

Obesity: Impact on Worker Health and Productivity
and the Role of the Occupational and Environmental Health Nurse

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ABSTRACT

Obesity in the United States (U.S.) is now at epidemic proportions. Approximately 67% of the U.S. population is currently either overweight or obese. Obesity is considered a serious health condition. It is a disease process which threatens to decrease life expectancy which has been increasing annually since 1900. The seriousness of obesity is also more pervasive in younger aged groups as a higher percentage of children and adolescents are becoming overweight or obese. Overweight and obesity are not limited to the U.S. as other industrialized nations are seeing an increase in the prevalence of overweight and obese individuals.

Obesity and its associated comorbid conditions are associated with escalating health care costs and increased impact on society due to premature disability and mortality. The financial ramifications associated with obesity in the workplace are astronomical, as approximately 59% of the workforce is either overweight or obese. In addition to health care associated costs, other costs include decreased productivity, presenteeism, absenteeism, short-term disability, early disability, and mortality. The current trend of rising costs associated with obesity will continue to escalate without serious intervention.

The plan for intervention should be multi-pronged beginning at the federal level initially, focusing on policies which address solutions to obesity. Incentives for employers to implement wellness programs and programs which target overweight and obese populations are needed. The occupational and environmental health nurse possesses the expertise to assist employers and workers achieve good health outcomes and make strides in overcoming the impact of obesity.

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I will always remember Judy's advice when facing large obstacles that seem insurmountable at the time and "just take it one bite at a time".

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CHAPTER I

INTRODUCTION

The American society has reveled in advanced technology and many discoveries that have resulted in disease eradication. Diseases such as Smallpox, Cholera, and Typhoid fever are not normally seen in the United States (U.S.) today. Significant strides have been made in disease management which has reduced high mortality rates associated with coronary heart disease (CHD) and stroke. However, obesity threatens to decrease current life expectancy.

Obesity in the U.S. is at epidemic proportions and is a serious public health concern. It has been estimated that approximately “97 million adults in the United States (U.S.) are overweight or obese” (National Heart Lung and Blood Institute [NHLBI], 2008, p. 5). The percentage of overweight and obese individuals has risen to an alarming rate, doubling since the year 2000. Approximately 67% of the U.S. population is currently either overweight or obese and there is no indication of decline.

Obesity has become one of the major causes of preventable death in the U.S. Many communities are striving to control and prevent childhood obesity as many adults struggle with debilitating comorbid conditions associated with increased body weights. Obesity involves the loss of productivity, early morbidity and mortality, and has escalated health care costs. Obesity also places a burden on society as many obese individuals become disabled and depend on social programs for income and health care.

Obesity is considered a complex disease process. Measures to identify the degree of individual adiposity, or body fat, have been identified and include Body

Mass Index (BMI) and waist-to-hip ratio. Previous methods of managing obesity treated the symptoms through bariatric surgery or liposuction procedures. However, controlling, reducing, and eradicating the obesity epidemic will need to take a proactive public health approach (Isoldi & Aronne, 2008).

About 59% of obese individuals are workers. Obese workers are expected to maintain the same productivity level as their average weight peers.

The purpose of this document is to describe the impact of obesity on worker productivity and health in the workplace and how the occupational and environmental health nurse (OEHN) can develop strategies to reduce, prevent, and control obesity.

CHAPTER 2

LITERATURE REVIEW

Obesity is a public health epidemic. It is important to understand the history and trends of obesity, along with appropriate measures to control, prevent, and reduce it. There are many avenues of treatment which include pharmacological, surgical, and potential intervention at the cellular level. Individuals need to accept responsibility for personal health if we are to effectively impact this growing problem. It is imperative for workplaces to understand that if the obesity epidemic is not controlled, life expectancy which has been increasing steadily since 1900 will decrease.

History of Obesity

The historical significance of obesity provides, in part, the context for understanding the nature and impact of this disease. The word obesity is derived from a Latin word, “Obesus”, which is a contraction of two Latin words, ob- and edere, which means to devour or to eat away (Aronson, 2003).

The history of obesity can be traced back 30,000 years to prehistoric ancestors. It was important for individuals to store energy efficiently to survive fast and famine that historically followed times of plenty. According to Haslam (2007), “to fight obesity, we are flying in the face of evolution and instinct, consciously countermanding the urge for survival and be as inactive as possible in order to conserve energy” (p. 31).

In earlier centuries, obese individuals were the exception and rarely seen. There were no studies of obesity, and in some cultures, the few cases of obesity were considered a status symbol and exemplified wealth. The ancient Greeks were

among the first civilizations to recognize obesity, its dangers, and association with disease (Haslam, 2007).

Haslam provided a thorough history of obesity, associated medical conditions, diet, and exercise as well as beliefs of the great physicians such as Hippocrates, who understood obesity and its complications. Hippocrates wrote about the association between diet and health, the impact of an appropriate diet on good health, theories on health preservation, the concept of calorie consumption and expenditure, and described associated comorbidities.

Polybus, the son-in-law of Hippocrates, shared the same beliefs of the ancient Egyptians which focused on quantity and quality of diet. Binging and purging were common practices among the early Egyptians (Haslam).

Pythagoras was an early advocate of dietary moderation as was the physician, Iccus, who believed in the importance of exercise. Herodicus, one of Hippocrates' teachers, and Galen also supported similar views of Iccus. Galen went a step further and conducted a case study of obesity management. The Greek philosopher Plutarch supported Galen's beliefs and concluded that thin people are healthier and overeating should be avoided (Haslam).

Modern European physicians and writers shared similar views about obesity. In early Britain, obesity was a problem associated with affluent societies. Sir Thomas Elyot, who wrote "*The Castel of Helth*," was one of the first writers who promoted primary prevention of disease (Haslam).

During the 1500s to the late 1800s, Thomas Cogan shared Hippocrates' and Galen's beliefs that humans who exercised were healthier and less prone to illnesses. Other physicians, such as William Vaughn and Andrew Boorde,

considered obesity an addictive behavior. Early texts focused on preservation of health through diet and exercise. Obesity was not considered a disease linked to other comorbid conditions (Haslam, 2007).

As the prevalence of obesity rose, medical literature recognized benefits of weight reduction. Thomas Sydenham, the Hippocrates of English medicine, acknowledged obesity as a complex disease process with diverse causes, and Dr. Tobias Venner was the first physician to use the word ‘obesity’ in a medical context and described the importance of treating obesity in his text “*Treatise*”. Later, several authors believed health could be maintained if obesity were avoided. Dr. George Cheyne, suffering from gross obesity and associated comorbid conditions, wrote about the physiological changes associated with obesity from a personal perspective (Haslam).

The physician, Joannes Baptista Morgagni, recognized the link between obesity and disease in relation to the location of fat mass in the body through anatomical dissection. Dr. William Wadd, a surgeon, performed post-mortem dissection of the obese patient which confirmed Morgagni’s work. At the time of these anatomical discoveries, writers published commercially available diet programs, the first of which was written by William Banting and focused on a low carbohydrate diet, the forerunner to the Atkins diet (Haslam).

Later in this period, the association between weight and women’s health was recognized. Robert Thomas described the association between amenorrhea and endometrial cancer. Avoidance measures included decreased food intake, exercise, and the use of laxatives. Around this same time, Dr. Shadrach Ricketson discovered the association between women’s health issues, obesity, and development of other

comorbid diseases (Haslam, 2007).

As the 18th century ended, physicians were beginning to associate obesity with other conditions. Nathan Buchan believed diabetes resulted from consumption of alcohol, not obesity. However, he documented an association between changes in the integumentary system and obesity. During the same time, Robert Thomas identified the presence and site of fat accumulation in relation to the development of diabetes. He noted the presence of metabolically active visceral fat as a causative factor with wasting of subcutaneous fat. He identified the relationship between obesity and other disorders, and is credited with determining obesity as a precursor of angina. He described a link between gender and angina, and believed it was more prominent in males with short necks, who were obese and sedentary. He determined an association existed between obese individuals and the prevalence of stroke. Another physician, William Osler, described other causative factors of angina, associating it with a sedentary lifestyle. He believed it occurred more among the poor, and Edward Hyde described the symptoms of CHD two centuries prior to these physicians' further study of CHD (Haslam).

By the end of the 19th century, the link between fat deposit site and gender had been defined with men described as apples and women as pears. The French physician, Jean Vague, is credited with the first description of android (apple shaped) and gynoid (pear shaped) obesity and concluded the specific metabolic processes associated with each type. Obesity, up to this point, had not been considered as a distinct disease process, but one primarily associated with a sedentary or leisurely lifestyle, and a weakness of humanity (Haslam).

Fashion designers in the early 20th century geared clothing styles for women

with less ample figures. In the 1940s, Metropolitan Life Insurance Company published height-weight tables with ideal weights that implied that age-related weight gain was unhealthy. Researchers at the University of Minnesota indicated that yo-yo dieting damages health, while the Framingham Massachusetts Heart study focused cardiovascular disease risk factors (National Association for the Advancement of Fat Acceptance [NAAFA], 2008).

A turning point regarding obesity occurred in 1951. The U.S. government and the medical community began a campaign against obesity. A few years later, Jack Lalane, a fitness expert, premiered on a television exercise show focusing on the importance of fitness. As thinness and weight loss became an obsession, weight loss programs such as Weight Watchers International were developed. Weight loss fads, such as “*The Doctors Quick Weight Loss Diet*” by Stillman and Baker, and “*Dr. Atkins Diet Revolution*” by Dr. Robert C. Atkins, were followed by “*The Complete Scarsdale Medical Diet*” by Tarnower and Sinclair, all best sellers. Celebrity weight loss issues were televised, and included the death of Karen Carpenter, a singer popular in the 1970s who died of heart failure associated with anorexia nervosa; and Oprah Winfrey’s extreme weight loss using a liquid diet and associated success and failure (NAAFA).

Fat phobias became common and obesity-associated stigma rose. Esquire magazine polled 1,000 women between the ages of 18-25 regarding their personal feelings about being extremely fat. It was reported 54% of the respondents would rather be run over by a truck, while 63% stated they would rather be either mean or stupid instead of fat. Pharmaceuticals for weight loss were developed, and thousands of liposuction procedures were conducted by the American Society of

Plastic and Reconstructive Surgeons (NAAFA, 2008). At the same time, the glamorization of thinness resulted in an estimated eight million Americans, mostly made up of young, white women, suffering from either anorexia or bulimia by the National Association of Anorexia Nervosa and Associated Disorders (NAAFA). This era ended with a standard definition of obesity of Body Mass Index.

Looking back over the history of obesity, many early writers and physicians discussed the impact of obesity on the body, and offered descriptions of obesity-related conditions. Only recently has obesity been considered a complex disease process. Even though obesity has been related to many serious health conditions costing millions of dollars with individual lives shortened, obesity had to become an epidemic to draw attention to the need for intervention.

Definition of Obesity

There are several ways to define obesity. Simply put, obesity means having too much body fat. According to the Weight-Control Information Network of the National Heart, Lung, and Blood Institute (NHLBI), there is a difference between being overweight and obese. Individuals who are considered overweight have extra body weight from muscle, bone, fat, and/or water (NHLBI, 2008). The Centers for Disease Control and Prevention (CDC) define obesity as “having a very high amount of body fat in relation to lean body mass or Body Mass Index of 30 or higher” (2008c, p. 1).

Body Mass Index (BMI) is not a direct measurement of fat, but is derived by using weight and height calculations. The CDC (2008a) and the NHLBI (2008) define overweight as a BMI of 25 to 29.9 kg/m² and obesity as a BMI of 30 kg/m² or greater as shown in Table 2.1. Examples are provided in Table 2.2 of

TABLE 2.1

BMI CATEGORIES BY WEIGHT STATUS

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

Source: CDC (2008a).

TABLE 2.2**WEIGHT/BMI RANGES FOR SAMPLE HEIGHTS**

Height	Weight Range	BMI	Weight Status
5' 2"	100 lbs or less	Below 18.5	Underweight
	104 lbs to 131 lbs	18.5 to 24.9	Normal
	136 lbs to 158 lbs	25.0 to 29.9	Overweight
	164 lbs or more	30 or higher	Obese

Height	Weight Range	BMI	Weight Status
5' 4"	104 lbs or less	Below 18.5	Underweight
	110 lbs to 140 lbs	18.5 to 24.9	Normal
	145 lbs to 169 lbs	25.0 to 29.9	Overweight
	174 lbs or more	30 or higher	Obese

Height	Weight Range	BMI	Weight Status
6' 3"	137 lbs or less	Below 18.5	Underweight
	144 lbs to 182 lbs	18.5 to 24.9	Normal
	189 lbs to 219 lbs	25.0 to 29.9	Overweight
	227 lbs or more	30 or higher	Obese

Source: National Heart, Lung, and Blood Institute (2009).

weight and BMI ranges for three different heights. An individual is considered to have morbid obesity when the BMI is equal to or greater than 40 kg/m^2 .

BMI is a reliable measure for determining body fat. “Research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA). BMI can be considered an alternative for direct measures of body fat” (CDC, 2008a, p. 1). Table 2.3 illustrates calculation of BMI. In addition to BMI, other predictors of overweight or obesity-related diseases include waist circumference, waist-to-hip ratio, and other risk factors.

Waist circumference is a helpful determinant as abdominal fat is a predictor of risk for cardiovascular disease and metabolic syndrome (Grogan, 2008). Waist measurement greater than 40 inches in men and greater than 35 inches in women are indicators of increased health risks (NHLBI, 2008). Typically, waist circumference is not used as an indicator in individuals with a BMI greater than 35.

Waist-to-hip ratio is another indicator of developing obesity-related diseases. This indicator is derived by taking the waist measurement at its smallest point, usually just above the navel, and dividing by the hip measurement, taken at the widest point. Waist-to-hip ratio of greater than 0.9 for men and 0.85 for women indicates increased health risks due to obesity.

There are two types of obesity based on the characteristics of adipose tissue. The first type is endogenous or hyperplastic obesity, which is described as too many fat cells with a normal amount of fat. The second type is exogenous or hypertrophic obesity, where there is a normal amount of fat cells but they are greatly enlarged. Both genders can experience either type of obesity, but women and children usually have hypertrophic obesity while men frequently have

TABLE 2.3

CALCUALTION OF BMI

BMI is calculated the same way for both adults and children. The calculation is based on the following formula:

Measurement Units	Formula and Calculation
Kilograms and Meters (or centimeters)	Formula: $\text{weight (kg)} / [\text{height (m)}]^2$ With the metric system, the formula for BMI is weight in kilograms divided by height in meters squared. Since height is commonly measured in centimeters, divide height in centimeters by 100 to obtain height in meters. Example: Weight = 68 kg, Height = 165 cm (1.65 m) Calculation: $68 \div (1.65)^2 = 24.98$
Pounds and Inches	Formula: $\text{weight (lb)} / [\text{height (in)}]^2 \times 703$ Calculate BMI by dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703. Example: Weight = 150 lbs, Height = 5'5" (65") Calculation: $[150 \div (65)^2] \times 703 = 24.96$

Source: CDC (2008b).

endogenous obesity (Seidel, Dains, Ball, & Benedict, 2003).

Etiology of Obesity

Human body fat is mainly composed of unilocular adipocytes. Obesity occurs as a result of an increase in number (hyperplasia) or increase in size (hypertrophy) following macrophage infiltration of fat tissue. This change in adipocytes is considered to be the most important mechanism of increased fat in body mass (Garruti, Cotecchia, Giampetruzzi, Giorgino, & Giorgino, 2008).

The two types of adipocytes are unilocular (white adipocytes) and multilocular (brown adipocytes) (Farmer, 2008). The unilocular adipocytes, the most abundant cell type in mammalian fat, store energy as triglycerides in periods of energy excess, which is mobilized in periods of energy defect (fasting) or energy demand (exercise). An increase in total fat mass occurs only when the balance between energy intake and energy expenditure is impaired resulting in an increase in size (hypertrophy) of existing adipocytes. Morbid obesity exists when a person has a BMI of 40 or a BMI of 35 along with one comorbid condition. It is the most severe form of obesity and presents as a coexistence of hyperplasia and hypertrophy of unilocular adipocytes.

Multilocular adipocytes are represented by a totally different cell type. A mitochondrial protein is expressed by these cells as well as an uncoupling protein 1 (UCP1) which is mainly devoted to thermogenesis, or energy dissipated as heat. Multilocular adipocytes are typically found in human retroperitoneal adipose tissue deposits. “In both human and animal obesity, excess fat mass is never due to an increased number or size of UCP1-positive adipocytes” (Garruti et al., 2008, p. 194).

Scope of the Problem

As a developed nation, the United States has the highest prevalence of obesity. Obesity among children and adults is increasing throughout the world. According to Magee (2004), “it’s an urgent epidemic with catastrophic implications” (p. 1).

Comorbid conditions associated with obesity impact longevity and quality of life. Hospitals need more durable equipment to handle larger patients, ambulances require specialized equipment to lift and transport morbidly obese individuals, and commuter services may need to install larger seats. Assisting obese individuals with transportation to emergency care centers may require larger emergency response vehicles equipped with transport devices which can withstand larger weight capacities (Zezima, 2008). These changes have financial implications. Taxpayers assume the increased costs in county-administered emergency response services. Purchasers of health care assume higher costs, and those using public transportation may also face increased costs due to decreased capacity and the need to provide additional trips in order to service the same number of commuters. Obese individuals are faced with higher costs due to increased utilization of medical services and equipment (Orszag, 2008).

Incidence and Prevalence of Obesity

Since 1989, the U.S. has seen a dramatic increase in obesity. Of the 30 states having an obesity prevalence greater than 25%, 3 states - Alabama, Mississippi, and Tennessee - had a prevalence equal to or greater than 30% (CDC, 2008b) (Table 2.4).

Figure 2.1 reveals trends from 1990 to 2007 regarding the prevalence of

TABLE 2.4
PERCENT OF OBESE ADULTS (BMI \geq 30) IN U.S.

2007 State Obesity Rates							
State	%	State	%	State	%	State	%
Alabama	30.3	Illinois	24.9	Montana	21.8	Rhode Island	21.4
Alaska	27.5	Indiana	26.8	Nebraska	26.0	S. Carolina	28.4
Arizona	25.4	Iowa	26.9	Nevada	24.1	S. Dakota	26.2
Arkansas	28.7	Kansas	26.9	New Hampshire	24.4	Tennessee	30.1
California	22.6	Kentucky	27.4	New Jersey	23.5	Texas	28.1
Colorado	18.7	Louisiana	29.8	New Mexico	24.0	Utah	21.8
Connecticut	21.2	Maine	24.8	New York	25.0	Vermont	21.3
Delaware	27.4	Maryland	25.4	N. Carolina	28.0	Virginia	24.3
Washington DC	21.8	Massachusetts	21.3	N. Dakota	26.5	Washington	25.3
Florida	23.6	Michigan	27.7	Ohio	27.5	W. Virginia	29.5
Georgia	28.2	Minnesota	25.6	Oklahoma	28.1	Wisconsin	24.7
Hawaii	21.4	Mississippi	32.0	Oregon	25.5	Wyoming	23.7
Idaho	24.5	Missouri	27.5	Pennsylvania	27.1		

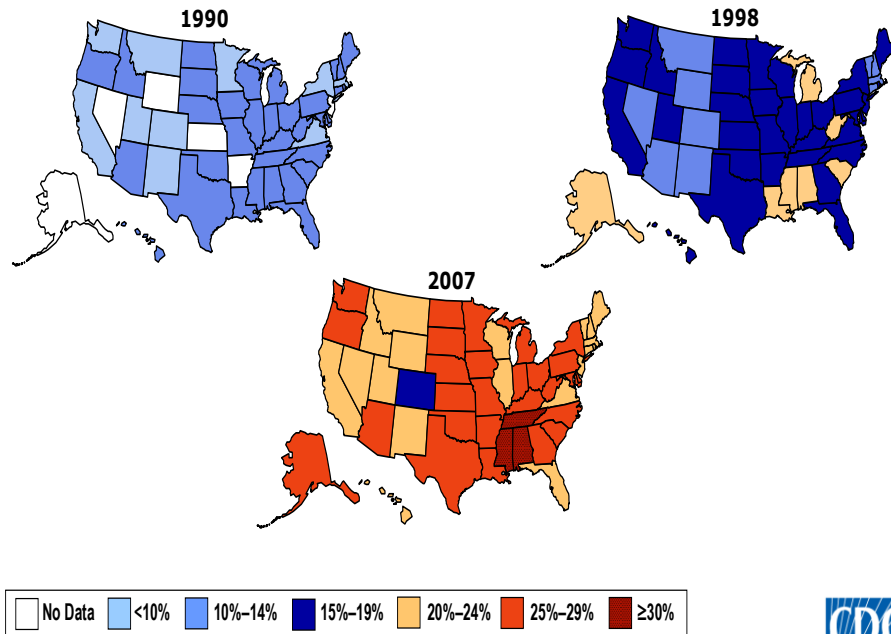
Source: CDC (2008b).

FIGURE 2.1

Obesity Trends* Among U.S. Adults

BRFSS, 1990, 1998, 2007

(*BMI ≥ 30 , or about 30 lbs. overweight for 5'4" person)



Source: CDC (2008c).

obesity. In 1990, of the states which participated in the Behavioral Risk Factor Surveillance System (BRFSS), 10 states had a prevalence of obesity less than 10%, and no states had a prevalence equal to or greater than 15%. By 1998, no states had a prevalence less than 10%, 7 states had prevalences between 20-24%, and no states had a prevalence of obesity equal to or greater than 25%. By 2007, only 1 state, Colorado, had a prevalence of less than 20% (CDC, 2008d). The 2005-2006 NHANES survey revealed the prevalence of obesity was 33% for adult men and 35% for adult women. These numbers correlate to a prevalence of obesity among adults of 69% in the U.S.

Recent research has shown that most ethnic groups in the U.S. have an increasing prevalence of obesity (Burke et al., 2008). The study also supports the development of comorbid conditions resulting from obesity. A concern raised from this study was the potential for reducing life expectancy due to cardiovascular disease. Burke stated, “one could worry that this will cause us to reverse our 50 year decline in cardiovascular disease mortality due to the obesity epidemic” (Rauscher, 2008, p. 1).

Miller, Alpert, and Cross (2008) studied the prevalence of obesity among nurses which revealed a mean BMI of 27% for participants, with 54% of participants in the overweight or obese BMI category. Many nurses reported that they were overweight (53%) and lacked the motivation to make lifestyle changes while, according to Miller et al.,

40% are unable to loose weight despite healthy diet and exercise habits.

Although 93% of nurses acknowledge that overweight and obesity are

diagnoses requiring intervention, 76% of nurses do not pursue the topic of

obesity with overweight and obese patients. (2008, p. 259)

Morbidity and Mortality of Obesity

Obesity and abdominal adipose content is associated with coronary heart disease (CHD) morbidity and mortality (Harrington & Wells, 2008). “Data from the Framingham Study described obesity as an independent predictor of cardiovascular disease, particularly in women” (Harrington & Wells, p. 269). BMI values ranging from 25-28.9 had 2 times the risk of CHD, and BMIs of 29 or greater having 3 times the risk of CHD as compared to lower BMIs according the Nurses’ Health Study data (Harrington & Wells).

While the percentage of comorbid conditions resulting from obesity is unknown, research supports significant comorbid disease associated with individuals having a BMI ≥ 30 (Brehm et al., 2007; Burke et al., 2008), especially in the morbidly obese who have a BMI ≥ 40 (Petry, Barry, Pietrzak, & Wagner, 2008; Thompson, 2007). Ferraro, Su, Gretebeck, Black, and Badylak (2002) reported that disability risk was higher for obese persons, but not consistently for overweight individuals.

Based on the number of obesity-associated deaths, Flegal, Williamson, Pamuk, and Rosenberg (2004) stated:

the increasing prevalence of obesity over the last two decades has generated considerable concerns about its health burdens. It is frequently stated in scientific and lay literature that obesity causes about 300,000 deaths per year in the United States. It has been suggested that obesity is second only to smoking as a preventable cause of death. (p. 1486)

The ability to estimate annual deaths attributable to obesity in the U.S. population

requires a large amount of information, including the number of deaths in a given year, the prevalence of obesity, as well as the relative risk of mortality associated with obesity. It may be difficult to develop accurate and precise estimates of mortality mostly due to the impact of age on mortality risks associated with obesity (Flegal et al., 2004). Hu, Willett, Stampfer, Spiegelman, and Colditz (2005) believed that the calculation method reported by Flegal et al. “did not take into account the chronic long term effects of obesity or its dynamic nature” (p. 832). It is important to consider that weight loss does not reverse all adverse effects of comorbid disease processes.

According to the 2005 National Vital Statistics Report (Kung, Hoyert, Xu, & Murphy, 2008) and the 2006 preliminary data (Heron, Hoyert, Xu, Scott, & Tejada-Vera, 2008), the 15 leading causes of death were heart disease, cancer, stroke, chronic lower respiratory diseases, accidents, diabetes, Alzheimer’s disease, influenza and pneumonia, kidney disease, septicemia, suicide, chronic liver disease and cirrhosis, hypertension, Parkinson’s disease, and homicides. Since there is no indication of a relationship with these causes of death and obesity, it is difficult to know the percentage of deaths resulting from obesity. Determining the associated morbidity and mortality due to obesity may be as complex as the disease process itself.

Incidence and Prevalence of Obesity Among U.S. Workers

The workplace is a snapshot of the general population. As obesity is at epidemic proportions in the general U.S. population, that same trend occurs in U.S. workplaces.

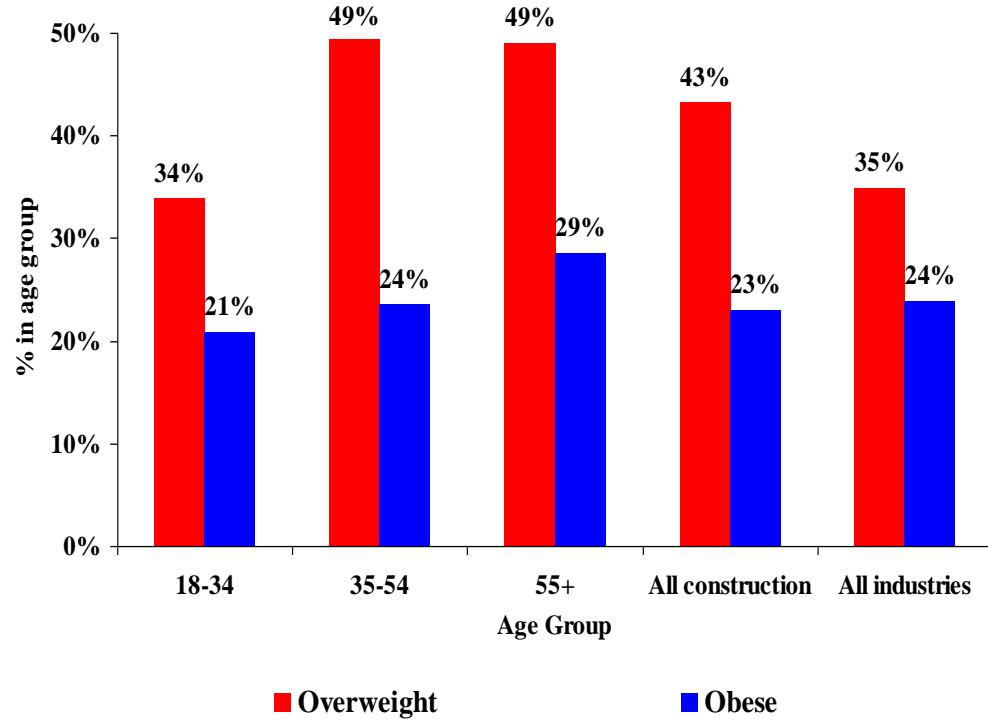
Obesity and associated comorbid conditions affect workers across the nation

and contributes to long-term disability (Harrington & Wells, 2008; Schelbert, 2009). However, research is limited regarding current obesity rates among different types of workers. Caban et al. (2005) studied pooled and annual prevalence rates of obesity in 41 occupational categories from the National Health Interview Survey from 1997 to 2002 for men and women. During this time period, the highest obesity rates were noted in female workers and white workers in general. Obesity rates rose across all worker groups, without respect to race and gender when comparing two survey periods. “Among various US working groups, the prevalence of obesity increased almost 10% between the survey years 1986 and 2002” (Caban et al., p. 1614). Workers who were employed as motor vehicle operators experienced a higher prevalence of obesity for both time periods. These data support the current research which correlated decreased activity levels among obese and morbidly obese adults (Gates, Succop, Brehm, Gordon, & Sommers, 2008; He & Baker, 2004).

According to the Electronic Library of Construction Occupational Safety and Health (eLCOSH, 2008), “in 2005 about two out of three construction workers (66%) were either overweight or obese, compared with 59% for all industries” (p. 1). Table 2.5 shows the comparison by percentage of obesity between construction workers and workers in general industries. Brehm et al. (2007) conducted a study on the prevalence of obesity and cardiovascular risk factors among several small manufacturing companies in Kentucky. Of the workers who participated in the study, 85% of male participants and 67% of female participants were overweight or obese. While this study is not generalizable to all manufacturing employees in the U.S., it provides data regarding obesity in

TABLE 2.5

**OVERWEIGHT AND OBESITY AMONG CONSTRUCTION WORKERS
BY AGE GROUP AND COMPARISON WITH ALL INDUSTRY**



Source: eLCOSH, (2008).

Kentucky manufacturing plants. It also provides insight into the need for implementing successful intervention programs for obesity in the workplace (Brehm et al., 2007).

Impact of Obesity in U.S. Workplaces

According to CDC (2007a) prevalence and trend data (see Appendix), 53.1% of the population of the states, D.C, and territories work for an employer; another 8.8% are self-employed; and 4.3% of students are employed. This represents a total of 77.7% of individuals who perform some type of work on a regular basis. About 37% of the population is considered overweight with a BMI of 25.0-29.9% and 26% of the population is considered obese with a BMI of 30.0-99.8% (CDC, 2007a). This calculates to 63% of the population being overweight or obese (Table 2.6). As the worker population is derived from the general population, health issues significantly affect both the general and worker populations. Workers may be less productive due to increased absenteeism, disability, hospitalization, prolonged recovery periods, and increased need for more medications. As about 78% of the U.S. populations are workers, the workplace can be an ideal location to help to control obesity.

Causes of Obesity

Several causes of obesity have been identified. Excess body fat may occur through a single cause or a combination of causes (NHLBI, 2008). The root cause of obesity is the consumption of more calories than are burned by the body through metabolic demands and physical activity resulting in an excess of fat mass. Other causes include diet, inactivity, smoking cessation, pregnancy, certain medications, and some medical problems.

TABLE 2.6

**PREVALENCE AND TRENDS DATA
OVERWEIGHT AND OBESITY (BMI)-2007**

Weight Classification by Body Mass Index (BMI)			
State:	Neither Overweight or Obese (BMI 24.9 or less)	Overweight (BMI 25.0-29.9)	Obese (BMI 30.0-99.8)
Nationwide (States, DC, & Territories)	37.0	36.7	26.3
Alabama	33.4	35.7	30.9
Alaska	34.8	36.9	28.2
Arizona	37.3	36.8	25.8
Arkansas	34.4	36.3	29.3
California	41.0	35.7	23.3
Colorado	44.4	36.4	19.3
Connecticut	40.8	37.5	21.7
Delaware	34.9	36.8	28.2
District of Columbia	44.7	33.1	22.2
Florida	37.9	38.0	24.1
Georgia	35.0	36.3	28.7
Guam	39.0	36.4	24.6
Hawaii	43.2	35.1	21.7
Idaho	36.9	38.0	25.1
Illinois	37.0	37.4	25.6
Indiana	36.8	35.8	27.4
Iowa	35.3	37.0	27.7
Kansas	36.2	36.1	27.7
Kentucky	30.9	40.4	28.7
Louisiana	34.8	34.5	30.7
Maine	37.0	37.7	25.2
Maryland	37.3	36.4	26.3
Massachusetts	41.1	37.2	21.7
Michigan	35.7	36.1	28.2
Minnesota	38.0	36.0	26.0
Mississippi	31.9	35.5	32.6
Missouri	36.7	35.1	28.2
Montana	38.2	39.2	22.6
Nebraska	35.3	38.2	26.5
Nevada	37.0	38.4	24.6
New Hampshire	38.2	36.7	25.1
New Jersey	37.7	38.2	24.1
New Mexico	39.2	35.7	25.1
New York	38.0	36.4	25.5
North Carolina	35.4	35.9	28.7
North Dakota	35.1	37.9	27.0
Ohio	36.5	35.4	28.1

TABLE 2.6 (Continued)

**PREVALENCE AND TRENDS DATA
OVERWEIGHT AND OBESITY (BMI)-2007**

Weight Classification by Body Mass Index (BMI)			
State:	Neither Overweight or Obese (BMI 24.9 or less)	Overweight (BMI 25.0-29.9)	Obese (BMI 30.0-99.8)
Oklahoma	34.9	36.3	28.8
Oregon	37.9	35.7	26.3
Pennsylvania	37.4	34.9	27.8
Puerto Rico	35.0	38.3	26.6
Rhode Island	39.2	39.1	21.7
South Carolina	34.7	36.3	29.0
South Dakota	34.5	38.3	27.2
Tennessee	32.6	36.7	30.7
Texas	34.3	37.2	28.6
Utah	42.1	35.6	22.4
Vermont	41.2	36.9	21.9
Virginia	38.2	36.6	25.3
Virgin Islands	35.8	37.9	26.3
Washington	37.9	36.2	25.9
West Virginia	32.0	37.7	30.3
Wisconsin	37.7	37.0	25.3
Wyoming	37.8	37.7	24.5

Source: CDC (2007a).

The average American diet is a direct causative factor of overweight and obesity. Many individuals consume high calorie foods or increased portions of food. Consumption of high fat foods, such as “fast food,” is calorie dense. Diets high in sugar from soft drinks, candy, and desserts promote weight gain. Eating away from home contributes to the consumption of increased calories as portion sizes are larger and food preparation may include frying or using high fat sauces, gravies, or creams (CDC, 2007c).

Inactivity is another causative factor. Sedentary people are more likely to gain weight due to inadequate calories burned from lack of physical activity. Increased technology reduces the need for physical labor; busy lifestyles limit leisure time and physical activity, which also contributes to inactivity.

Individuals who quit smoking may gain weight. Smokers tend to have a higher metabolic rate than non-smokers. Nicotine raises the body’s metabolic rate so that smokers burn calories faster. Since taste and smell improve once smoking has ceased, people often eat more resulting in weight gain. The benefits of smoking cessation and improved health outweigh associated weight gain.

Pregnancy is another causative factor. Weight gain is essential during this time for the health of the unborn child. Some women have a difficult time losing the weight gained during pregnancy.

Medications such as corticosteroids and tricyclic antidepressants can lead to weight gain. Other medications which influence female hormone production such as the oral contraceptives, Estrogen Replacement Therapy (ERT), and fertility drugs may contribute to female obesity.

Medical problems can have a direct impact on the development of obesity.

Disorders that affect the metabolic rate, such as hypothyroidism and Cushing's syndrome, and different forms of arthritis, which limit participation in physical activity, also increase the likelihood of developing obesity (Mayo Clinic, 2007).

Risk Factors

There are several risk factors which contribute to a higher probability of developing obesity as an adult. These factors include genetics/non-genetic factors, family history, aging, gender, and lack of sleep.

Genetics potentially impact how efficient the body converts food into fuel, and how the body utilizes calories during periods of exercise. DNA coding affects the amount of body fat stored as well as where and how the fat is stored. According to Spalding et al. (2008), "the factors determining fat mass in adult humans are not fully understood, but increased lipid storage in already developed fat cells (adipocytes) is thought to be most important" (p. 783). The authors studied the dynamics of fat cells in adults. They measured radiocarbon (^{14}C) derived from nuclear bomb tests in which subjects from the Cold War era were exposed to increased ^{14}C in the atmosphere. After determining that adipocytes are generated from newborn cells in adulthood, the authors established that the number of adipocytes is constant in both lean and obese adults, with "approximately 10 percent of fat cells renewed annually at all adult ages and levels of BMI" (Spalding et al., p. 783). In early onset obesity, there is no change in the number of fat cell deaths or generation rates, indicating regulation of fat cell numbers even in obese adults. Because this study focused on individuals with early onset obesity, it could not rule out new adipocytes forming after years of obesity and a potential cell threshold being reached. Understanding these complicated facts provides insight to

the development of future treatment, control, and potential eradication of obesity.

Non-genetic factors also affect the potential development of obesity. Diet and physical activity are strongly associated with eating/physical activity patterns developed during childhood. Other non-genetic risk factors include a family history of diet-related obesity. According to Hill and Trowbridge (1998), “despite obesity having strong genetic determinants, the genetic composition of the population does not change rapidly. Therefore, the large increase in obesity must reflect major changes in non-genetic factors” (p. 271).

Family history of obesity is another risk factor. If one or both parents are obese, the risk of becoming obese increases. Being obese as a child is another contributing factor to adult obesity (CDC, 2007c).

Aging is a contributing factor in the development of obesity. As the aging process occurs, muscle mass decreases resulting in a decreased metabolism. Thus older individuals have reduced calories needs. Simply aging and maintaining the same dietary habits can result in obesity, especially when combined with the lack of physical activity (CDC, 2007c).

Gender is another risk factor. Women are more likely to become obese due to less muscle mass than men. As a result, females burn fewer calories at rest leading to increased risk of obesity.

Lack of sleep is also linked to overweight and obesity (Petrucci, 2007). Adults who sleep five hours or less a night are more likely to become obese when compared with adults who sleep at least seven to eight hours a night. Individuals who lack sufficient amounts of sleep consume foods higher in calories and carbohydrate content, increasing the potential for overeating and weight gain. These

individuals and diabetics have similar insulin and blood sugar levels. During sleep, hormones are released which control appetite. Sleep deprived individuals have lower levels of the hormone leptin, an appetite and hunger depressant. At the same time, they have high levels of gherlin, a hormone which causes hunger (Petrucci).

Physiological Changes Associated with Obesity in Adults and Associated Comorbidities

Obesity effects many body systems. It increases the risk of developing multiple health disorders as well as impacts the quality of life. According to Harrington and Wells (2008),

obesity is associated with a loss in health-related quality of life that is commonly assessed using the EuroQol (which includes such dimensions as mobility, self-care, usual activities, pain, and anxiety and depression) and a portion of the SF-36 (which includes the dimensions of physical function, role limitation, social functioning, pain, mental health, and vitality. (p. 267)

Decreased mobility, social function, and role limitation are associated with obesity as are increased low back and hip pain, and knee dysfunction.

As a result of the impact on body systems, obesity, morbid obesity, and comorbid conditions have a circular relationship which adds to the body's burden of disease. Fat distribution plays a central role in the development of some of these processes and is a major component of human disease.

Cardiovascular System

Obesity causes changes to the internal structures of the heart affecting its normal function. Obesity and excess abdominal adipose tissue have a direct relationship to moderately elevated cholesterol and triglyceride levels. It is also associated with lower levels of high-density lipoprotein levels (HDL), normal to

higher levels of low-density lipoprotein (LDL), and elevated blood pressures when compared to non-obese individuals. As a result, obesity is a predisposing condition in coronary heart disease (CHD), coronary artery disease (CAD), ventricular dysfunction, cardiac arrhythmias, heart failure, and stroke. These changes may also occur in the absence of hypertension (Harrington & Wells, 2008).

The heart adapts to increased adiposity by an increase in resting oxygen consumption which leads to various other changes in internal structures. In the presence of hypertension, internal pressures of the heart increase. The heart's workload increases at a higher rate from physical activity in the obese compared to individuals of normal weight, which results in enlargement of the left side of the heart. Current research supports the presence of reduced physical work capacity and reduced cardiac efficiency in obese subjects as compared to non-obese subjects (Harrington & Wells).

Other changes in the cardiac system caused by obesity are significant. Adipositas cordis, or obesity cardiomyopathy, occurs in the morbidly obese. Hypertrophy of the heart and systolic dysfunction arise due to increased wall stress which results in diastolic dysfunction. A change in the cardiac autonomic nervous system occurs. The heart rate can increase with as little as a 10% increase in body weight. Obesity contributes to electrocardiograph (EKG) changes, such as tachycardia, increased atrial and ventricular depolarization, increased QT interval, ST and T-wave abnormalities, ST depression, left axis deviation, as well as atrial abnormalities (Harrington & Wells).

In addition, obese individuals are at higher risk for hypertension. "As compared to lean subjects, the frequency of hypertension is six times greater for

those who are obese” (Harrington & Wells, 2008, p. 268). As a result of increased body weight, systolic and diastolic blood pressure rise affecting individuals who have an increased distribution of adipose tissue. INTERSALT, a large international study (as cited in Harrington & Wells), found that an increase in body weight by 10 kg is associated with a 3.0 mmHg increase in systolic and a 2.3 mmHg increase in diastolic pressures. These findings support individuals having a higher risk of CHD and stroke occurring with obesity (Harrington & Wells).

The NHANES I study (as cited in Harrington & Wells) “supports a higher risk of developing heart failure at a rate of 30% associated with being overweight with other studies demonstrating abdominal body fat distribution the stronger risk factor than overall obesity” (p. 269).

Several vascular conditions are associated with obesity. The incidence of venous thromboembolism (VTE) is higher in obese individuals who have a waist-to-hip ratio more predictive of disease risk than BMI. Risk factors for VTE and obesity are decreased or impaired mobility, lower extremity venous insufficiency, decreased fibrinolytic activity, and the presence of other comorbid diseases. Examples of venous insufficiency, which are attributed to obesity, include an increase in varicose veins, lymphedema, and leg ulcers.

Obese males and females have an increased risk for stroke. Excessive adipose tissue results in a higher prothrombic and proinflammatory state. “There appears to be an increased risk of ischemic stroke in the obese population as compared to hemorrhagic stroke with a 5% increase in ischemic stroke per one unit increase in BMI” (Harrington & Wells, p. 270).

Pulmonary System

Obesity also affects the pulmonary system by causing changes in the lung volume values, expiratory maneuvers, and ventilation perfusion. Long-term consequences of obesity may result in obstructive sleep apnea (OSA), obesity hypoventilation syndrome (OHS), and increased incidence of asthma (Harrington & Wells, 2008).

Obese individuals have difficulty breathing from inefficient chest wall muscle movement. Two other factors associated with respiratory difficulty in the obese person include decreased muscle mobility and the inability of the diaphragm to fully descend during inspiration from increased adiposity of the abdominal area. Consequently, less air enters the lungs and the accessory respiratory muscles have to work harder leading to dyspnea. The sensation of shortness of breath is not only associated with increased physical activities but also at rest. Moderate physical efforts result in obese individuals becoming easily dyspneic. “This higher perception of shortness of breath is often described as an unpleasant stimulus and contributes to the decrease in exercise tolerance and willingness to engage in physical activity on a routine basis” (Harrington & Wells, p. 272).

Harrington and Wells also report that individuals with elevated BMI levels had respiratory muscle weakness which resulted in a decrease in exercise capacity measured by oxygen consumption. Respiratory weakness and decreased exercise capacity have a negative impact on exercise tolerance and aerobic capacity. In addition, morbidly obese individuals experience a significant increase in oxygen consumption necessary to support the respiratory system compared to normal individuals.

Obese individuals expend more energy to carry the extra body weight, causing an increased metabolic cost measured by total oxygen consumption. As a result, there is decreased oxygen available to skeletal muscles to perform physical activities, contributing to decreased cardiopulmonary performance. An elevated BMI results in higher metabolic demand to complete an activity due to an early onset of exhaustion which occurs at moderate intensity levels (Harrington & Wells, 2008).

The literature supports the relationship between BMI and abdominal fat distribution measured by waist circumference, to a reduction in forced lung volumes and ventilation. Lung and residual lung capacity and reductions in the expiratory reserve volume (ERV) occur with obesity (Harrington & Wells).

Gas exchange is also altered by obesity resulting in an inverse relationship between oxygenation and BMI. Impaired oxygenation occurs from chronic underventilation of the lung because the diaphragm is unable to fully expand, eventually leading to the collapse of alveoli in the bases of the lungs.

Obese individuals can experience symptoms of OSA which includes apnea, awakening, loud snoring, choking, unrefreshing sleep, and excessive daytime sleepiness without actually suffering from the disorder. OSA occurs due to partial or complete obstruction of the upper airway during sleep as a result of the collapse of the pharyngeal airway (Harrington & Wells). When the diagnosis of OSA is confirmed, there are gender differences. In men, neck size is closely associated with OSA severity where as in women OSA is strongly predicted by BMI and age.

Obesity hypoventilation syndrome is another serious condition. “The diagnostic criteria for OHS include a BMI $\geq 30\text{kg/m}^2$, daytime partial pressure of

carbon dioxide (PaCO_2) > 45mmHg, associated sleep-related disorder, and absences of other known causes of hypoventilation” (Harrington & Wells, 2008, p. 273).

Obese individuals with OHS have symptoms similar to OSA. Overtime, the consequences of OHS may lead to pulmonary hypertension and right-sided congestive heart failure.

Pulmonary embolism (PE) and the incidence of asthma are associated with obesity as well. PE is higher in obese individuals, particularly in women (Harrington & Wells). Epidemiologic studies have shown that obesity increases the prevalence of asthma, although the biological association is not currently understood (Harrington & Wells). Obesity is also associated with increased incidence of asthma which responds less favorably to the standard treatment provided to most asthmatics. There is a significant association between obesity and gender in the development of asthma, with a higher prevalence among obese women. Not only is asthma an issue for obese individuals, but “there is an association between obesity, gastroesophageal reflux disease (GERD), and asthma” (Harrington & Wells, p. 273).

Neuroendocrine System

The relationship between the neuroendocrine system and obesity cannot be overlooked. According to Garruti et al. (2008), not only is obesity an excess of fat mass and energy deposit, adipocytes also function as an endocrine organ with the ability to release molecules (adipocytokines) that have endocrine, autocrine, or paracrine roles. The development of central obesity and metabolic syndrome (MbS) is also related to a chronic low-grade inflammatory state of the cytokines. The cytokines, produced by both adipocytes and macrophages, infiltrate adipose tissue

as well as liver and muscle. Garruti et al. found that “appetite and energy balance are regulated by several neuroendocrine circuits. If a deregulation of energy balance occurs, body fat mass increases” (p. 193).

As an endocrine organ, adipose tissue secretes leptin as well as other products. “In animals, leptin displays central and peripheral effects important in regulating not only satiety but also fertility” (Garruti et al., p. 194). Leptin’s function is mainly hormonal but not exclusively. Adipocytes have receptors which are spread out in different peripheral organs, including the ovary where the leptin is secreted. The obese (*ob*) gene has been linked to chromosome 7 (National Institutes of Health, 2008a). The *ob* gene in human homozygotes undergoes a mutation in utero which “displays a phenotype having main features of morbid obesity, MbS, and reduced fertility” (Garruti et al., p. 194) which is an important factor in the potential development of obesity.

In MbS, obese individuals have decreased glucose oxidation due to the free fatty acids (FFA) entering the liver via the portal circulation. This results in a direct source of FFA for the liver. Since obese individuals have a larger amount of visceral fat mass, an enormous amount of fatty acids (FA) reaches the liver (Garruti et al.).

Associated with the changes in the neuroendocrine system several complex body systems interact with adipose tissue for the body to function in a steady energy state. Some of these systems influence body fat mass itself while other systems regulate energy balance with body fat alone. It is believed that sustained weight loss can reverse the negative relationship of some of these systems with body fat associated with weight gain (Garruti et al., 2008).

Significant comorbid conditions affecting the neuroendocrine system of the obese include metabolic syndrome, diabetes and associated CVD, and dementia. These conditions are highly associated with early mortality.

Metabolic syndrome (MbS) is the result of a cluster of conditions occurring together. A main feature of MbS is upper body obesity, especially of the waist, better known as being an “apple” shape. Upper body obesity typically occurs with accumulation of fat located intraperitoneally, retro-peritoneally, or subcutaneously. Excess intraperitoneal fat is typically associated with insulin resistance and Type II diabetes rather than excess adipose deposits located retro-peritoneally or subcutaneously. Other components of MbS include elevated blood pressure (arterial), elevated triglycerides, a low HDL, insulin resistance, overweight, and a sedentary lifestyle.

Not only is the development of Type II diabetes in MbS a concern, it also has a high cardiovascular risk (Lois, Young, & Kumar, 2008). According to Fox et al. (2008), there is an increased likelihood of developing diabetes as BMI increases.

The lifetime risk of diabetes has been estimated at 32.8% for men and 38.5% for women. The lifetime risks of diabetes increases in proportion to body mass index, ranging from 7.6% among underweight individuals to as high as 74.4% among individuals with stage 2 obesity. (p. 4)

These are significant reasons for educating and encouraging workers to adopt healthy lifestyle habits.

Research studies have shown that obesity is linked to heart failure. The study by Fox et al. concluded “the lifetime risk of CVD among individuals with diabetes is high, and risk is accentuated with increasing adiposity” (p. 4). Along

with the association between life span risks of diabetes and increased body mass index, individuals with obesity and diabetes have an elevated natural lifetime risk of CVD “with the lifetime risk of CVD approaching nearly 80% in obese women and nearly 90% in obese men” (Fox et al., 2008, p. 2).

Another concern of central obesity or adipose tissue found in the abdominal area, especially during the midlife period, is an increased risk of dementia. Whitmer et al. (2008) studied the development of dementia and found it occurs independently of diabetes and cardiovascular comorbid conditions. Individuals with central adiposity who do not develop diabetes are still at risk for increased morbidity based on the findings of this study (Whitmer et al.).

Psychiatric and Other Obesity-Related Disorders

Obesity is associated with an increased incidence of psychiatric disorders. Petry et al. conducted a study of 41,654 adults and found that obese individuals were 2 times more likely to suffer from depression, anxiety, and other mental health conditions compared to normal weight adults. “Adipose tissue is often a major site for the release of inflammatory markers such as interleukins and acute phase proteins” (Hamer & Stamatakis, 2008, p. 538). Evidence supports a causal role of inflammatory processes in obesity. According to study findings, “in summary, little is known about the stress induced biological mechanisms of obesity. Our study suggests that inflammatory processes explained ~ 25% of the unique variance in the association between psychosocial stress and obesity” (Hamer & Stamatakis, p. 539).

Obesity has a negative effect on female fertility. According to Edwards et al. (2007), “a strong association exists between morbid obesity and infertility,

pregnancy complications and adverse perinatal outcomes” (p. 93). The decreased levels of globulin, which binds sex hormones, results in increased levels of free androgens and estrogen circulating in the bloodstream. These increased levels may be responsible for hirsutism and irregular menses, anovulatory cycles, or amenorrhea. Weight loss allows the globulin levels to return to a normal range allowing for regained fertility (Edwards et al., 2007).

Other disorders which have been documented as consequences of overweight and obesity include gallbladder disease, osteoarthritis, some cancers - endometrial, breast, and colon - and polycystic ovary disease (CDC, 2007e; Mayo Clinic, 2007). These disorders result in obese individuals having a poorer quality of life than individuals of average weight.

Societal Concerns Regarding Obesity and its Long-Term Impact on Health

The circular relationship between the cause and effect of obesity and disease, and disease and obesity needs to be controlled. Not only is society aging with baby boomers retiring, but society as a whole is also becoming fatter. With greater than 60% of the U.S. population either overweight or obese, the implications are serious. Comorbid conditions and the potential for increased disability and decreased life expectancy related to obesity or associated illness threatens to further increase health care costs for employers and society.

Even though females are more likely to be obese, previous research links a lower risk of obesity to a subset of women who have increased socioeconomic status, higher occupational status, and higher educational levels (Truang, Phil, & Strum, 2005). Wardie, Waller, & Jarvis (2002) concluded that “higher educational attainment and higher socioeconomic status were associated with a lower risk of

obesity in men and women; whereas higher occupational status was associated with lower risk of obesity for women only” (p. 1299).

Obesity contributes to higher medical costs with the need for specialized medical equipment and increased staff to care for obese patients. Health care workers who move larger patients experience higher physical demands and may have increased incidence of injuries.

Currently, the U.S. “replacement” generation, children and adolescents, are also suffering from the obesity epidemic. Two serious questions need to be addressed. How can workers who currently comprise the nations’ workforce remain productive and diminish the increased morbidity of obesity? How can the knowledge gained from helping workers be transferred to future workers, ensuring a healthy workforce tomorrow?

CHAPTER 3

OBESITY AS A PUBLIC HEALTH CONCERN

Obesity as a public health concern has been well documented (Allison, Zannolli & Narayan, 1999; Burke et al., 2008). Currently obesity is at epidemic proportions in the U.S., and other industrialized countries are also experiencing increased obesity rates. In a previous study of obesity in adolescents, Russia was the only nation that had not seen an increase in obesity rates (Wang, Monteiro, & Popkin, 2002). The impact of obesity on workers and workplaces has also been well documented (Caban et al., 2005). Industries are realizing increased health care costs for obese workers compared to workers of average weight. Obesity attributable medical expenditures for the U.S. are approximately \$75 billion annually (An, Saloner, & Ranji, 2008). For employers, obesity-related losses of more than \$13 billion annually due to loss productivity with expectations of significant increases over the next few years, are unacceptable. The impact of obesity is more than a financial concern. The physical and emotional health, as well as the longevity of the U. S. adult population, is at stake.

Stigma of Obesity on Affected Workers

Obese individuals, especially the morbidly obese, suffer bias and stigmatization in society today. They are perceived as being at fault for their current condition and may be stereotyped as lazy. In many different types of current media and fashion, more emphasis is placed on the slender model. Data from the North American Association of the Society for Obesity (NAASO) support that slender role models are more appealing to the eye, with obese individuals less likely to be portrayed in leading roles or as positive role models (NAASO, 2008).

Weight stigma is defined as personal negative attitudes which affect interpersonal interactions and activities in a detrimental way (NAASO, 2008). Stigma may be verbal and physical along with other barriers and obstacles due to an individual's weight. In a more severe form, stigma can result in discrimination in the workplace. There are many forms of verbal bias which include teasing, ridicule, stereotypical inferences, derogatory names, or disparaging remarks. Physical stigma includes touching or grabbing areas of adiposity or other aggressive behavior toward overweight or obese individuals. Other barriers faced by the obese include medical equipment which does not accommodate obese persons, publicly placed chairs and seats which are too small, and stores which do not offer clothing for larger individuals (NAASO).

Most adults in America have long standing attitudes toward obesity that began in childhood. Studies show that even kindergarteners prefer playing with average weight children rather than overweight children, and also prefer a physically handicapped child as a playmate versus an overweight child (NAASO; Vacek, 2007). This mindset continues through high school and adulthood. Media types, models, and movie stars are presented as happy and beautiful which is inferred to being thin.

The workplace is no different. Workers bring this mindset into workplaces and the public perpetuates this belief system. According to the NAASO, social consequences associated with overweight and obesity are serious and pervasive. An example of workplace obesity bias includes being denied a position or promotion due to personal appearance, not a result of job qualifications.

The ability to obtain a job can be difficult for overweight people. According

to NAASO (2008), “experimental studies have found when a resume is accompanied by a picture or video of an overweight person (compared to an average weight person), the overweight applicant is rated more negatively and is less likely to be hired” (p. 1).

Peers and managers may associate negative stereotypes with obese individuals, perceiving these workers as lazy, sloppy (dress, appearance, work habits), and lacking competence and self-discipline when compared to normal weight peers. These individuals are often perceived to be disagreeable and in general, poor role models (NAASO; Puhl & Brownell, 2001; Schwartz, Chambliss, Brownell, Blair & Billington, 2003). Obese workers may also earn less than their average weight counterparts, earn less for the same type of job, and have a greater likelihood of holding lower paying jobs. They are less likely to receive promotions, being bypassed for workers of average weight. Obese individuals tend to internalize bias and stigmatization, blaming themselves for their current situation which affects them psychologically.

Besides workers and management perceiving overweight and obese workers negatively, health care workers including nurses and physicians, can also be biased against obese individuals. Bachman et al. (2008) conducted a roundtable discussion among nurses regarding weight stigmatism and bias. Participating in this discussion, a nurse from The Duke University Medical Center weight loss program indicated that 100% of patients reported some type of weight bias with 60% reporting inappropriate comments from their physicians (Bachman et al., p. 8). According to Schwartz et al., nurses were surveyed about perceptions toward obese patients and found “24% of the nurses reported that they are repulsed by obese

persons” (2003, p. 1038).

Financial Impact of Obese Workers

It is well known that health care costs have been rising for the last several years and are currently rising at the fastest rate in U.S. history. According to the National Coalition on Health Care (NCHC, 2008), total health care expenditures in 2007 were 2.3 trillion dollars which surpassed 2 trillion dollars spent in 2006. Total health care expenditures are expected to reach 3 trillion dollars by 2011 if they continue at the same rate. The total dollar amount spent on health care represents 16% of the gross domestic product (GDP). Should health care costs continue to rise at the same rate, the GDP for health care costs is predicted to reach 20% by 2016. These data support the U.S. is spending more on health care than any other industrialized nation. Even with this large sum of money spent for health care, the number of uninsured Americans continues to grow. Currently, there are 47 million individuals who are not covered by some type of health insurance plan.

Employer-sponsored health coverage premiums have increased by 87% since 2000, with a rise of 6.1% in 2007 (NCHC). Small businesses carried the burden of higher cost with a 6.8% increase in health care premiums. Workers are assuming a larger share of these costs through higher premiums, deductibles, and co-payments. Many U.S. workers have difficulty affording health care or preventative care services as wages have grown at a slower pace than health care costs.

The typical annual premium that a health insurer charges an employer for a health plan covering a family of 4 was about \$12,100 in 2007 (NCHC). For employers, health insurance expenses are the fastest growing cost. Workers

contributed nearly \$3,300 for health care premiums in 2007, a 10% increase from 2006 and an increase of more than 143% since 2000. Worker costs associated with out-of-pocket health care expenditures for deductibles, co-payments for medications, and co-insurance for physician and hospital charges rose by 115% during the same period.

In the 2008 Congressional Budget Office (CBO) testimony by Peter Orszag (2008), data were captured which compared distribution of health care spending by the U.S. population aged 19 or older by weight. These data confirmed the cost of health care associated with each BMI category and the increased health care costs for overweight, obese, and morbidly obese individuals compared to those of normal weight. The health care costs per person in all weight categories, and the percentages of obese persons increased from 1987 to 2001. Spending for morbidly obese individuals almost doubled per person for the same period (Table 3.1) (Orszag). These statistics impact employers as they insure many working adults.

Direct costs associated with obesity and resulting health problems include preventative, diagnostic, and treatment services. Indirect costs of morbidity and mortality vary. According to the CDC (2007d), “morbidity costs are defined as the value of income lost from decreased productivity, restricted activity, absenteeism, and bed days, while mortality costs are the value of future income lost by premature death” (p. 1).

Employers lose approximately 4.3 billion dollars annually from obesity-related absenteeism; 30% of their losses are from increased absenteeism for obesity alone. Each year, approximately 42 billion dollars for health-related productivity is lost from obese workers, who also experience significantly more health-related lost

TABLE 3.1

DISTRIBUTION OF POPULATION BY WEIGHT CATEGORY AND HEALTH CARE SPENDING

Box 1.

Continued

Distribution of Population Aged 19 or Older and Health Care Spending by Weight Category

	1987		2001	
	Percentage of Population	Spending Per Capita (Dollars)	Percentage of Population	Spending Per Capita (Dollars)
All Persons	100.0	2,352	100.0	3,166
Underweight	3.6	2,695	1.8	3,092
Normal	51.6	2,259	38.6	2,783
Overweight	31.4	2,322	35.8	3,103
Obese	12.2	2,655	20.7	3,737
Morbidly Obese	1.3	2,674	3.1	4,725

Source: Congressional Budget Office analysis using the National Medical Expenditure Survey (1987 data) and the Medical Expenditure Panel Survey (2001 data).

Note: Weight categories are defined using the body-mass index (BMI)—a measure of body fat based on height and weight that applies to adult men and women—as follows: underweight (BMI is less than or equal to 18.5); normal (greater than 18.5 and less than 25); overweight (greater than or equal to 25 and less than 30); obese (greater than or equal to 30 and less than 40); morbidly obese (greater than or equal to 40).

Another way to examine the effect of obesity on spending is to ask how much would be saved if the prevalence of obesity returned to that of 1987, given the 2001 levels of spending for each respective category of body weight. That approach implies that changes in the prevalence of obesity account for around 12 percent of the spending growth between 1987 and 2001. The different results generated by the two methods reflect the change in the relative magnitude of spending on obese persons compared with spending on persons of normal weight. In 1987, spending per morbidly obese person was about 18 percent higher than spending per person of normal weight, but by 2001 it was 70 percent higher.

Source: Orszag (2008).

time than workers of normal weight. These workers are 2 times more likely than the general worker population to be absent 14 or more times per year at a cost of 2.4 billion dollars annually in paid sick time alone (Thompson, 2007).

Thompson reported that obesity cost “U.S. companies more than 13 billion (dollars) annually in health care and lost productivity, including 39 million lost work days” (p. 266). Crawley and Gates (2008) indicated that female workers account for the majority of obesity–related absenteeism and incur 75% of these absences. Across all occupational categories, obese women were 61% more likely to miss work than healthy weight women.

Men in sales and professional occupations who suffer from obesity were absent from work more often than men of healthy weight. Among other occupations, such as managers, office workers, and equipment operators, the morbidly obese missed more time from work than any other category. According to Crawley and Gates, “obesity seems to have a threshold effect on presenteeism, with moderately and extremely obese workers being significantly less productive than other workers” (p. 2).

With an aging workforce, industries can no longer afford to ignore obesity, its associated costs, and potential for premature deaths among their workers. Wee et al. (2005), who studied obesity and age, found that not only were mean per capital annual health care expenditures associated with overweight and obesity substantial, but costs associated with higher BMI levels continued to rise disproportionately among whites and older adults.

Three key elements significantly affect an employer’s ability to control business costs. They include health care costs associated with disability-related

absences, costs incurred due to lost productivity, and lost earnings due to cost of replacement workers (Thompson, 2007). As these costs continue to rise, the workplace cannot afford to ignore rising obesity rates among workers.

Socioeconomic Concerns of Obese Workers

Higher health care costs also affect the obese worker (Wee et al., 2005). The worker, who has increased lost productivity resulting in fewer wages, also suffers more comorbid conditions, longer hospital stays, decreased physical capacity for work, and social stigmatization and bias resulting from being obese (Zizza, Herring, Stevens, & Popkins, 2004). Obese individuals suffer from psychological disorders such as depression, anxiety, and decreased self-esteem, which further affect their ability to be productive at work (Petry et al., 2008).

Larger people typically need more room to accommodate their size. Obese individuals may require two seats on an airplane instead of one, need to rent a larger vehicle, and perhaps require larger hotel accommodations. These requirements mean higher costs for the obese. These higher costs also affect employers of obese executives. Obese professionals have less potential for corporate advancement than individuals of normal weight (NAASO, 2008).

Blue collar obese workers suffer some of the same issues with larger sized clothing and transportation, but also have other concerns. According to the U.S. Bureau of Labor and Statistics [BLS] (1999), short-term disability benefits were available to 58% of blue collar workers compared to 62% of white collar workers. Fewer long-term disability benefits are available to blue collar workers compared to white collar workers, 28% versus 62%, which means less take home pay for periods of hospitalization and long-term disability [BLS]. Comorbid conditions require

increased medical attention, hospitalization, and medications (American Stroke Association [ASA], 2009; Ferraro et al., 2002; Orszag, 2008; Zizza et al., 2004). This results in obese workers having increased out-of-pocket medical costs. If blue collar workers have less take home pay due to increased absenteeism, they may delay seeking appropriate medical care. The lack of appropriate medical care contributes to premature development of comorbid conditions and early mortality for the obese worker.

Disability and premature death are serious concerns for obese workers. As they become more debilitated, they have difficulty performing essential job functions. Specialized equipment may be required for them to perform essential job tasks (ASA, 2009; Job Accommodation Network, n.d.a).

Job loss is a serious concern for the obese. Loss of insurance and income significantly impairs physical and mental health. The inability to obtain another job with similar earnings and benefits not only affects the obese worker but the family as well. Society in general is affected as many unemployed individuals turn to social programs for assistance, such as food stamps, government subsidized health care, and housing.

Measures to Control the Obesity Epidemic

The nation cannot afford to allow obesity to grow at its present rate. Resources and solutions must be found to assist those who are already overweight or obese.

Research indicates that bariatric surgery is the most effective in controlling sustained weight loss over a 10 year period (Mark, 2008). Magee (2004) cited, “in 2003 there were more than 103,000 gastric bypass surgeries for morbid obesity in

the U.S.” (p. 1). As obesity rates continue to rise, intervention has replaced prevention. Surgeries, larger seating accommodations, and even larger caskets are growing at an alarming rate which creates the illusion that society accepts obesity as a norm instead of finding solutions to reduce, prevent, and possibly eradicate this disease process.

It is imperative that ways are found to fight this epidemic, not just leaving it up to individuals who are struggling with obesity. Even when individuals are successful with weight loss, there is a high rate of recidivism (Eckel, 2008; Winick, 1996). The current overweight and obesity rates confirm weight loss methods alone are not a successful solution.

Many resources (Magee, 2007; NAASO, 2008; National Institutes of Health, 2008b) confirm the need for an action plan at the policy level. The World Health Organization Regional Office for Europe has successfully advanced the European Charter on Counteracting Obesity (Deitel, 2007). It stands to reason that the U.S., with the highest rate of obesity, would adopt a similar approach but this has not occurred.

Magee (2007) described five public policy tools for obesity which include:

1. Public disclosure by restaurants in regards to calorie and nutrition content;
2. Court cases on obesity in which fast food chains are challenged on deceptive representation of nutritional benefits of their food choices;
3. A tax policy increasing taxes on non-nutritional selections funneling revenue toward public health and nutritional programming;
4. Amending school policies on nutrition and exercise; and

5. Wide spread public health screening.

A multisystem approach is needed to control the obesity epidemic based on solid public health intervention and education. It will require appropriate allocation of funding from the federal and state levels and support of political leaders. The downside of government funding and control potentially includes:

1. Higher taxes from federal and state funding;
2. The possibility of a “sin” tax on fast food and unhealthy snacks similar to taxes on tobacco and alcohol products;
3. Fast food restaurants declaring bankruptcy from litigation requiring business closings and loss of jobs;
4. Further economic downturn resulting from business closures and increased unemployment; and
5. Failure of funding to impact the obesity epidemic and improve the health of the U.S. citizens.

Healthy People 2010 published the national health objectives which aim to reduce obesity to 15% of adults by 2010 (CDC, 2007b). While it is possible to reduce obesity, it is unrealistic that the goal will be attained in 2010.

Empowering Individuals to Make Change

The risks associated with overweight and obesity have been well researched and defined. Risk communication may be a tool that can be used to educate and empower individuals to make healthy changes. Windham and Osorio (2004) pointed out that risk communication can be used to provide people with the information necessary to make independent and informed decisions about their personal health and safety. Educating workers about the risks of obesity and its

long-term consequences will enable them to make appropriate lifestyle choices and changes to improve their health.

Rogers (2003a) states, “the original focus of risk communication was on developing and delivering a message from an expert or agency to the public in order to help the public better understand a situation and its implications for health and well-being” (p. 259). Anderson and Nehls-Lowe (2006) point out that risk communication skills of health agencies are a pivotal function in conveying health information to the public. Individuals must trust the source of communication before they act on it. According to Sattler & Lipscomb (2006), risk communication is an art whose messenger is perceived as trusted and credible. These statements support the OEHN as an appropriate source for delivering risk communication and education about health risks.

Personal Responsibility

Obesity impacts many body systems. While the causes of obesity are complex, individual responsibility cannot be overlooked for one’s own health. Individuals are autonomous and have the right to make personal lifestyle choices, even when they result in poor health outcomes.

In addressing obesity, there is less discussion about the individual’s responsibility to maintain personal health. According to Kaminisky (2009), to some extent, the disputes stem from a reluctance to acknowledge that obesity in fact covers two issues: the first, i.e., the social issue, covers the prevalence of obesity and is thus determined by quantity. The second, i.e., the individual issue, is determined by quality and addresses individual behavior and choice (p. 529).

Workers, as well as private individuals, make daily choices to eat healthy or not; to participate in physical activity or not; as well as deciding to make necessary lifestyle changes to positively impact personal health. Kaminisky (2009) also states “society as a whole has to acknowledge responsibility with regard to the causation and alteration of conditions that prevent individuals from being as slim as they want to be” (p. 529). Taking actions that will change health outcomes are not easy and often time require support of other individuals and resources, but the decision to change lies with the individual.

Workers need to be provided with appropriate information that will allow them to make informed choices about whether to take care of personal health or not. According to Civaner and Arda (2008), “to some extent, all individuals who are not dependent on others for their care play some part in determining the status of their own health...” (p. 267).

In a 2006 survey of U.S. citizens, approximately 53% of participants believed that people with unhealthy lifestyles should be required to pay higher insurance premiums and higher deductibles for medical care than people of with healthy lifestyles (Civaner & Arda, 2008). This is somewhat arguable as many other factors, such affordable, accessible healthy food options, and health care need to be considered before implementing this change.

Workers and individuals are provided with certain legal rights, including seeking one’s right to health. Once workers are informed of health care benefits and how to access these benefits, they should not wait for someone else to offer them. This can also be argued from a moral standpoint, as it is inappropriate that workers utilize health benefits and seek the rights they are entitled. Such actions require the

worker to make personal choices and act on them accordingly to control personal health conditions such as obesity.

Obese workers need to understand how personal negative health conditions affect family members and other members in society. Civaner and Arda (2008) stated, “Patients should understand how their behavior may affect others and should therefore refrain from unreasonably placing at risk the health of others” (p. 268). This is especially true for the obese worker who provides the main source of finances and health care benefits to other family members.

Although it is understood that individuals have a personal responsibility for making healthy lifestyle choices, society also has the potential to impact or influence personal responsibility making personal responsibility seem as complex as obesity. Kim and Willis (2007) stated in regards to personal and society responsibility for health

The discussion of responsibility involves two conflicting views. One view holds that a social problem is caused mostly by deficiencies of individuals, often those who are affected by the problem. Because the problem is understood as resulting from flaws in individual behaviors, change efforts focus mostly on modifications of the problematic behaviors. According to the second view, on the other hand, a social problem results primarily from certain flaws in social and environmental conditions such as unequal distribution of economic resources, unsafe environments, or unethical business practices. (p. 360)

The OEHN is instrumental in helping workers understand that changing unhealthy behaviors is a personal choice, but it is only a start in addressing obesity.

The worker must also desire to take advantage of health care benefits provided to them and tap resources that will help them obtain personal health goals.

CHAPTER 4

THE ROLE OF THE OCCUPATIONAL AND ENVIRONMENTAL HEALTH NURSE

The occupational and environmental health nurse (OEHN) is integral to the health of the workforce. Having extensive knowledge of the work environment, the OEHN is committed to the total well being of the worker and the workforce. The OEHN has the preparation, training, and previous work experience to help develop strategies to reduce the obesity epidemic. “Occupational and environmental health nurses with expertise in identification of hazardous chemical and physical exposures, as well as preventative strategies, are critical resources to their colleagues in the larger community and the global environment” (Rogers, 2003a, p. 260).

The role of the OEHN is complex and is complemented by an interdependent role with other disciplines to promote health and safety at the worksite. That breadth and depth of the OEHN role is best summed up by Rogers (2003b) who states:

Knowledge and understanding about complex work processes and related hazards, mechanisms of exposure, and control strategies to minimize or abate risks are essential to OEHN practice. Expertise in this area is grounded by a multidisciplinary knowledge framework guided by nursing science. (p. 51)

This expertise is needed to address workplace issues of the obese worker.

Interdisciplinary Team

An interdisciplinary team is essential for an effective occupational health

and safety program. The OEHN is an important member of the interdisciplinary team, and is integral to management and coordination of programs and services. She/he has knowledge of workforce health which includes statistical data about the illnesses and injuries impacting worker populations. Besides the OEHN, other members of the occupational health team include the occupational medicine physician, industrial hygienist, safety professional, managers, workers, union representatives, employee assistance program counselors, etc. The occupational health team can conduct joint walkthroughs to determine workplace hazards, evaluate safety practices, conduct injury illness investigation, and determine and evaluate ergonomic concerns. The team will need to consider the needs of larger workers when completing the walkthrough.

Levels of Prevention

The OEHN utilizes a three level approach to prevention - primary, secondary, and tertiary. Each level will be discussed in relation to obesity.

Primary Prevention

At the primary level of prevention, which includes health protection and health promotion, the focus is to eliminate or reduce risks through protective actions and actualize health potential. The primary level of prevention includes education that is aimed at reducing risk of disease. The OEHN can educate workers about obesity, associated morbidity and mortality risk factors, and methods to control their weight. Reaching out to families of workers and providing education at the level they best comprehend is also important.

The OEHN possesses knowledge of the workplace and associated job requirements to help match the worker to the appropriate job. The OEHN should

understand the physiological changes to the body resulting from obesity. Obese workers have a higher potential for impaired cardiac function and increased oxygen demands (Harrington & Wells, 2008). Hot work environments increase cardiac demands and can have a greater negative impact on obese workers. Adequately sized workspaces may no longer be appropriate for a workforce which is increasing in size. Appropriate sized seating should be large enough and durable enough for heavier weights. Driving equipment needs to allow for the girth of the obese worker. Employers may need to purchase larger equipment and specialized clothing for obese employees, which affect the workplace financially. Maintenance may have to modify work areas. According to Schulte, Wagner, Downes, and Miller (2008):

there is a growing body of research linking occupational hazards and diseases with obesity. Obesity has been shown to affect the relationships between exposure to occupational hazards and disease or injury. It may also be a co-risk factor for them. Obverseley, workplace hazards may affect obesity-disease relationships, be co-risk factors for disease or injuries or for obesity. (p. 556)

Secondary Prevention

The secondary level of prevention consists of early detection of health issues, interventions directed at stopping progression of disease such as health surveillance and health screening, and limiting disability. Assessment and surveillance activities of workers provide the OEHN with a snapshot of current and potential health issues in the workplace. Through these activities, the OEHN is able to identify workers with increased risk to hazards or health conditions. The OEHN

can also determine the prevalence of comorbidities which are highly associated with obese workers. While health risk appraisals are more comprehensive for determining overall health risk, the presence and severity of overweight and obesity can be identified through determining BMI, waist-to-hip ratio, and the presence of comorbid conditions such as diabetes, hypertension, and other factors associated with coronary heart disease.

Secondary prevention also includes prompt medical treatment to limit further deterioration in worker health. Once obese individuals have been identified through elective, personal, and confidential health risk screening measures, appropriate referral is necessary to assist workers in taking the necessary steps to address health problems. It is important for all workers to understand that confidentiality will be maintained once the health screening process has been instituted.

Tertiary Prevention

Tertiary intervention occurs once disability associated with disease has stabilized or is irreversible. Tertiary prevention for the obese worker includes medical referral and further intervention for treatment of comorbid conditions or disabilities. The worker's personal health care provider should be involved in the treatment of obesity and associated comorbidities. The OEHN is the best resource in the workplace for identifying professionals within the community who specialize in providing treatment and care for obese workers. Since there are many programs and plans for weight loss, it is essential that overweight and obese workers have the most current information about recommended medically directed programs. It is important for the health care providers to address current medical conditions as well

as obesity to limit negative outcomes. The OEHN can help workers understand the limitations of programs and set realistic goals. Once the disability has been addressed, the OEHN can assist with job accommodations.

Bariatric surgery is an option for the morbidly obese worker. It is necessary to identify comprehensive bariatric programs available in the surrounding communities which address lifetime exercise and appropriate dietary changes along with surgical intervention. Current research studies reveal that bariatric surgery has longer lasting results for sustained weight loss in obese individuals (Mark, 2008), and is considered to have a greater impact on comorbid conditions such as Type II diabetes. Bariatric surgeon, Dr. Roc Baughman (personal communication, October 26, 2008) revealed one of the main reasons people seek bariatric surgery is that they feel they have no other alternative, having failed at most conventional methods for weight loss.

Referrals and Support

Once at-risk employees are identified, it is important to have a mechanism of referral for further treatment. The OEHN should confer with the benefits administrator to ensure appropriate specialists are part of the worker provider network and can be utilized by workers without an increased out-of-pocket cost. The OEHN may need to support workers by providing education and explanation regarding suggested treatment options and plans. By inviting specialists, such as bariatric surgeons and medical bariatrists, nutritionists, and fitness experts to present seminars or educational sessions at work, larger groups of workers can be reached. By providing programs such as “lunch and learn” sessions, workers can benefit from speakers from the local health department or hospital who can provide

information about the necessary steps to develop healthy lifestyles. Once workers have determined which treatment options are appropriate for them, the OEHN can provide insight into which on-site wellness programs can best support workers' weight loss efforts.

Workers who are not ready for intervention measures for reducing obesity will need reassurance and support. The OEHN can provide information about available community resources aimed at weight reduction and improved health for workers who desire assistance in the community.

Education

An essential role of the OEHN is providing education to workers, families, and management about obesity. When planning and presenting programs, the OEHN should also be aware of age range, gender, and culture of the workforce. Once workers understand the long-term consequences of obesity including premature disability and death, they will have a better understanding of the need for intervention even if they are not at the point of change. Eckel (2008) found that the absence of readiness on the individual's part should not exclude him or her from education or communication regarding the importance of weight reduction.

Topics to be included in educational programs include the definition and explanation of overweight and obesity; obesity as a complex disease process; the relationship between obesity and comorbid disease processes; the increased risks of premature deaths; current treatments available for reducing obesity; and the impact of weight loss on health outcomes. The OEHN needs to emphasize that while obesity is associated with a sedentary lifestyle, it does not occur from laziness or lack of motivation. Other education that should be included for all targeted groups is

information about psychological disorders that also may accompany this disease. Workers and management should have a good understanding about the sensitive nature of obesity and the effect of stigmatization. It is especially important to add special emphasis in these areas when dealing with managers as these issues can further impact already elevated workplace costs associated with obese workers.

The OEHN will also need to provide education about the importance of appropriate evaluation, intervention, and treatment. Intervention and treatment are major decisions for obese workers. Educating families about obesity is extremely important for fostering healthy behaviors, reinforcing education, and providing a supportive network for the obese worker.

It is also important to educate workers and management about successes which can be realized through onsite wellness programs targeting obesity. The OEHN can help workers and management understand that weight loss contributes to increased energy levels, decreased levels of fatigue, improved self-esteem, and decreased anxiety and depression, all which will positively impact the workplace. Workers who are parents of obese children or other family members can be positive role models who understand the difficulty associated with weight loss.

Implementation of Workplace Obesity Programs

The OEHN has knowledge of effective strategies and appropriate resources which can be utilized to improve employee health. Prior to implementing workplace programs, the OEHN should review data about what does and does not work. Once data have been gathered and analyzed, appropriate programs need to be identified along with resources that should be utilized to begin implementation. The OEHN has to be accountable as a corporate partner and avoid unnecessary expenditures.

Research supports the impact of obesity on workers. Gates et al. (2008)

concluded that:

moderately or extreme obese workers (BMI \geq 35) experienced the greatest health related work limitations, specifically regarding time needed to complete tasks and ability to perform physical job demands. These workers experienced a 4.2% health related loss in productivity, 1.18% more than other workers, which equates to an additional \$506 annually in lost productivity per worker. (p. 39)

These facts substantiate the need for workplace intervention against obesity. The study also determined that presenteeism is greater among obese workers when compared to workers of average weight and may result in higher costs to the company than obesity-related absences (Gates et al.).

In a study of the effects of obesity and cardiometabolic risk factors on costs and productivity in the U.S., Sullivan, Ghushchyan, and Ben-Joseph (2008) determined that it was not clearly understood just how obesity interacted with cardiometabolic conditions to result in greater medical and lost productivity costs, but the results were consistent with previous studies. The OEHN can positively affect employee health and productivity by instituting workplace programs which target obesity and associated comorbid conditions. These endeavors will demonstrate concern for the business and assist in positively impacting the financial bottom line.

A workplace environment which fosters positive attitudes toward obese and overweight workers provides incentives for weight loss. Through collaboration with management, other interdisciplinary team members, and available external resources,

intervention programs targeting obese workers can be instituted successfully. It is important to keep workers involved in on-site programs by creating a health and wellness committee or a task force to foster encouragement among those workers striving to lose weight. By utilizing workers who have been successful in losing weight as mentors, workers will be surrounded by positive role models.

Worksites which invest in on-site or off-site fitness centers are also a resource for the OEHN. If worksites need to utilize outside resources, partnering with the YMCA or other off-site qualified exercise facility is an appropriate alternative. Partnerships may be developed with outside resources to offer exercise programs and activities at a lower negotiated price for the employer. The OEHN can justify programs in the community to management as a complement to on-site wellness program offerings. By utilizing fitness experts, wellness programs will have improved outcomes. It makes good business sense for the occupational and environmental nursing professional to partner with other professionals who are also knowledgeable about weight loss programs and interventions aimed at reducing obesity.

The OEHN must document workplace program successes, including utilization data, positive outcomes on worker health, decreased comorbid conditions, and positive changes on worker productivity. The OEHN will need to develop a surveillance monitoring and tracking program to capture these data. It is necessary to determine which programs provide the most assistance to workers in achieving weight loss goals. Through communication of program successes and utilization reports, management will see the positive impact of workplace interventions.

It is also important to capture the impact of wellness programs on cost. By capitalizing on costs savings, the impact of wellness programs on worker health, and potential reversal of negative health outcomes, the nurse is then able to justify health and wellness programs and continued support for future programs that focus on obesity.

Financial Impact

The OEHN, as a business partner and health advocate, understands the impact of obesity and its cost on worker and business health. Costs associated with obesity include lost productivity, higher insurance premiums, increased utilization of short-term disability due to increased comorbid conditions and disability among obese workers, longer hospital stays, and early morbidity and mortality.

Statistics from the American Heart Association (AHA) estimate stroke-related medical costs and disability to be 68.9 billion dollars annually (Lloyd-Jones et al., 2009). These statistics, along with the incidence of one stroke occurring every 40 seconds, and death from a stroke occurring every 3-4 minutes (ASA, 2009), confirms the potential staggering impact of obesity-related costs. Utilizing these data that capture the associated costs of obesity morbidity and mortality, the OEHN can increase employers' understanding of the large potential costs savings which exists through proactively addressing obesity in the workplace.

Significant decreases in obesity rates result in cost savings for the workplace and workers alike. Savings from reduced health care costs alone can be astronomical. Cost savings associated with improved productivity can be measured and result in significant amounts of money. It is important for the OEHN to educate workers and managers that cost savings are more likely to be long-term as

workers consistently follow a tailored weight loss and exercise plan.

Initially, workers will notice the improvement from losing as little as 10% of their weight. Research supports that a sustained weight loss of 10% is associated with an increased life expectancy and decreased lifetime medical care expenses (Oster, Thompson, Edelsberg, Bird, & Colditz, 1999).

As weight loss continues, some workers will experience eradication of conditions such as hypertension and Type II diabetes. Health care cost savings will result from discontinuation of associated medications. A reduction of short-term disability (STD) claims will occur as comorbid conditions improve or completely resolve. Long-term savings will be realized as workers' successfully reach weight loss goals and maintain a healthy weight evidenced by decreased disability costs and decreased premature mortality. Increased productivity results in decreased utilization of family medical leave. The OEHN must show the financial benefits of increased productivity through tracking FMLA usage, STD utilization and length of claims, as well as decreased length of hospital stays.

Fostering a Supportive Environment

Employers are required to provide a safe and healthy workplace for all employees (OSH Act, 1970). Employers must realize that not only are worker populations aging, they are also becoming obese, which will continue unless significant interventions occur. They must ensure that the workplace is a safe working environment for obese individuals. Obese workers need appropriate seating arrangements and equipment which are safe for them to use, such as adequately sized seats on forklifts with seat belts which will accommodate larger individuals. It is also important to determine which equipment can be operated

safely by larger workers.

The workplace should also provide a supportive environment to workers who are impacted by obesity and related health concerns. This can be accomplished by providing break areas which provide healthier food choices. Improved nutritional snack options are important for everyone's health, not just those who are already faced with the challenge of extra weight. On-site cafeterias should offer healthier food options which are as affordable as the more calorie dense items. For example, salad bars can be stocked with fresh vegetables and fruits with reduced calorie salad dressings. Examples of appropriate portion sizes using food model displays and calorie content charts can be posted to assist workers who want to make better food choices

Success stories of workers or worker family members who have lost weight can be published with the worker's permission in workplace publications. Employers can also extend monetary incentives to employees who successfully lose weight and improve comorbid conditions through decreased cost of benefit packages. Employers can also reward workers financially who have reached and are maintaining milestones in weight loss.

The OEHN has a very important role in educating workers about the many facts surrounding obesity and treatment, designing and implementing successful wellness programs, working as an advocate and conscientious business partner and being an agent for healthy changes. The OEHN and employer can both foster a supportive environment and reward weight loss and healthy behaviors, but workers must accept responsibility for their individual health.

Partnering with the Community

As an essential member of the community, the OEHN should establish relationships with other professionals needed for continued successful partnerships which will support the workplace mission to reduce overweight and obesity. The OEHN's efforts in the workplace are supplemented by utilization of available community resources. The OEHN who is able to partner with health care providers to address local health issues as well workplace issues demonstrates concern for the health and well-being for others in the community. By participating in community health fairs, the OEHN fosters support for the community by providing information to residents on ways to reduce obesity and associated health risks. This relationship may lead to the development of a community wellness or obesity task force. The OEHN can bring expertise and knowledge to the community's efforts against obesity. Sharing knowledge and information about successful programs with community health care professionals, serves to strengthen ties with other members of the community.

The OEHN can network with other health care professionals, such as public health nurses, health educators, etc. to promote healthier choices in restaurants. This can be successfully done by educating restaurant owners about obesity and its associated risks. Encouraging restaurants to provide nutritional information of menu items will allow customers can make informed food choices by knowing calorie content. These activities aid in bringing recognition of health risks by community public leaders, will serve to inform them of the need for health care reform, and policy changes which can positively impact the current obesity epidemic.

Legal and Ethical Issues

Workplaces today face many legal and ethical issues including obesity. It is important to understand some of the legal issues which may affect obese workers, such as discrimination, ADA and FMLA concerns, as well as Workers' Compensation concerns. Employers should ensure overweight and obese workers are treated the same as workers of normal weight.

Americans with Disabilities Act

Thompson (2007) states, "fat is not a disability as defined by the Americans with Disabilities Act. Obesity is a lifestyle choice not an unchangeable fact of life; therefore obesity is not gaining traction as a civil rights issue" (p. 269). Current obesity treatment, research, and ADA law do not support this point of view (Garruti et al., 2008; Staman, 2007).

The Americans with Disabilities Act (ADA) was enacted by Congress in 1990. Its purpose is to provide a clear and comprehensive mandate to eliminate discrimination against individuals with disabilities. As defined by the ADA, "disability is as a physical or mental impairment that substantially limits one or more of the major life activities, a record of the impairment, or being regarded as having impairment" (as cited in Staman, p. 2). The Equal Employment Opportunity Commission (EEOC) further described how obesity is covered under the ADA. According to the EEOC's ADA compliance manual:

being overweight is generally not an impairment. On the other hand severe obesity, which has been defined as body weight more than 100% over the norm is clearly an impairment. In addition, a person with obesity may have an underlying or resultant physiological disorder, such as hypertension or a

thyroid disorder. A physiological disorder is an impairment.” (Staman, p. 3)

In 1992, a female worker in Rhode Island won an obesity ADA claim; in 1996 another female worker in Texas also won an obesity ADA claim (Hass, 1996). Michigan, San Francisco, and the District of Columbia are locations where obesity is a protected class. In locations where obese individuals are not considered a protected class, cases are ruled on a case-by-case basis, sometimes being won under the Rehabilitation Act of 1973. As stated in section 504 of the Rehabilitation Act, “no otherwise qualified individual shall, solely by reason of her or his disability... be subjected to discrimination under any program or activity receiving federal financial assistance” (as cited in Staman, 2007, p. 3). Based on these regulations obese individuals may have limited success in bringing discrimination claims against employers. Employers need to understand that some courts have ruled on behalf of the plaintiff, awarding protection under the ADA. As obesity rates continue to rise without any indication of decline, efforts to protect obese employees from discrimination is essential to limit liability.

Job Modification and Accommodation Due to Obesity

Employers are required to provide reasonable accommodation for workers with special needs, including the obese. According to JAN (n.d.a), a reasonable accommodation is described as:

a modification or adjustment to a job, the work environment, or the way things usually are done that enables a qualified individual with a disability to enjoy an equal employment opportunity. An equal employment opportunity means an opportunity to attain the same level of performance or

to enjoy equal benefits and privileges of employment as are available to an average similarly situated employee without a disability. (p. 6)

There are also requirements for a reasonable accommodation by the ADA (as cited in JAN, n.d.a) and include three aspects of employment:

- 1) To ensure equal opportunity in the application process;
- 2) To enable a qualified individual with a disability to perform the essential functions of a job; and
- 3) To enable an employee with a disability to enjoy equal benefits and privileges of employment.

The Job Accommodation Network (JAN) provides some common accommodation needs for workers who are obese (JAN, n.d., a). Obese individuals may require elevators or a large-rated stair lift or wheelchair to access work areas above ground level, require a large rated ergonomic chair and obese drivers of company vehicles and industrial equipment may require seat belt extenders which are available through some manufacturers. Obese workers may specially designed ladders and harnesses for working at heights or large scooters or wheelchairs for traveling around the plant and fire routes and exists may need to be larger.

Unfortunately, accommodations such as these may not be financially feasible for employers. According to the EEOC (2009), “an employer does not have to provide a reasonable accommodation that would cause an ‘undue hardship’ to the employer” (para. 1). Several factors are considered when determining if an accommodation represents an undue hardship for the employer and include:

- The nature and cost of the accommodation needed;
- The overall financial resources of the facility making the reasonable

accommodation;

- The number of persons employed at this facility; the effect on expenses and resources of the facility;
- The overall financial resources, size, number of employees, and type and location of facilities of the employer (if the facility involved in the reasonable accommodation is part of a larger entity);
- The type of operation of the employer, including the structure and functions of the workforce, the geographic separateness, and the administrative or fiscal relationship of the facility involved in making the accommodation to the employer; and
- The impact of the accommodation on the operation of the facility (EEOC, 2009).

Employers who accommodate larger workers in the workplace positively reinforce their concern for the safety and health of the entire workforce, but there also needs a proactive approach to reduce obesity.

Family and Medical Leave Act

The Family and Medical Leave Act (FMLA) of 1993 was established to provide “eligible” workers job protected unpaid leave from work for several different reasons including a worker’s own serious health condition which renders them unable to perform job functions. Workers have 12 weeks of FMLA each calendar year which can be taken on an intermittent basis (U.S. DOL, 2008).

As obesity is associated with comorbid medical conditions and decreased productivity levels due to increased cardiac demands, obese workers have more absences when compared to workers of normal weight and are likely to utilize

FMLA more than workers of normal weight (Thompson, 2007). Employers have the option of substituting paid leave for unpaid leave (U.S. DOL, 2008). According to the HR Café (2009), “by the time workers get about 50 pounds overweight, lost workdays jump to tenfold, to 117 days per 100 full time employees (FTEs), verses only 14 days per 100 FTEs for those at ideal body weight” (p. 1). While FMLA covered absences protect the worker from job loss due to illness, obese employees utilize and perhaps exhaust all avenues for paid leave

In short-term disability claims alone, Leopold (2004) reported that 85% of obesity claims over the last 3 years were females, with 48% of these claims for females between the ages of 35 and 54. Leopold also indicated the primary medical reasons for these claims were gastric bypass, gastric stapling, and other new procedures to eradicate or control obesity.

The burden of FMLA and short-term disability (STD) for employers lies in lost productivity, increased work, longer hours by other workers, and the cost of training replacement workers or paying overtime to workers to compensate for lost work hours. For the worker, FMLA absences for obesity-related health issues mean job protection for increased absentee rates, but a decreased annual income. Diminished income can be problematic for the worker who is a single parent or the only employed worker in a family with several members.

The OEHN can be the subject matter expert and serve as administrator of the FMLA program. The OEHN can utilize statistical data from FMLA and STD claims, insurance claims for obesity-related conditions, and lost productivity costs to justify worksite wellness programs

Advocate

The OEHN possesses skills as an advocate and facilitator of change. When dealing with workers, handling sensitive issues, and developing programs in the workplace, the OEHN should “first, do no harm” (Rogers, 2003c). As an advocate, the OEHN should ensure that workers have enough information to make informed decisions about their health care.

Workers need to understand that an individual approach to weight loss is needed. Regardless if the employee participates in a diet modification and exercise plan, pharmaceutical intervention to complement diet and exercise, or weight loss surgery, the OEHN is able to provide support, encouragement, and perhaps temporary job modification.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Obesity is a serious public health concern. The percentage of overweight and obese individuals has risen to an alarming rate of about 67% in the U.S. in the last 10 years. The percentage of adults with morbid obesity has doubled since 2000 (Orszag, 2008). Workforce populations are also affected by these statistics.

Obesity is associated with impaired productivity, increased comorbid conditions, and early disability and mortality if left untreated. As with other complex disease processes, obesity may require lifelong treatment and include behavioral therapy if it is to be controlled (Isoldi & Aronne, 2008). The current method of addressing morbid obesity is through bariatric surgery and other treatment options. While preventative measures have been identified, action is needed to slow the growing rate of obesity in adults and children. Individuals will need to be proactive regarding obesity. They need to utilize resources to effectively treat obesity while understanding the need to adopt healthy lifestyles. Workplaces and communities need to work together in creating effective partnerships to confront obesity, and share resources which will control, reduce, and perhaps eradicate this unnecessary disease and disability they portend for the future.

Implications

Medical costs have risen as a result of obesity. Approximately 59% of today's workers are suffering from overweight or obesity, resulting in significant financial loss to employers. Because obesity threatens to cause decreased life expectancy in the U.S. for the first time since 1900, it must be controlled.

The workplace is a logical location to offer weight management programs.

The OEHN is well positioned to recognize and develop strategies aimed at reducing obesity. By focusing on the health, safety, and wellness, the OEHN positively affects the quality of life for workers, their families, and the community, and demonstrates the business value of wellness programs to management.

Health/Workplace Policies and Recommendations

The control of obesity is a multilevel issue. Health policy is needed to address many public issues related to obesity. For successful control, obesity should be a national health priority, with the development of a National Obesity Prevention Advisory Board and a nationwide public educational campaign on obesity (Levi, Kaiman, Juliano, & Segal, 2008).

To aid workplaces in successfully implementing wellness programs to address obesity, the government should provide incentives to offset expenses for implementing such programs. Once an incentive program for employers has been instituted, the OEHN is “well prepared to make appropriate decisions and manage health surveillance, screening, and prevention programs” (Rogers & Livsey, 2000, p. 97). Materials from organizations such as the American Association of Occupational Health Nurses, e.g., Obesity Management Programs in the Workplace, as well as the NHBLI and NIH are good resource tools that the nurse can utilize to develop successful programs. The OEHN should educate employers on strategies to control, prevent, and reduce obesity and its risk factors. In addition, the OEHN can provide motivation and guidance for weight control to employees.

Future Research

Therapies which address obesity are inadequate (Eckel, 2008). Research is needed on the role of genetics on obesity. Determining how to reverse the behavior

of white adipose tissue so that it behaves much the same way as brown adipose tissue would help to eradicate obesity, as brown adipose tissue has never been associated with obesity. Human bodies are programmed to eat for survival. Modern civilization is no longer faced with long periods of famine. Two important factors contribute to the challenges for successfully treating obesity. One challenge lies in controlling and potentially reversing the genetic component of the body's ability to store fat to sustain itself through famine. Another important and significant challenge in reducing obesity includes controlling the functions of leptin and ghrelin. Research alone on leptin and ghrelin levels and controlling them through pharmacology would significantly aid overweight and obese people.

Stress is associated with obesity. Through research, the stress-induced biological mechanisms of obesity could be better understood and methods developed to control these mechanisms. This is important as it is unlikely individual stressors can be reduced successfully.

As the U.S. is faced with the rapid development of overweight and obesity, long-term mechanisms of weight loss, such as bariatric surgery, need to be further studied. Bariatric surgery has been associated with successful reversal of comorbid conditions such as Type II diabetes, hypertension, and hyperlipidemia. Individuals undergoing bariatric surgery are required to make lifestyle changes which include nutrition education and a regular exercise plan. It is important to confirm if these same results could be achieved through diet induced long term weight loss. If this is possible, the specific calorie intake levels that individuals need to maintain must be known. Individuals who successfully achieve weight loss by diet modification should also receive nutritional education and a tailored exercise plan, which is

affordable, to maintain a steady state of weight loss. The OEHN has a good understanding of human behavior and can apply this knowledge to best practices associated with weight reduction, disease prevention, and avoidance of early mortality.

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**APPENDIX
PREVALENCE AND DATA TRENDS: DEMOGRAPHICS 2007 EMPLOYMENT**

State:	Employed	Self employed	No work >yr	No work < yr	Home maker	Student	Ret	Unable to work
Nationwide (States, DC, and Territories)	53.1	8.8	1.7	2.8	7.7	4.3	16.4	4.8
Alabama	48.3	6.7	2	3.2	9.1	3.8	17	10
Alaska	56.4	8.9	1.5	6.1	7.6	4.5	10.2	4.8
Arizona	47.7	10.4	3.2	2.2	9.4	3.2	18.6	5.3
Arkansas	46.6	10.8	1.5	3.6	8.7	3.8	17.3	7.7
California	50.5	10.6	1.7	3.3	10.1	5.9	13.9	3.9
Colorado	54.9	10.8	1.5	3	9	3.7	13.7	3.5
Connecticut	55.1	9.5	1.4	2.7	7.6	4.8	15.6	3.3
Delaware	55.4	6.6	1.2	2.6	4.6	5.5	19.6	4.6
District of Columbia	56.3	8.3	2.7	4.2	3.6	4.8	15.6	4.5
Florida	50.2	10.4	1.7	2.5	6.2	2.9	21.3	4.7
Georgia	51.4	9.8	2.4	3.2	7.6	4.2	14	7.3
Guam	55	5.3	4.4	2.4	12.7	7.7	11.5	1
Hawaii	56.8	7.6	1.4	1.8	5.1	4.1	20	3.2
Idaho	51.1	11.2	1.1	2.2	10.4	4.5	15.4	3.9
Illinois	53.1	8.7	1.6	3.2	8.7	5.5	14.2	4.9
Indiana	53.3	7.4	1.9	3.5	8.2	4.4	16.4	5.1
Iowa	56.3	9.6	0.8	1.8	5.6	4.9	18.1	2.9
Kansas	57.8	8.6	0.9	1.7	7	3.5	16.8	3.6
Kentucky	48.1	5.4	1.7	2.2	9	3.6	18.9	11.1

APPENDIX (CONTINUED)
PREVALENCE AND DATA TRENDS: DEMOGRAPHICS 2007 EMPLOYMENT

State:	Employed	Self employed	No work >yr	No work < yr	Home maker	Student	Ret	Unable to work
Louisiana	50.8	8.6	2.2	2.4	8.4	4.3	17.2	6.1
Maine	50.5	11.3	1.8	3.3	6.3	3.6	17.3	5.9
Maryland	56.2	8.8	1.6	3.1	7.2	3.6	15.9	3.7
Massachusetts	56.2	8.4	1.9	2.9	6.5	3.5	15.5	5.1
Michigan	51.8	7.8	2.5	2.7	7.7	5.2	17.7	4.8
Minnesota	59.2	7.8	0.6	2.2	4.7	5.4	17.6	2.5
Mississippi	50.1	7.8	2.1	3.4	6.9	4	15.5	10.2
Missouri	52.9	7.7	2	3.2	7	4.3	17.2	5.6
Montana	49.5	13.8	1.4	2.6	7.2	4	17.2	4.3
Nebraska	57.6	9.5	0.7	1.6	7.6	4.5	15.3	3.4
Nevada	53.2	9.4	1.6	3.5	9.5	3.1	15.6	4
New Hampshire	54.1	10.1	1.8	2.8	6.5	3.9	16.3	4.6
New Jersey	54.5	7.8	2.2	3.2	7.9	3.4	15.7	5.4
New Mexico	48.4	9.9	1.1	3.7	9.2	6.1	16.2	5.3
New York	50.9	10	2.8	2.8	7.5	4.8	16.5	4.8
North Carolina	52.6	7	1.9	3.6	7.2	4.1	16.9	6.8
North Dakota	55.6	12.6	1.3	2	5.9	4.1	15.9	2.6
Ohio	52.7	7.1	2.1	2.7	8.5	4.4	16.8	5.7

APPENDIX (CONTINUED)
PREVALENCE AND DATA TRENDS: DEMOGRAPHICS 2007 EMPLOYMENT

State:	Employed	Self employed	No work >yr	No work < yr	Home maker	Student	Ret	Unable to work
Oklahoma	48.3	8.8	1.8	2.7	9.2	4.7	16.6	7.8
Oregon	47.4	10.7	1.4	4.4	8.2	4.7	18.9	4.4
Pennsylvania	51	7.6	1.9	2.5	8.5	4.9	18.4	5.2
Puerto Rico	35.9	11.5	3	2.9	16.6	9.5	13.8	6.8
Rhode Island	56.2	6.9	1.9	3	5.5	4.3	16.7	5.5
South Carolina	53.8	8.2	2.1	3	7	2.9	15.6	7.5
South Dakota	54.8	13.7	1.1	1.6	5.8	4.1	15.5	3.2
Tennessee	51.2	6.4	2.4	1.9	8.9	3.3	17.3	8.5
Texas	51.9	8.8	2	3.3	10.7	3.5	13.8	6.1
Utah	56.3	10.1	1	2	13	4.3	10.7	2.7
Vermont	53	13.2	1.2	2.8	5.8	4.6	15.6	3.8
Virginia	55.8	7.2	1.4	2.1	8.8	4.8	15.5	4.4
Virgin Islands	56.4	14.7	2.6	3.9	3.8	3.3	12.2	3.1
Washington	51.9	8.8	1.6	3.1	9	4.6	16.6	4.4
West Virginia	46.6	5.6	1.7	3.2	10.5	4.3	18.6	9.4
Wisconsin	57.8	8.1	1.4	2.6	5.5	4.8	16.5	3.3
Wyoming	55.9	10.9	0.9	1.9	8.5	2.9	15.6	3.4