Leyd LM and Carlson ER, J Obes Weight Loss 2018, 3: 009
DOI: 10.24966/OWL-7372/100009

HSOA Journal of Obesity & Weight Loss

Review Article

The Impact of Obesity on United States Health Care Expenditures

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Abstract

Obesity is a complex and multifactorial health problem in the United States that is related to genetic and behavioral abnormalities. General consensus demonstrates that approximately 34% of United States adults and 17% of United States youth are obese. In addition, it is believed that 70% of obese adolescents will remain obese as adults. While overweight, obese and morbidly obese habitus states are often collectively designated independently of other disease processes, these states should be considered systemic diseases that are associated with pathologic conditions of numerous organ systems leading to early death in untreated patients. When treatment is provided to patients suffering from obesity, substantial healthcare resources and expenditures are directed to these patients. Although increasing childhood overweight and obesity trends are occurring worldwide, childhood obesity in the United States exists at a magnitude nearly double that observed in other industrial nations. A strategic plan for the prevention of obesity in young patients in the United States, therefore, should be formulated to reduce the incidence of obesity in American adults with a resultant decrease in health care expenditures. When deemed appropriate candidates, obese patients may undergo bariatric surgery with very favorable and durable results.

Keywords: Bariatric surgery; Cancer; Diabetes; Dyslipidemia; Morbidly obese; Obese; Overweight

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Citation: Leyd LM, Carlson ER (2018) The Impact of Obesity on United States Health Care Expenditures. J Obes Weight Loss 3: 009.

Received: December 27, 2017; **Accepted:** January 17, 2018; **Published:** February 1, 2018

Introduction

Overweight, obese and morbidly obese people collectively constitute a group of patients who define a public health concern of great significance in the United States. With increased recognition of these diagnoses, obesity has been described as an epidemic in the United States and obesity rates are increasing worldwide [1]. Overweight and obese habitus states are mathematically defined based on Body Mass Index (BMI) that is determined as weight in kilograms divided by height in meter square (kg/m^2). A healthy BMI is generally considered less than 25 kg/m^2 and obesity is defined as a BMI of 30 kg/m^2 or greater. Overweight is defined as a BMI between 25-29.9 kg/m^2. Morbid obesity is defined as a BMI greater than 40 kg/m^2. It is estimated that approximately 60-70% of the adult population in developed countries is overweight or obese and rapid increases are occurring in developing countries [2]. Pursuant to the epidemic, estimates indicate that obesity is present in approximately 34% of American adults and 15-20% of American children and adolescents [1]. Further supportive of the epidemic status, every segment of American society is affected with obesity [1]. Specifically, obesity is more common in the elderly and disproportionately diagnosed most commonly in Non-Hispanic blacks, followed by Hispanics, followed by Whites [3]. Predictions based on logistic regression analysis suggest that by 2030, obesity in American adults will increase by approximately 33% with a resultant 42-51% of adults being obese and morbid obesity prevalence approximating 11% [4]. The increased prevalence of obesity has been associated with increases in cardiovascular disease, cancer, type 2 diabetes, degenerative joint disease requiring joint replacement, non-alcoholic fatty liver disease, sleep apnea, cognitive dysfunction and others. Most of these diagnoses represent chronic diseases that negatively impact patient quality of life as well as American society by consuming substantial healthcare expenditures. Ranking second only to smoking as a preventable cause of death, obesity contributes to over 300,000 deaths per year [5]. It is the purpose of this paper to report the direct effects of obesity on United States health care expenditures, to assess the association of indirect expense of obesity due to medical sequelae and to offer possible solutions to this public health problem thereby decreasing United States healthcare expenditures as part of a theory of social impact. In select cases, surgery represents a solution to morbid obesity and provides durable health benefits to such patients.

Medical Sequelae Associated with Obesity

Obesity adversely affects most human physiologic systems including the cardiovascular system, endocrine system, hepatobiliary system, musculoskeletal system and cognitive function. The obesity epidemic can therefore be recognized to directly and indirectly increase United States healthcare costs. In recognition of the association of obesity to cardiovascular disease, Pandya et al., reported that cardiovascular disease represents the leading cause of death and health care costs in the United States [6]. The Centers for Disease Control and Prevention estimated the direct and indirect cost of cardiovascular disease to be $4.3 billion in 2010, many cases of which are associated with obesity [7]. Under these circumstances, obesity

is indirectly contributing to increased health care costs given the fact that the pathophysiology of cardiovascular disease is multifactorial and related to obesity. With an aging population, an obesity epidemic and improved treatment of cardiovascular disease with decreased mortality, an increase in the health care costs of cardiovascular disease in the United States should be anticipated from 2015-2030. Finally, Pandya et al., provided compelling evidence of the association of obesity and cardiovascular disease by pointing out that the prevention of greater than one million cases of cardiovascular disease could be realized by 2030 if obesity prevalence remained at 2010 levels [6].

Type 2 diabetes and dyslipidemia are associated with obesity and increased BMI, weight gain and increased abdominal fat distribution are established risk factors for the development of type 2 diabetes. It is estimated that 90% of patients with type 2 diabetes are obese [8]. The American Diabetes Association reported that the estimated annual cost of diabetes in medical expenditures increased from $132 billion to $174 billion in 2007, in no small part due to the epidemic of obesity in the United States [9]. Obesity is also associated with elevated triglycerides, low levels of High Density Lipoprotein (HDL) cholesterol and high levels of Low Density Lipoprotein (LDL) cholesterol that together define dyslipidemia. The association of obesity, type 2 diabetes and several human cancers has gained significant attention due to the increased prevalence of obesity and type 2 diabetes [10]. Multiple etiologic factors are considered in the pathogenesis of cancer in obese patients with type 2 diabetes including hyperglycemia with hyperinsulinemia, insulin-like growth factor I, dyslipidemia, adipokines and cytokines and an altered gut microbiome [2,10]. Overweight and obese states are associated with cancer of the uterus, esophagus, kidneys, pancreas, ovaries, breast, colon and gallbladder [1,2,10]. In addition to the increased prevalence of cancer in obese patients, there is an increased risk of death of patients with these cancers [2,11].

Obese men and women are increasingly being diagnosed with Obstructive Sleep Apnea Syndrome (OSAS) that is manifest by partial or complete upper airway obstruction during sleep. These airway obstructions result in periods of apnea (no airway flow) or hypopnea (decreased airway flow), both of which lead to hypoxemia (decreased oxygen concentration of the arterial blood). Symptoms of OSAS include daytime somnolence and hypertension. Substantial medical expenditures are realized in the surgical and non-surgical treatment of OSAS including those related to the use of Continuous Positive Airway Pressure (CPAP) devices.

Obesity is also associated with non-alcoholic fatty liver disease that is associated with hepatomegaly, abnormal liver function blood tests and macrovesicular steatosis that can lead to cirrhosis. While once contested, it is now well known that fatty liver related to obesity leads to cirrhosis that in turn results in increased mortality [12]. Of further note is the association of osteoarthritis and obesity. Osteoarthritis is the most common musculoskeletal disorder and a leading cause of functional disability in the United States. While formerly attributed to the "wear and tear" mechanical and aging processes, osteoarthritis of the major joints is now believed to be associated with obesity, trauma, heredity and metabolic syndrome related to dyslipidemia [13]. Courties et al., reported that hypercholesterolemia and hypertriglyceridemia, both associated with obesity, have been associated with increased risk of osteoarthritis, while increased HDL levels are protective against osteoarthritis of the knee joint [13]. The total number of total knee replacement procedures performed each year now exceeds 640,000 at a total annual cost of about $10.2 billion [14].

Evidence also exists that obesity is also associated with cognitive dysfunction [15]. Obesity is known to be an independent risk factor for Alzheimer's disease and is associated with temporal lobe atrophy in adults. Gundstad et al., studied 408 patients from the Brain Resource International Database and categorized them according to BMI and age [15]. There were 178 normal weight younger adults, 140 overweight/obese younger adults, 32 normal weight older adults and 58 overweight/obese older adults. Body mass index was significantly related to performance in all cognitive tests in the study, even in seemingly healthy adults. Excluding people with significant medical comorbidity permitted the authors of this study to determine the independent contribution of elevated BMI in impaired cognitive function. Further, Boeka and Lokken examined neuropsychological performance in a cohort of morbidly obese patients as part of preoperative assessment for weight loss surgery [5]. Their results indicated differences in cognitive performance of morbidly obese patients on tests of executive functioning including planning, mental flexibility and problem solving compared to normative data. No significant differences were identified between obese patients with and without diagnosed medical comorbidity including hypertension, type 2 diabetes and OSAS that supports the independent involvement of obesity in cognitive dysfunction.

Economic Consequences of Obesity

Adults

There are multiple sources of information that are accessed to determine the cost of healthcare in the United States including the Medical Expenditure Panel Survey (MEPS), the National Health and Nutrition Examination Surveys (NHANES) and the National Health Expenditure Accounts (NHEA). The MEPS is a comprehensive, nationally representative survey of the noninstitutionalized United States population that has been conducted since 1996. The MEPS represents a series of large-scale surveys of families and individuals, their medical providers and employers throughout the United States. MEPS is the most complete source of data on the cost and use of health care and health insurance coverage. The NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interviews and physical examinations of patients. The National Health Expenditure Accounts (NHEA) are the official estimates of total health care spending in the United States from the Centers for Medicare and Medicaid Services (CMS) and the estimates of health expenditures that are part of Gross Domestic Product (GDP) produced by the Bureau of Economic Analysis (BEA) as part of the National Income and Product Accounts (NIPAs). Dating back to 1960, the NHEA measures annual United States expenditures for healthcare goods and services, public health activities, government administration, the net cost of health insurance and investment related to health care [16]. The data are presented by type of service, sources of funding and type of sponsor. Currently available data in 2017 from the Centers for Medicare and Medicaid Services reveals that total United States healthcare spending grew 5.8 percent in 2015, reaching $3.2 trillion or $9,990 per person [17]. As a share of the nation's Gross Domestic Product, health spending accounted for 17.8 percent [17].

Further, CMS estimated that healthcare expenditures increased from approximately 5% of the GDP in 1960 to 16% of the GDP in 2008 and the National Health Statistics Group predicts that expenditures will grow to over 19% in 2019 [18]. The percent of United States national medical expenditures devoted to treating obesity-related illnesses in adults increased 29% from 6.13% in 2001 to 7.91% in 2015 [19].

The increased prevalence of obesity that has occurred in the U.S. during the last 30 years has been accompanied by a substantial increase in the literature on the direct medical cost of obesity [20]. Cost of illness estimates are commonly cited in the medical literature despite debate about the usefulness of quantifying the cost of illness in general and the cost of overweight and obesity, specifically [21,22]. For example, the American Diabetes Association estimated that the 2004 annual cost of diabetes in medical expenditures and lost productivity increased from $132 billion in 2002 to $174 billion in 2007 [9]. The American Heart Association estimated the direct and indirect cost of cardiovascular disease to be $403.1 billion in 2006 [23]. Although some cost estimates for overweight/obesity, diabetes and heart disease may double count one another, it is important to understand the magnitude of costs that could potentially be saved by better prevention and treatment of obesity.

In 2017, Biener et al., analyzed data from MEPS for 2001-2015 and estimated the percentage of healthcare costs associated with obesity in adults in the most highly populated states and the United States as a whole [19]. These authors examined the direct economic implications of obesity and also assessed the indirect economic impact of obesity including labor market outcomes such as employment, job absenteeism and lost wages. The authors identified some fluctuation in medical expense due to obesity from 2001-2015, but noted an upward trend in the share of national expenditures associated with obesity during this 15-year time period. For the United States as a whole, the percentage of medical expenses related to obesity increased from 6.13% in 2001 to 7.91% in 2015. The lowest expenditure for obesity was noted in Maryland in 2001 (3.57%) and the highest expenditure was noted in North Carolina (14.55%) in 2011. Overall at the state level, the authors found that medical expenses related to obesity were lowest in California, Florida and New York (3-6%) and highest in Illinois, North Carolina, Ohio, Virginia and Wisconsin (8-14%). The medical expenditures for obesity increased 83% in Maryland and 52% in Kentucky during this time period. Many factors were suggested for the disparities in states including differences in the prevalence of obesity, differences in healthcare utilization among the obese, differences in how physicians treat obesity and differences in the cost of medical services. The authors also examined the total medical expenditures associated with obesity as a function of payer including Medicare, Medicaid, commercial health insurance and out of pocket spending by the patient. The average percentage of expenditures for medical care related to obesity between 2010 and 2015 was 9.21% for commercial insurance, 6.86% for Medicare, 8.48% for Medicaid and 4.74% for patient out of pocket spending. The expenditures by Medicare and Medicaid are of particular interest because they indicate the medical costs assumed by society. Specifically, an average of 11.96% of Medicare expenditures in 2001-2015 were devoted to prescription drugs related to obesity while an average of 14.35% of Medicaid expenditures in 2001-2015 were devoted to prescription drugs related to obesity. By contrast, during the same time period, 5.19% of Medicare expenditures and 4.75% of Medicaid expenditures were devoted to inpatient hospital care related to obesity. From 2001-2015 an average of 11.29% of out of pocket prescription drug expenditures were related to care for obesity. Finally, these authors reported that their review of the international literature of the causal effects of obesity on economic outcomes indicated that obesity reduced the probability of employment. In their review, a 1% decrease in BMI was associated with a 2.1% increase in the retention of employment of obese women but no change in the employment of men. In terms of lowered earnings and wages for obese individuals, Biener et al., review of the literature revealed that BMI tends to correlate with wages in a significant and negative fashion for women but not statistically significant for men [19]. Among women, for example, the most significant impact is for white women where an additional 10 pounds lowers wages by 2.8% compared to a biologic sibling.

In 2017 Biener et al., further assessed the expenditures associated with medical care associated with obesity and found that obesity raised individual medical care costs by $3,429 per year in 2013 dollars [24]. With the assumption that the effects of obesity in Biener's study population, (adult respondents to the MEPS who have biological children in the household) generalizes to the full noninstitutionalized population of American adults, the total medical care costs of obesity for noninstitutionalized adults totaled $342.2 billion in 2013 that equated to 28.2% of all healthcare costs in this population that were attributable to obesity.

Tsai, Williamson and Glickper formed a systematic review of the direct cost of overweight and obesity in the United States [16]. PubMed (1968-2009), EconLit (1969-2009) and Business Source Premier (1995-2009) were searched for applicable published studies, specifically those that calculated the incremental cost per overweight and obese persons and to calculate the national aggregate cost. The search strategy combined the terms "obesity" or "obesity, morbid" with any of the following terms: "costs and cost analysis", employer health costs", "cost of illness" and "health care costs". The authors reviewed a total of 935 published papers or abstracts that only included United States subjects. A total of fifty United States studies were identified and seventeen studies were excluded for a variety of reasons, including median, rather than mean cost reported (n=1); unable to calculate the annual cost of obesity from the data reported (n=1); direct and indirect costs were combined (n=1); no BMI cutoff discussed (n=4); only inpatient or outpatient costs were included (n=3) and duplicate dataset (n=7). A total of thirty-three studies published between 1992 and 2008 comprised this systematic review. Of these, 24 reported on the cost of overweight, 30 on the cost of obesity and 26 on the cost of overweight and obesity combined. These authors reported that only four studies met all study criteria for their designation of a high-quality study, including analysis of adults of all ages, use of standard BMI designations, reporting cost or expenditure and the use of nationally representative samples. In these four studies, the medical costs in 2008 dollars ($Y2008) of overweight was $266, for obesity $1,723 and for overweight and obesity combined $1,023.The aggregate national cost of overweight and obesity was 4.8% of United States health spending in 2008 based on National Health Expenditure Accounts (NHEA) data. Finkelstein et al., who used the Medical Expenditure Panel Survey (METS) data, reported that the incremental cost of obesity to be $1,429 and that the cost of overweight was not significantly different than the cost of normal weight [25]. The total healthcare spending of obesity was estimated to be 9.1%. Among all

studies in the systematic review, the incremental cost of overweight was $498. Among the 23 studies that reported estimates of both the cost of normal weight and the incremental cost of overweight, the cost of overweight was 9.9% greater than the cost of normal weight patients. The aggregate national cost of overweight and obesity combined was $113.9 billion ($Y2008). Five studies reported cost estimates for morbid obesity (BMI greater than 40 kg/m^2). These studies indicated an average incremental cost of $3,012 that represented a 68% increase over the cost of normal weight. The cost of morbid obesity accounted for 35% of the total cost of obesity.

Children and Adolescents

Childhood obesity is a major public health concern with over 30% of children in the United States being overweight or obese [26]. As in adults, childhood obesity can result in diabetes, cardiovascular disease and cancer [26]. Wright and Prosser pooled data from the years 2006 to 2010 of the Medical Expenditure Panel Survey (MEPS) and analyzed a sample of 23,727 individuals between the ages of 6 and 17 years [26]. The weight classification for these individuals was underweight (BMI<5th percentile), normal weight (BMI between 5th and 85th percentile), overweight (BMI 85th-95th percentile) or obese (BMI>95th percentile). The overweight individuals comprised 18.1% of the sample. Total medical expenditures for office based, hospital inpatient, hospital outpatient, emergency department, prescription drug, dental and home health care expenditures in a single year were analyzed for 2006-2010 including those paid by Medicaid, Medicare, other public insurers, private insurers and out of pocket. The authors found that overweight adolescents had higher utilization of prescription drugs than normal weight adolescents and obese children had significantly higher use of outpatient hospital visits than normal weight children. Finally, obese adolescents had significantly more visits in every visit sub-category except hospital visits compared to normal weight adolescents.

Prevention of Obesity-Theories of Action

The reality of obesity is that it represents a significant burden on the United States health care expenditures, is associated with the development of medical sequelae and shortens the life expectancy of patients. The following theories of action are therefore suggested:

If obesity were successfully addressed, then comorbid diseases would be less prevalent. If comorbid diseases were less prevalent, then United States healthcare expenditures would decrease.

If the incidence of obesity could be reduced in children and adolescents, then fewer American adults would suffer comorbid diseases with resultant decreased United States healthcare expenditures.

Priority must be given to preventive interventions that are cost effective and those that realize cost savings. Cecchini and Sassi retrospectively examined the economic impact of education, counseling and long-term drug treatment on national healthcare expenditures and the use of health care services compared to business as usual approaches in the United States [27]. In 2010, prevention interventions had the potential to decrease total annual health care expenditure by up to $2 billion, although the estimate did not include the implementation costs. The largest portion of savings (60.6%) is produced by reduced inpatient care, followed by reduced use of drugs. The reduction in expenditure for outpatient care would be more limited. In the final analysis prevention initiatives for obesity may produce a significant decrease in the use of healthcare services and expenditures. Savings would become significant when implemented over a long period of time. Finally, Lee et al., indicated that using a computational simulation model in United States children ages 8-11 years of age, maintaining the current physical inactivity level would result each year in a net present value of $1.1 trillion in direct medical costs and $1.7 trillion lost productivity over the course of their lifetimes [28]. The authors indicated that if 50% of children would exercise, the number of obese and overweight youth would decrease by 4.18% thereby averting $8.1 billion in direct medical costs and $13.8 billion in lost productivity. Increasing the proportion of children who exercised to 75% would avert $16.6 billion and $23.6 billion in lost productivity. In the final analysis, national guidelines that recommend that children and adolescents engage in 60 minutes of moderate to vigorous physical activity each day represent an effective strategy to reduce the negative health impacts of obesity on American society while also markedly reducing the health care expenditures associated with obesity [29].

Prescription Weight Loss Drugs

The Food and Drug Administration currently approves five drug for weight loss (Table 1). These include lorcaserin (Belviq), naltrexone SR/buprioprion SR (Contrave), liraglutide (Saxenda), phentermine/topiramate (Qsymia) and orlistat (Xenical). Lorcaserin is a selective serotonin 2c receptor agonist that stimulates these receptors in the appetite center of the brain thereby curbing appetite. The combination of naltrexone SR and buprioprion SR results in opiod receptor antagonism by naltrexone and reuptake inhibition of dopamine and norepinephrine by buprioprion resulting in dimished appetite and cravings. Liraglutide is a glucagon-like peptide 1 receptor agonist that represents a higher dose of Victoza utilized in type 2 diabetes treatment. Phentermine/topiramate ER combines the appetite-suppressant sympathomimetic amine phentermine with the anticonvulsant topiramate. Orlistat is a peripherally acting pancreatic lipase inhibitor that reduces the absorption of ingested fat. It is the only weight loss drug that is approved for children 12 years of age and older. A recent study found that patients went to the pharmacy 15 times more frequently for antidiabetic drugs than for anti obesity medication even though 116 million adults fit the criteria for use of these drugs, compared with less than 30 million for whom antidiabetes drugs are indicated [30]. The question remains as to why doctors are so reluctant to prescribe these drugs. One theory is that obesity does not require pharmacotherapy, although the experience of virtually every clinician would argue that many, if not most, patients cannot achieve meaningful weight loss with behavioral changes alone. Others are concerned with lack of insurance coverage for these agents that can cost patients about $200 per month. Finally, primary care clinicians may not be familiar with these drugs or comfortable prescribing them. When prescribed with adherence to proper diet and physical activity, these drugs may be able to help patients realize approximately 5%-15% weight loss that should lead to significant improvements in many comorbid conditions, including diabetes, hyperlipidemia and cardiovascular disease.

Bariatric Surgery for Obesity

The obesity epidemic in the United States has gained significant attention from the media that has primarily focused its attention on diet and exercise as the main solutions available to address this epidemic. While the media emphasizes the value of a healthy lifestyle in

preventing childhood obesity, diet and exercise alone are frequently ineffective methods for obese adults to achieve lasting results [31]. Surgical treatment of obesity has received less media coverage and patient perceptions of surgical treatment are unclear [31]. Specifically, obese Americans overestimate the utility of diet and exercise and underestimate the safety and effectiveness of surgical treatment. The first bariatric surgical procedure for morbid obesity was performed in 1954 [32]. Since then, surgery for morbid obesity has become less invasive and safer. In 2018 the laparoscopic Roux-en-Y is the most common surgical procedure for obesity (Figure 1). In 2017 Adams et al., reported a prospective observational study that enrolled 1156 patients [32]. Morbid obesity was noted in 835 patients, 418 of whom underwent Roux-en-Y gastric bypass and 417 patients did not undergo surgery and therefore represented a control group for comparison (nonsurgery group 1). A second control group of 321 adults with severe obesity who had not undergone bariatric surgery was recruited (nonsurgery group 2). Twelve-year follow-up was provided for 388 of the surgical patients, 364 of nonsurgery group 1 patients and 301 of nonsurgery group 2 patients. The results of the study showed that Roux-en-Y gastric bypass provided long-term durability of weight loss and was associated with fewer obesity-related medical co-existing conditions than among patients who did not undergo surgery. The average percent weight loss in the surgery group was 28.0% at 6 years and 26.9% at 12 years. Of the patients who had type 2 diabetes at the time of surgery, type 2 diabetes remitted in 75% of patients at 2 years, 62% of patients at 6 years and 51% of patients at 12 years. A 91-92% lower incidence of new onset type 2 diabetes at 12 years was noted in the surgery patients compared to the nonsurgery patients. The surgery group had higher remission rates and lower incidence rates of hypertension and dyslipidemia than did the nonsurgery group. Of final note is that deaths by suicide or self-harm emergencies were noted to be higher in patients undergoing surgery than nonsurgical patients in this study. There is therefore a need to better predict and prevent this uncommon but very serious complication of bariatric surgery [32].

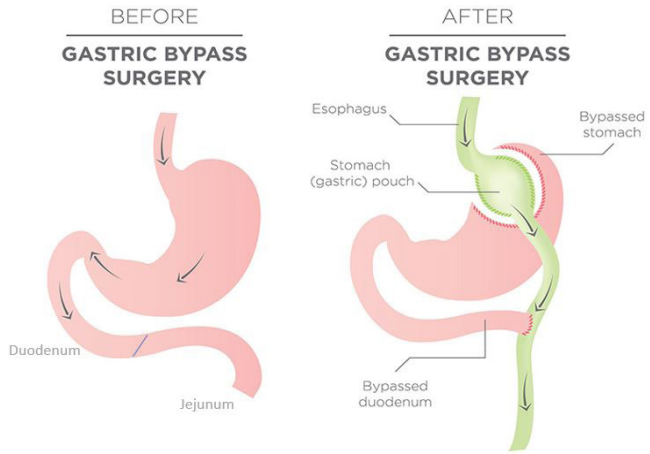

Figure 1: The Roux-en-Y gastric bypass operation for weight loss is the most common and successful type of gastric bypass procedure. The surgeon begins by creating a small pouch by dividing the upper end of the stomach. This restricts the intake of food. A Y-shaped section of the jejunum is attached to the stomach pouch to allow food to bypass the lower stomach, the duodenum, as well as the first portion of the jejunum. The procedure creates a direct connection from the stomach to the lower segment of the jejunum, thereby bypassing portions of the digestive tract that absorb calories and nutrients with resultant weight loss.

Discussion

The cause and effect relationship is clear of overweight, obese and morbidly obese states and the development of medical sequelae in adults. As this paper discusses, the international literature demonstrates obvious risk factors of such states with the development of cardiovascular disease, dyslipidemia, cognitive dysfunction, arthritis and some cancers. This notwithstanding, the effect of excess body weight on marital satisfaction and mental health has been less extensively studied. Mokhtari and Pollock [33], utilizing a nationally representative cohort of 1,640 United States women between the ages of 37 and 45 from the National Longitudinal Survey of Youth, analyzed the degree to which women's body weight was related to marital satisfaction and mental health, particularly regarding depression. The authors determined a negative relationship between increased body weight and marital satisfaction. Specifically, compared to normal weight women, overweight women were 23% less likely to be content with their marriages and obese women were 30% less likely to be happy with their marriages. These findings were independent of ethnicity, physical health limitations, length of the marriage, number of children and depressive symptoms. The addition of income to the analysis demonstrated the association between body weight and marital satisfaction null suggesting that income rather than body weight was the most important factor associated with marital satisfaction.

Poverty reduction policies including the 1996 Personal Responsibility and Work Opportunity Reconciliation Act have led to a marked increase in the involvement of women with young children in the labor force. In 2009 the United States Department of Labor, Bureau of Labor Statistics reported an increase in the number of employed mothers with children under the age of 18 from 47% in 1975 to 71% in 2008 [34]. With women steadily moving into the paid labor force, men have consequently increased their contributions to household labor including the production and support of child health. Changes in family structure and dynamics, particularly the significant rise in dual-earner families and working single parent families, are important factors that are likely contributing to escalating obesity rates among children and adolescents [35]. While studies investigating the positive association between the expansion of the maternal workforce and childhood obesity rates exist, evidence is largely absent demonstrating the role of fathers in child weight [34]. Benson and Mahktari used economic theory, a nationally representative dataset and proper econometric modeling and analysis to study the joint role of parental employment on children's health utilizing the metric of Percentile Body Mass Index (pBMI) [34]. Specifically, these authors used the 2007 wave of the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) for children who live with both parents to address how father's work hours influence childhood obesity. Intuitively, the study identified that decreases in parental contributions to child health associated with increased parental labor force participation negatively impacted child health with increases in childhood obesity. The positive coefficient estimates on mother's (12%) and father's (2%) hours of work were felt to be consistent with the joint parental decision making process in promoting favorable child health. The influence of father's hours of work in the study was more than double that of mother's hours of work. The study identified another predictor of child pBMI in parental wages was measured by the log of the mother's wage relative to that of the father's wage. Higher hourly wage for mothers relative to those of father's were predictive of lower pBMI outcomes for their children. Sociodemographic

factors were also influential in pBMI in that being Hispanic had the highest positive influence on pBMI, while being geographically located in the south and increasing child age were associated with lower pBMI. Other protective factors influencing pBMI included parent-child activities such as reading, building, talking, performing yard work, engaging in sports, hand crafts, washing dishes and completing homework, all of which decreased pBMI. The building/repair work was associated with a decreased risk for overweight and obese childhood states presumably due to increased expenditures of calories. The observation of reading being associated with decreased likelihood of overweight and obese states suggests that this activity might support engagement with children with subsequent motivation for adopting physical activity and weight control goals. In the final analysis, the findings of this research indicate that father's household production input hours may be more efficient than those of mother's in terms of the production of child health. Father's may benefit, therefore, from training, social support and educational resources emphasizing the health issues of children including meal preparation, the encouragement of physical activities and social support.

Conclusion

Obesity is a diagnosis that is not randomly distributed in American society in that it observes no gender, racial, age or ethnic bias. Obesity is a disease that satisfies an epidemic designation in the United States and an epidemic that research has proved is difficult to reverse. It is a disease that demonstrates pathologic involvement of nearly every human organ system and is a leading preventable cause of death in the United States. It is therefore a justifiable public health concern in our society and predictions indicate increasing trends in overweight, obese and morbidly obese states over time. Perhaps equally concerning is that research concludes that the treatment of obesity and its medical sequelae consumes substantial medical expenditures in the United States. For all of these reasons, pessimism certainly exists regarding the diagnosis of obesity, yet research also provides optimistic strategic initiatives regarding obesity. Specifically, increasing vigorous activity amongst children will decrease the negative impacts of obesity on society while also reducing the economic burden of this disease. In addition, the outcomes of bariatric surgery in select adults are promising, particularly since diet and exercise have limited positive effects over time in obese patients. In the final analysis, obesity is a multifactorial and multisystem disease that is life threatening for patients and economically burdensome for society. Continued public health oversight and intervention will therefore be value-added in the prevention and treatment of obesity in the United States.

Conflict of Interest

L. Michelle Leyd and Eric R. Carlson do not perceive a conflict of interest in terms of the publication of this article in the Herald Scholarly Open Access Journal of Obesity & Weight Loss.

Approved Weight Loss Drugs	Orlistat(Xenical®, alli®)	Phentermine-Topiramate(Osymia®)	Lorcaserin(Belviq®)	Naltrexone-Bupropion(Contrave®)	Liraglutide (Saxenda).
Type of Drug	Peripherally acting pancreatic lipase inhibitor; ↓ absorption of ingested fat.	Appetite- suppressant (sympathomimetic amine) and anticonvulsant.	Selective serotonin 2c (5HT-2c) receptor agonist; stimulates 5HT-2c receptors in appetite center.	Dopamine and norepinephrine reuptake inhibitor and opioid antagonist.	Glucagon-like peptide 1 receptor agonist.
Dosing and Evaluation	120 mg, 3 times daily with meals (or OTC alli® at half dose, 60 mg)	Start 3.75/23mg, ↑ to 7.5/46mg after 2 weeks. Evaluate after 12 weeks; ↑ dose or d/c if < 3% weight loss.	10 mg twice daily (does not require titration) or 20 mg ER once daily. Evaluate after 12 weeks; d/c if weight loss < 5%.	Week 1: 8 mg/90 mg daily; ↑ weekly to target daily dose 32 mg/360 mg by week 4 (two pills, twice daily). Evaluate after 12 weeks on target dose; d/c if weight loss < 5%.	SubQ injection (arm, thigh, abdomen; rotate site). Start at 0.6 mg daily; ↑ by 0.6 mg weekly for 5 weeks to target dose 3 mg. Evaluate after 16 weeks; d/c if weight loss < 4%.
Adverse Effects	GI (diarrhea, flatulence), especially if large amounts fat ingested.	Paresthesia, dizziness, dry mouth, dysgeusia, insomnia, constipation.	Headache, dizziness, fatigue, nausea, dry mouth, constipation; hypoglycemia with other diabetes drugs.	Nausea, diarrhea, constipation, headache	Nausea; GI symptoms.
Precautions	Binds fat-soluble vitamins; have patient take daily multivitamin at bedtime. ↑ urinary oxalate; predisposes to kidney stones.	Known teratogen; rule out pregnancy before starting; test monthly during treatment.	Serotonin/neuroleptic malignant syndrome if on serotonergic or anti-dopaminergic drug; valve disease, CHF, psychiatric disorders; priapism.	Warning about suicidal thoughts in patients < 24 years.	Hypoglycemia a risk in patients on antidiabetic meds; may be severe in those on sulfonylureas or insulin.
Contraindications	Pregnancy, cholestasis, malabsorption syndromes, use of cyclosporine.	Pregnancy, glaucoma, use of MAOIs, hyperthyroidism.	Pregnancy	Pregnancy; uncontrolled hypertension; seizure disorders; chronic opioid use; MAOI use.	Pregnancy, breastfeeding; thyroid cancer, multiple endocrine neoplasia type 2, acute pancreatitis.

Table 1: The 5 FDA approved drugs for weight loss.

BP = Blood Pressure; CHF = Congestive Heart Failure; d/c = Discontinue; GI = Gastrointestinal; MAOI = Monoamine Oxidase Inhibitor; OTC = Over the Counter; subQ = subcutaneous; T2DM = Type 2 Diabetes Mellitus; ER = Extended Release

Adapted from: Kahan S: Quick takes: What you should know about the 5 FDA approved obesity drugs. www.Medscape.com. March 2, 2017. Accessed January 15, 2018.

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