nervous system activity and changes in hormonal control (50, 51, 52)

- Patients with OSA have reduced slow wave sleep (SWS). Shown to lead to increased appetite for high caloric/carbohydrate dense food (53)
Suppression of SWS led to reduced insulin sensitivity and higher likelihood of developing diabetes 2 and obesity (54).

Subjects with diabetes 2 had shorter SWS duration and higher arousal indices (55,56).

Many patients with diabetes 2 suffer from OSA. Of interest is the strong link between OSA, obesity and diabetes 2 (57,58).
Sleep deprivation – Prevention
Child Obesity

- Children with shorter sleep duration are at higher risk for obesity than children with longer sleep durations (59,60)

- This risk is reduced by 9% for each additional hour of sleep

- This risk is higher in boys than girls (59,60)
Obese Children

OSA

- Obese children with OSA, compared with other obese children
  - Eat 2.2x more fast food and less healthy food
  - 4.2x less likely to be involved in organized sports

- OSA severity is positively correlated with plasma ghrelin levels (60)
Example- sleep screening & treatment

- 14 year old boy
- Tired, irritated, issues at school (past 12 months)
- Tonsillectomy 5 years ago
- Height 5’5” (168cm)
- Weight gain 40 lbs. in one year (20 kg)
- Now 197 lbs. (90 kg)
Sleep Quality before therapy
Sleep Quality on CPAP (first night)
## Sleep Quality Improvements

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<th>Test before therapy</th>
<th>Test with use of CPAP</th>
<th>Improvement</th>
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<tr>
<td>Stable sleep</td>
<td>2 hrs</td>
<td>5 hrs 10 min</td>
<td>3 hrs 10 min increase</td>
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<td>Unstable sleep</td>
<td>5 hrs 15 min</td>
<td>1 hrs 45 min</td>
<td>3 hrs 30 min decrease</td>
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<td>e-LFC_BB</td>
<td>3 hrs</td>
<td>25 min</td>
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<td>Sleep Time</td>
<td>8 hours 30 min</td>
<td>8 hours 33 min</td>
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What we need to better understand the relationship between Sleep Deprivation and Obesity

- Reviewing of the medical literature addresses the limitation of the literature we have today and highlights the importance of the need to perform:
  - Well designed, controlled, large scale studies
  - Long follow-up time
  - These studies need to assess sleep duration objectively not subjectively
Let’s be open minded and have the courage to throw out yesterday’s ideas when they do not appear to be working and find ways to solve this problem.
Referenced literature

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Referenced literature

• 12. Centers for Disease Control and Prevention, percentage of Adults Who Reported an Average of <6 Hours of Sleep per 24-hour Period, by Sex and Age Group – United States 1985 and 2004. MMKWR. 2005;54(37):933
## Referenced literature

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- 34. Hall MH, Muldoon MF, Jennings JR, Buysse DJ, Flory JD, Manuck SB. Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. Sleep. 2008;31(5):635-43
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- 43. Patel SR, Hu FB. Short sleep duration and weight gain: a systematic review. Obesity (Silver Spring) 2008;17:11-21
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• 60. Chen X, Beydoun Ma, Wang Y. Is sleep duration associated with childhood obesity? A systematic review and meta-analysis. Obesity (Silver Spring) 2008;16(2):265-74