The Dangerous Liaison: Weight Gain and Its Associated Comorbidities

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Abstract

Overweight and obesity have tangible physical consequences that affect mortality and economics, as well as increase the risk of numerous diseases. Obesity significantly increases the risk of diabetes, coronary heart disease and colon cancer (among others), decreases life span, and exacts a large financial toll on both the patient and the healthcare industry. Weight loss among overweight and obese persons regains the health benefits lost with excess weight: improved insulin sensitivity, decreased risk for diabetes, and improved mortality rates from diseases associated with obesity. A healthy lifestyle also affords those benefits, even without weight loss. Visceral adiposity, which can be clinically ascertained with measurement of waist circumference, is an important indicator of high risk associated with excess weight and should be among the routine vital signs obtained at every office visit.


Overweight is defined as a body mass index (BMI) of 25 to 29 kg/m². Obesity is defined as a BMI greater than 30 kg/m², with severe obesity (Classes I-III) beginning with a BMI of 35 kg/m². Overweight and obesity often cause significant emotional distress but also have tangible physical consequences that affect mortality and economics and increase the risk of numerous diseases.

Morbidity and Mortality With Obesity

Data from the Framingham Heart Study and the Third National Health and Nutrition Examination Survey (NHANES III) reveal a loss of 1 to 2 years in life expectancy as BMI increases from 27.5 kg/m² to 32.5 kg/m² to 37.5 kg/m² (Figure 1). This effect occurs in both men and women and appears to decrease slightly with age, suggesting that weight gain in younger years (ie, from 35 to 55 years) may have more devastating consequences. These results were confirmed in a recent study showing years of life lost with obesity. Fontaine et al showed severe obesity (BMI > 45 kg/m²) decreased remaining life span by 22% for young white men and 40% for young black men. For white and black young women, the reductions were 13% and 9%, respectively. The optimal BMI was 23 to 25 kg/m² for whites and 23 to 30 kg/m² for blacks.

More directly, obesity is associated with numerous comorbid conditions (Table 1); even small increases in BMI substantially increase the risk of these conditions. All of these conditions contribute tremendously to adverse quality of life. The best-known relationship is between obesity and coronary heart dis-
ease (CHD). Data from NHANES III show the risk of CHD is elevated in moderately obese men and women aged 45 to 54 years compared with nonobese counterparts (41.8% and 34.9% vs 32.4% and 25%, respectively). The effect increases with body weight more so than with age (Figure 2). Colon cancer also has a strong relationship with obesity, with highest risk (relative risk, 3.72) of colon cancer at a BMI of 28 to <30 kg/m²—defined as simply overweight.

Comorbid conditions also exact a large financial toll on obese persons and the healthcare system. Estimates place the cost of obesity at $100 billion, of which $30 billion is spent by individuals on weight-loss products. More than $50 billion is due to direct medical costs. Direct cost estimates indicate roughly $33 billion are spent each year on type 2 diabetes due to obesity, with another $7 billion from CHD, and important contributions from orthopedic conditions, biliary disease, and cancers, all due to obesity.

Diabetes is emerging as a major explanation of the declining health and life expectancy associated with obesity. The risk of diabetes increases enormously with relatively small increases in weight. The risk begins to increase at overweight stages (Figure 3) and increases exponentially with severe obesity. Data from NHANES III show the risk of diabetes increases substantially with weight gain and increase in age; severely obese women aged 55 to 64 years have an 18% increase in diabetes prevalence; for men in that age and weight group, the increase in prevalence is 23%. The results also show weight gain in adult life has important detrimental effects on diabetes risk (Figure 4).

**Risk Factors of Obesity**

Several important risk factors raise the health risk associated with a given level of obesity. Of primary concern is the location of excess weight. Visceral fat has been shown to be the most dangerous type of fat storage, and visceral obesity is easily measured. A waist-to-hip ratio of >1.0 in men and >0.85 in women, or (more easily determined) a waist circumference of >40 inches in men and >35 inches in women places individuals in a high-risk group. Additional risk factors are listed in Table 1.

**Table 1. Comorbid Conditions Associated With Obesity**

- Hypertension
- Cardiovascular disease
- Dyslipidemia
- Type 2 diabetes
- Sleep apnea/hypoventilation syndrome
- Osteoarthritis
- Infertility
- Cancers: Breast, colon, endometrium, prostate, and kidney
- Other: Idiopathic intracranial hypertension, lower extremity venous stasis disease, gastroesophageal reflux, stress urinary incontinence

Data adapted from Shape Up America Web site.

**Figure 1. Interaction Between BMI and Age in Loss of Life Expectancy**

**Figure 2. Interaction Between BMI and Age in Subsequent Risk of CHD**

BMI = body mass index; CHD = coronary heart disease.

Data from Thompson et al.
Factors for health problems associated with obesity include progressive weight gain as an adult, personal or family history of obesity, bulimia nervosa, binge-eating disorder, depression, anxiety, stress, menopause, and physical inactivity. Because visceral fat is a clear indicator of health risk and is easily determined, measuring waist circumference should be part of the vital signs obtained at each office visit. Visceral fat is also directly proportional to decreased insulin sensitivity, more so than other regional fat depots (Figure 5).9

Benefits of Obesity Treatment

Given the extent of adverse consequences of obesity, the next obvious question is whether these health risks lessen with weight loss. Insulin sensitivity increases with modest weight loss (11 kg) in obese persons after just 6 weeks on a very-low-calorie diet—a 25% increase in insulin sensitivity with 10% weight loss.10 As with its relationship to visceral fat, insulin sensitivity increases linearly with decreased weight (Figure 6).11 This may be explained by the observation that visceral fat is lost first in obese individuals.

Obesity is only one marker for risk factors with excess weight. Lifestyle changes, while often resulting in weight loss, play a very important role in improving health among obese and overweight individuals, even without weight loss. A healthy lifestyle may therefore be a better indicator of disease risk associated with obesity. A well-planned effort at reducing dietary fat can significantly improve weight loss and glucose tolerance compared with the more passive dietary advice imparted by physicians to their patients. A study of 136 persons with impaired glucose tolerance compared the effects of a 1-year structured program aimed at reducing daily intake of dietary fat (n = 66) versus general dietary advice about healthy food choices (n = 70). The results show those on the reduced-fat diet lost an average of 3 kg during the first 3 years of follow-up, but ultimately gained it back, plus a few additional pounds. Those on the control diet steadily gained weight during the follow-up period. Those in the reduced-fat

Figure 3. Relationship Between BMI and Risk of Diabetes

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Women: Nurses Health Study (N = 114,291)</th>
<th>Men: Health Professionals Study (N = 51,529)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-23</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>24-27</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>28-31</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>32-35</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

BMI = body mass index.
Data for Nurses Health Study adapted from Colditz et al.!
Graph of Health Professionals Study reproduced with permission from Chan et al.2 Copyright 1994, The American Diabetes Association.

Figure 4. Relationship of BMI and Weight Gain to Relative Risk of Diabetes

<table>
<thead>
<tr>
<th>Weight Change (kg)</th>
<th>Women: Nurses Health Study</th>
<th>Men: Health Professionals Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>6-10</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>&gt;10</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

BMI = body mass index.
Data for Nurses Health study adapted from Colditz et al.!
Graph of Health Professionals Study reproduced with permission from Chan et al.2 Copyright 1994, The American Diabetes Association.
cohort showed modest but significant improvement in 2-hour glucose levels during their period of weight loss. However, after 5 years of follow-up in which weights were similar between both groups, those following the reduced-fat diet had significantly lower 2-hour blood glucose levels (Figure 7). These results suggest health benefits are more strongly associated with improved diet than with absolute weight.

Larger studies have confirmed the benefits of lifestyle modification. Pan et al showed a 29% decrease in the likelihood of developing diabetes with lifestyle intervention. More recently, the Finnish diabetes intervention study evaluated the effect of individualized counseling aimed at reducing weight, total intake of fat, and intake of saturated fat, as well as increasing intake of fiber and physical activity in 522 middle-aged overweight subjects (mean age, 55 years; mean BMI 31 kg/m²) with impaired glucose tolerance. A control group was also part of this study. After 1 year, mean weight loss was 4.2 ± 5.1 kg in the intervention group and 0.8 ± 3.7 kg in the control group; the net loss by the end of year 2 was 3.5 ± 5.5 kg in the intervention group and 0.8 ± 4.4 kg in the control group (P < .001 for both comparisons between groups). The cumulative incidence of diabetes after 4 years was 11% (95% confidence interval [CI], 6% to 15%) in the intervention group vs 23% (95% CI, 17% to 29%) in the control group. The risk of diabetes was reduced by 58% (P < .001) in the intervention group.

The Diabetes Prevention Program compared the effect of lifestyle changes (ie, goals of 7% weight loss and at least 150 minutes of physical activity per week) to metformin (which reduces blood sugar and aids in weight loss) and placebo in 3234 persons (mean age 51; mean BMI 34 kg/m²) in the upper half of impaired glucose tolerance (ie, at high risk for developing diabetes). Overall, those with lifestyle changes had a 58% reduction in diabetes compared with a 31% reduction in the metformin group; the differences among the 3 groups were observed as early as 1.5 years after the study began.
Obesity poses a greater risk of developing diabetes, and weight loss reduces that risk. The Third Adult Treatment Panel of the National Cholesterol Education Program has identified diabetes as a risk factor for CHD. Studies have shown weight loss in diabetic individuals improves mortality. A prospective analysis of 4970 overweight individuals over 12 years showed intentional weight loss of 10% to 15% of initial weight resulted in 33% reduction in mortality, with a 25% reduction for all persons with intentional weight loss and a 28% reduction in cardiovascular disease and diabetes mortality. Weight loss of >70 lbs was associated with small increases in mortality. A review of medical records from 263 patients with type 2 diabetes showed weight loss during the first year after diagnosis of diabetes directly increased life expectancy; for the average patient, each kilogram of lost weight was associated with 3 to 4 months of prolonged survival. Although it is not clear if these studies reflect a more compliant population (those patients who are more compliant with dietary recommendations and lifestyle changes being at lower risk for a variety of reasons), the overall results strongly suggest modest changes in weight and lifestyle are highly beneficial.

Taken together, the data strongly show a high risk associated with weight gain. The National Heart, Lung and Blood Institute now defines high risk by waist circumference as a measure of visceral adiposity (Table 2).1

CONCLUSION

Obesity imposes serious consequences beyond the psychological toll of excess weight. Overweight and obesity significantly increase the risk of serious diseases that are both life-threatening and greatly attenuate quality of life. Treatment directed at lifestyle modification to reduce obesity is therefore of great importance, particularly in persons with visceral obesity.

![Figure 7. 5-Year Effects of Reduced Dietary Fat vs Conventional Diet in Individuals With Impaired Glucose Tolerance](image)

**Table 2. Guide to Type 2 Diabetes, Hypertension, and Cardiovascular Disease Risk**

<table>
<thead>
<tr>
<th>Disease Risk by Waist Size (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
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<tr>
<td>--------------------</td>
</tr>
<tr>
<td>Underweight</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>Obese</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Extremely Overweight</td>
</tr>
</tbody>
</table>

*Waist circumference for high risk: men, 40 in (100 cm); women 35 in (90 cm).

Data adapted from National Heart, Lung and Blood Institute. National Institutes of Health.1
REFERENCES


