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Effectiveness of Weight Control through Weight Watch Programs

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The Effectiveness of Weight Control through Weight Watch Programs

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Abstract

Linear probability estimation and survey data are employed to quantify the influence of the lifestyles of individuals on the change in their body mass index (BMI). The analysis also explores the effects of demographic characteristics (age, gender, and ethnicity) in weight management. Results suggest evidence of association between changes in lifestyle and changes in the BMI of individuals.

Introduction

Obesity is one of the most serious health conditions facing adults and the youth alike in the U.S. today, and evidence suggests that the threat is worsening rapidly, reaching epidemic proportions. Among adults aged 20 or older, the prevalence of overweight rose from 55.9% to 64.5% in 1988-1994 to 1999-2000 and that of obesity rose from 22% to 30.5% for the same period (Flegal et al. 2002). Among children aged 6 through 19 years, 65.1% were overweight or obese and 4.9 % extremely obese in 2001-2002 (Hedley et al. 2004). A major concern about overweight and obesity is the serious risks of obesity-related chronic conditions such as type II diabetes, coronary heart disease, hypertension, gallbladder disease, breast cancer, endometrial cancer, colon cancer, and osteoarthritis. All these conditions are known to considerably reduce the quality of life, increase morbidity and mortality, and lead to premature death (Arvaniti and Panagiotakos 2008). Furthermore, economic costs associated with overweight and obesity is estimated at over $99.2 billion per year and constitutes a substantial burden on the U.S. healthcare system (Allison et al. 1999).

As the prevalence of overweight and obesity is increasing, so is the awareness of their health consequences among the public. This growing consciousness is translated by the spread of weight-watch programs aimed at establishing healthy lifestyles that will reduce the weight of participants. The scientific knowledge of the relationship between diet and health is being increasingly used to study the quality of diet (Guthrie and Morton 2000). Although inconclusive, many previous studies suggest the existence of a significant relationship between lifestyle and weight status of adults and children alike. Those findings have important policy implications because provisions of health and nutritional information to communities may help people to establish healthy eating habits and lifestyles, which are likely to contribute to the reduction in weight problems. Few studies, if any, have attempted to link participation in weight-loss programs to reduction in Body Mass Index (BMI) of participants. More research is needed to determine what specific lifestyles and diet habits would augment clinical care in reducing and controlling weight gain. Specifically, there is a need to assess the effectiveness of some weight-watch programs in relation to the instruction content and weight reduction of participants. It is logical to expect that the more knowledgeable and well-informed people are about the nutrient content of food items and health consequences of various diets, the better they can translate this information in planning household meals, implying healthier diets for household members.

This study intends to address this need by supplementing the literature an analysis of collected data that contributes to understanding factors that may influence the likelihood and extent of weight loss. Thus, the primary objective of the study is to identify demographic factors and lifestyles that influence or determine weight loss. Specifically, the study intends to (1) examine and assess the likelihood of participation in weight loss programs reducing the Body Mass Index, (2) estimate and quantify the effect of selected demographic factors, food consumption patterns, and physical exercise habits. The results should provide important policy implications to public health officials with respect to the development of nutritional education, and information delivery if needed, as the potential health benefits from reduction

in overweight and obesity are of considerable public health importance.

Definition of Obesity

Obesity refers to an excessive accumulation of fat in adipose tissue, which is the form of excess energy stored by the body. It results from a positive balance of body energy: that is, when total-calorie-intake exceeds total expenditure (Smith 1999). This excess of body fat is characterized by an increase in body weight. As a result, the terms overweight and obesity are used somewhat interchangeably in the literature. A commonly used measure of overweight and obesity is a weight-to-height ratio called the Body Mass Index (BMI), which is defined as body mass in kilograms divided by the squared height in meters. Using the BMI, the National Heart, Lung, and Blood Institute (NHLBI) (Rolfes et al. 2009) provides cutoff guidelines to define obesity in adults as shown in Table 1.

Table 1: Weight status definitions for adults

NHLBI Classification	**BMI Range**
Underweight	BMI < 18.5
Normal weight	18.5 ≤ BMI < 25
Overweight	25 ≤ BMI < 30
Obese class 1	30 ≤ BMI < 35
Obese class 2	35 ≤ BMI < 40
Obese class 3	BMI ≥ 40

Conceptual framework

The examination of the relationship between the lifestyles of individuals and their Body Mass Index (BMI) is an empirical question that can be studied in the context of available data. The data used in this study was collected through a survey described in the next section. However, even the most thoroughly designed data gathering effort requires a strong cooperation from all subjects of the study to share the relevant information accurately.

Data Specifications

Data used in this study was collected using a survey questionnaire. The subjects of the study included a well-diversified group of students, faculty, and staff enrolled in the SAU weight-watch program. Participants in the weight-watch program all shared a common goal: to reduce their weight by adopting healthy lifestyles. All participants were required to attend weekly educational classes on healthy lifestyles, including nutrients and calorie content of various food groups, exercising, etc. Participants were also required to get weighed at the SAU nursing center once a week to keep track of individual and collective progress. The complete list of data collected is shown on Table 2 below. However, not all of the collected variables were used for analysis.

The empirical model

The following model that we applied is aimed at estimating the change in BMI equation:

$$Y = X\beta$$

where Y is a vector of dependent variables defined as the change in the BMI of participants, as follows.

$$Y = \frac{W_1 - W_2}{H^2}$$

W_1 is a vector of the weight of participants at the beginning of the program in kilograms

W_2 is a vector of the weight of participants at the end of the program in kilograms

H is a vector of the height of participants in meters

X is a vector of independent variables used in the estimation of Y,

β is the vector of coefficients to be estimated. A positive coefficient signifies that corresponding independent variable contributes to the increase of the BMI of individuals. A negative coefficient signifies that corresponding variable contributes to the reduction of the BMI of individuals.

Table 2: Dependent variables used in the study

Dependent variables	Measure or description
Age	In years
Gender	Male =0; Female =1;
Ethnicity	White: Yes =1; No =0; Black: Yes =1; No =0; Hispanic: Yes =1; No =0; Asian: Yes =1; No =0;
Height	Height in number of feet and inches
Weight	Weight in pounds
Pre-existing health condition if any	For any health condition Yes =1; No =0;
Number of times of exercise per week	Number of times of exercise per week per week
Average time spent each exercise session	Number of minutes per exercise session
Average hours of sleep per day	Average number of hours of sleep per day
Experiencing stress	Not at all = 1 Rarely = 2 Often = 3 Very often = 4
Change in consumption of soft drinks	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of alcoholic beverages	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of carbohydrates	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of vegetables	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of red meat	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of water	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5

Table 2: Dependent variables used in the study, continued

Dependent variables	Measure or description
Change in consumption of white meat	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of salt	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of fat/ oily food	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of sweets	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in consumption of caffeine	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Change in appetite	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Tendency to eat out	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Tendency to prepare own food	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Tendency to buy own groceries	Considerably decreased = 1 Slightly decreased = 2 Stayed the same = 3 Slightly increased = 4 Considerably increased = 5
Reading and using information on food labels	Yes =1; No =0
Counting calorie content of food consumed	Yes =1; No =0

Consider the following model aimed at predicting the change in the BMI for participants in this study:

$$(1) \quad Y_i = 1 \text{ if } Y_i^* = X_i\beta + \varepsilon_i \geq 0$$
$$Y_i = 0 \text{ if } Y_i^* = X_i\beta + \varepsilon_i < 0$$

where Y_i is an observed dummy variable which takes the values of 1 when the participant's BMI has increased at the end of the experiment period and 0 otherwise, Y_i^* is the latent variable (unobserved critical threshold), X_i is a vector of regressors, β is a vector of parameters, and ε_i is the error term.

Assuming that $\varepsilon_i \sim N(0, \sigma^2)$, ε/σ is distributed as standard normal (mean zero and unit variance). Equation (1) can therefore be estimated using a probit model. The parameter estimates are obtained using the Maximum Likelihood Method (Maddala 1983).

Literature review

The choice of independent variables was based on the review of literature related to the topic of the research. Most studies agree that lifestyle has tremendous influence on BMI. The weight of individuals depends on the type, level, and frequency of physical activity and food choices, including amounts of sweets, fatty foods and meat. The frequency of "eating outside of home", the number of hours sleeping in a day, level of emotional stress, and demographics also play an important role.

Physical activity is known to increase the body metabolism and therefore energy expenditure, which translates into reduction in the body weight. Research concluded that 45 to 60 minutes of daily exercise can help prevent normal-weight individuals from becoming overweight. Studies report that almost 60% of adults never engage in any kind of outside-the-work demands, physical activity lasting 10 minutes or more per week (Brownson et al. 2005).

The influence of gender on the dietary trends and eating habits was studied in the group of college students. A higher percentage of women than men had tried a low-fat diet and a low-carbohydrate diet. Significantly higher percentages of women than men agreed that they had too much sugar in their diets and that it is important to limit carbohydrate consumption and amount of fat consumption to lose weight. (Davy et al. 2006)

Cultural norms and socio-economic status also influence food preferences and dietary choices and, therefore, influence the BMI of individuals. According to the Mokdad, obesity in the United States is more prevalent in the Southern States (Mokdad et al. 2001). The prevalence of obesity among African Americans is 30%, compared to 25% in Hispanics and 18% in whites. Another study that assessed BMI among urban low socio-economic status (SES) African-American adolescents concluded that students' behaviors, school, and family environments may increase overweight risk among this population (Youfa et al. 2007).

Recent studies suggest that short sleep duration is associated with obesity. Truck drivers, for example, work irregular shifts and their work schedule is associated with short-sleep duration. A study of this group has shown an association of short-sleep duration with high levels of blood glucose and cholesterol levels, which contribute to obesity (Moreno et al. 2006). Kohatsu and colleagues have suggested existence of a link between short sleep duration and BMI in a rural population in Southeast Iowa (Kohatsu et al. 2006). Another study reports nationally representative data on the sleep habits of American children age 3-18 years. This study emphases the importance of sleep in children's physical health and suggests that sleep is important factor in understanding childhood weight problems (Snell et al. 2007).

Stress levels of the individuals can affect their BMI. In general, emotional stress is known to trigger overeating—consuming large amounts of food within a short period of time (Vanderlinden et al. 2004). The excess calories become converted into fat and are stored in the adipose tissue.

Preexisting health conditions can also affect the weight of individuals. Diabetes mellitus is a disorder characterized by insulin resistance and, as a result, elevated levels of glucose in the blood. Ninety five percent of people with diabetes have type 2 diabetes. Obesity, especially central obesity and a sedentary lifestyle (exercise fewer than three times per week) are risks factors associated with type 2 diabetes (Haas 2010). Eighty percent of individuals that are diagnosed with type 2 diabetes are overweight. Adults who are overweight are significantly more likely to develop type 2 diabetes than are individuals with BMI in normal range (Hu et al. 2001). Scientists estimate that 18 million Americans will have type 2 diabetes by the year 2020 (Green et al. 2003). In addition to overall obesity, the distribution of body fat is also a risk factor for type 2 diabetes. In many cases, type 2 diabetes is preventable. For people at risk for type 2 diabetes, weight management, regular exercise, and a healthy diet can reduce the risk (Gill and Cooper 2008). Even small changes can make a big difference. For example, losing as little as 10 to 15 pounds or taking a 30-minute walk daily have been shown to lower blood glucose

and thus possibly prevent development of diabetes.

Metabolic syndrome is another condition that is associated with insulin resistance. Approximately 47 million adults in the United States (20%) have metabolic syndrome (Shaw et al. 2005). Risk factors associated with metabolic syndrome are the same as those associated with type 2 diabetes: obesity, poor eating habits, and lack of exercise.

High intakes of protein are often accompanied by high intakes of fat, saturated fat, and cholesterol. In addition, growing research shows that very high, chronic intakes of red meat (beef, pork, and lamb) or processed meats (bacon, sausage, hot dogs, ham, and cold cuts) are associated with increased risk for colorectal cancer (Chao et al. 2005). Nonmeat-eaters are generally thinner than meat eaters. Studies attribute this difference to a higher intake of dietary fiber and a lower intake of animal fat (Appleby et al. 1998). Another study compares BMI in four diet groups (meat-eaters, fish-eaters, vegetarians and vegans). Fish-eaters, vegetarians, and vegans especially had lower BMIs than meat-eaters. High protein and low fiber intakes were the factors associated with increasing BMI (Spencer et al. 2003). Consuming less meat and fat may lead to lower overall energy-containing nutrients intake, which in turn results in weight loss. Foods that are low in fat content can benefit health overall by lowering total and LDL cholesterol blood levels, increasing HDL cholesterol, and improving blood glucose regulation (Lovejoy JC et al 2003).

There are rising trends in adults eating away from home, portion sizes of food increasing, and consumption of energy dense food increasing (Enns et al 2003). While the amount of calories consumed is increasing, Americans are also becoming less physically active. According to the research, 37% of adults and 42% of children eat fast food daily (Brilfel and Johnson 2004). Many fast-food restaurants offer healthy food choices such as salads, but overall most fast meals remain high in fat, simple carbohydrates, and calories. One the studies reports that fast food is nutritionally adequate but exceeds the national recommendations for fat, sugar, and sodium (Anding et al. 2001).

Analysis of the data from the National Health Interview Survey (NHIS) and the National Health and Nutrition Examination Survey (NHANES) 1999-2000 that examined trends in frequency of consumption of commercially prepared meals, lead to believe that in 1999-2000 more Americans ate out, and ate out more frequently. This trend is associated with adverse nutritional consequences (Kant and Graubard 2004). Foods with large amounts of added sugars, such as soft drinks, cakes, cookies, and candy, often have no or very little nutritional value beyond the calories they contain. In recent years, the consumption of added sugars in the United States has increased. Thirty three percent of the sugars come from soft drinks alone. Overall, Americans consume 80 g of added sugar per day – for a total of 320 kcal (Guthrie and Morton 2000).

Alcohol is not considered a nutrient, because it does not supports growth and development, but it does contribute to the amount of calories consumed by providing 7 kcal per gram. Excessive alcohol consumption can contribute to an increase in Body Mass Index (Suter and Tremblay 2005).

Results and Discussion

Results of the linear probability estimation are summarized in Table 3 below.

Demographic characteristics seem to play an important role in weight and BMI reduction. First, the age of participants positively associates with increases in BMI. This result suggests that the older one gets, the harder it is to decrease one's BMI. Older people have a relatively slower metabolism, which translates into less energy expenses. Also, adults aged 35 or above exercise relatively less than their younger counterparts. Results also suggest a significant gender difference. Unlike females, males in this study are positively associated with changes in BMI. Males are usually known to be more athletic and more engaged in physical exercise than females. This helps men expend more energy. Our results also show a differential response by race. Unlike Whites, the Body Mass Index of Blacks in our study has shown a significant increase.

Exercising is generally known to boost metabolism, burn energy, and, therefore, reduce the BMI. Also, exercising increases the amount of endorphins that are released in the blood, which decreases appetite, supposedly leading to a reduction in BMI. However, at this time our study does not confirm that.

Food choices have shown some influence on the BMI of participants. An increase in vegetable intake leads to the decrease in BMI, as expected. Vegetables are composed of soluble fiber and water. They provide satiety and feeling of "being full" with less calorie intake.

Furthermore, we found a direct link between BMI and the amount of red meat consumed. It is common to

Table 3: Linear probability estimation results

Independent variable	Coefficient estimate	Standard error	Mean
Constant	-15.199*	0.221221D+07	
Age	0.681***	32635.6751	36.94
Male	-21.495***	0.165418D+07	0.23
Black	27.335***	0.111167D+07	0.28
Exercise time	0.214	10237.1231	28.57
Vegetables consumption	-5.784**	978834.033	0.83
Red meat consumption	22.5503867	981575.785	-0.43
Soda consumption	-7.553*	437213.331	-1.11
Alcohol consumption	-2.615***	609379.013	-0.48
Fruits consumption	0.401*	965631.124	0.88
Milk consumption	12.515***	788328.539	0.11
Fat food consumption	17.615**	734663.589	-0.94
Salt consumption	4.197*	357909.793	-0.51
Eating out	-13.815**	775977.234	-0.80
Calories checking	-2.085*	597727.269	0.60
Sleep time	-3.735*	303146.143	6.44
Log likelihood function	-0.1077027E-11		
Restricted log likelihood	-19.95165		
Chi squared	39.90330		

, **,** indicate that the estimated coefficient is statistically significant at 10%, 5%, and 1% respectively.

think that meat as "all protein", while, in fact, a large portion of the composition of meat foods is fat. So, naturally, an increase in red meat consumption would lead to the increase in overall calories consumed and would contribute to the increase in BMI.

Increases in soda consumption were negatively associated with BMI. It could be the case that soda consumed was diet soda that does not contains added sugar. Then, increase in sugar-free soda consumption will lead to the decrease of the BMI. If regular soda was consumed, the expected relationship would be a direct relationship, because regular soda provides a lot of sugar and sodium, which would lead to the increase in BMI.

Alcohol consumption shows a negative association with the BMI. However, this result can be considered inconclusive. Alcohol is not a nutrient, but does contribute calories and, if consumed in excess, may lead to the increases in BMI.

Increases in fruit consumption showed a slight increase in BMI. This could be explained by the fact that fruits contain insoluble fiber and water as well as sugar. Increases in the amount of insoluble fiber and water will lead to the increase of the BMI. Our study also shows a direct relationship between milk consumption and increases in BMI. Milk is essentially composed of water, carbohydrates, and fat. So, increases in milk consumption will contribute to calories consumed and lead to an increase in the BMI.

The BMI increases with increases in fat food intake and this is consistent with expectations. Fat provides twice the calories compared to the carbohydrates and protein. Also, fatty foods may contain a considerable amount of salt, which leads to the water retention and is translated to an increase of the BMI.

Increase in salt intake demonstrated increases in BMI. Increases in BMI in this case could be attributed to the increase in overall body water retention.

The impact of eating away from home on BMI was inconclusive. It is generally expected that eating outside of the home will lead to increases of the BMI, because it is difficult to know how many calories are consumed during meals outside of the home. Also, it is easier to overeat because of the food availability. Healthy meals prepared at home are expected to demonstrate a decrease in the BMI. Investigators are hoping to confirm this expectation in future studies.

Checking the caloric content of various food items while shopping for groceries can help monitor calorie intake and weight and lead in reductions in BMI. Our research was able to confirm that recommendation.

Results show an inverse relationship between number of hours sleeping and BMI. Less sleep translates into having less energy available for the next day, which leads to the increases in appetite next day in an attempt to compensate for lost energy and, consequently, leads to the increase in BMI.

Concluding comments

This study confirms the influence of demographics, dietary habits, and other lifestyle choices on BMI of individuals. Our analysis of the collected data documents the idea that individuals can successfully manage their body weight by adopting healthier lifestyles. Educational programs aimed at controlling weight can therefore be successfully implemented through weight management programs.

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