

The Influence of Obesity, Alcohol Abuse, and Smoking on Utilization of Health Care Services

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Background and Objectives: *There is extensive evidence relating individual behavioral risk factors to adverse health outcomes and associated costs; however, more-comprehensive assessments have been limited. Our objective was to examine the relative effects of obesity, alcohol abuse, and smoking on health care use and associated charges. **Methods:** New adult patients (n=509) were randomly assigned to primary care physicians, and their utilization of medical services was monitored for 1 year. Variables measured included sociodemographics, self-reported health status, Beck Depression Index, measured body mass index, Michigan Alcohol Screening Test results, and smoking history. **Results:** Controlling for health status, depression, age, education, income, and gender, obesity was associated with the mean number of primary care visits, diagnostic services, and primary care clinic charges. Alcohol abuse was related to the mean number of emergency department visits and diagnostic services. Smoking was associated with the mean number of specialty clinic visits and hospitalizations. Smoking also predicted charges for emergency department visits, hospitalizations, and total health care charges. **Conclusions:** The economic burden of smoking is significant, even after only 1 year. Health care providers should focus attention on smoking prevention and cessation programs as an approach for managing medical costs.*

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Obesity, alcohol abuse, and smoking are behavioral risk factors for a variety of adverse health outcomes. Approximately 30.4% of adults in the United States are obese, 8.5% abuse alcohol or are alcohol dependent, and 22.5% are current smokers, resulting in significant health problems and associated costs.¹⁻¹⁰

The direct medical costs for obesity have been approximated at \$51.6 billion per year. Most of the studies examining obesity and related health care costs have used group data, applying estimates of population-attributable risks to estimates of total costs of care for each disease related to obesity;¹¹ only a limited number of studies have quantified the association of obesity and increased health resource utilization at the patient level.¹²⁻¹⁵ The estimated annual medical expenditures associated with alcohol abuse total \$26.3 billion.¹⁶ Several studies have examined the relationship between alcohol

abuse and patterns of health care utilization,¹⁷⁻²² demonstrating disproportionate use of acute and emergent medical services by alcohol users.^{21,22} Finally, cigarette smoking remains the single most-common preventable cause of death in the United States, imposing annual costs that result from increased medical services utilization over the life span.²³⁻²⁵ Direct medical care costs for smoking-related problems are about \$75.5 billion per year, representing 6%–8% of American personal health expenditures.²⁶

Although there is an extensive body of literature demonstrating the association of specific risk factors for health conditions and medical care utilization, few studies to date have compared the effects of obesity and other risk factors, such as tobacco and alcohol abuse, on health costs.^{27,28} Sturm recently evaluated the effects of obesity, smoking, and problem drinking on health status and health care resource use based on national survey data. In statistical analyses, specific health problems, in addition to general health status, were examined as dependent variables to assess the biomedical influence of the three risk factors studied. The effect of obesity

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on the number of chronic conditions was significantly greater than the smoking or drinking. Further analyses demonstrated that obesity was associated with a 36% increase in both outpatient and inpatient spending, compared to a 21% increase for smokers and smaller effects for problem drinkers.²⁷ However, chronic physical conditions (and the subsequent decrease in health status) are critical links in the pathway by which obesity, drinking, and smoking lead to increased medical costs, and they must be considered when examining the association of these risk factors with health care utilization and costs.²⁸

The purpose of our study was to examine the relative effects of obesity, alcohol abuse, and smoking on the use of health care services and the associated charges for 1 year of care. We sought to contribute to the findings of previous studies by controlling for patient health status, depression, and certain sociodemographic characteristics, since these have been previously demonstrated to significantly influence health resource utilization.²⁹⁻³¹ By statistically adjusting for health status, we attempted to eliminate potential sources of bias and confounding, while avoiding “over adjustment” that may occur by controlling for the specific physical ailments associated with obesity, drinking, and smoking.^{12,27} This is the first study of its kind to control for health status while investigating the influence of these three important health risk factors on the utilization of health care services at the patient level.

Methods

Study Design

The study was approved by our institutional human subjects review committee.

A total of 509 new patients comprised the original study population. These subjects received care from 105 primary care residents at the University of California, Davis Medical Center Ambulatory Care Center. Patients were interviewed by a research assistant prior to their initial visit with physicians. Data collected during the interview included sociodemographic information, self-reported health status, evaluation for depression, screening for alcoholism, and history of tobacco use. Height and weight measurements were also taken to calculate the body mass index (BMI). The utilization of medical services for the study period was determined by review of medical records and associated billing records.

Independent Variable Measures

BMI. BMI is calculated as weight in kilograms divided by the square of height in meters. According to the National Institutes of Health guidelines, the BMI is the recommended method for measuring obesity in clinical settings. Patients who have a BMI of 18.5 to 24.9 are considered “normal,” those with BMI of 25 to 29.9 are

“overweight,” and those having a BMI greater than or equal to 30 are “obese.”³²

Alcohol. The screening tool used to detect alcoholism was the short version of the Michigan Alcohol Screening Test (MAST).^{33,34} The “brief MAST” consists of a 10-question subset of the original 25-item MAST and has been demonstrated to be a reliable screening instrument in both clinical and nonclinical settings.³⁵ In this study, any patients stating they had ever had an alcoholic drink were also asked the 10 questions from the brief MAST.

Tobacco. Questions regarding the tobacco smoking history of each study participant were included on the patient questionnaire. Patients were designated “nonsmokers” if they had never smoked or had not smoked tobacco for 15 years or longer. The decision to group previous smokers who had not smoked for 15 years with nonsmokers was based on a recent report by the Surgeon General on the health consequences of smoking and the benefits of quitting.¹⁰ After 10 to 15 years, a previous tobacco user’s risk of premature death approaches that of a person who has never smoked.

Health Status. The Medical Outcomes Study Short Form-36 (MOS SF-36) is a reliable and valid 36-item questionnaire made up of eight scales: general health, physical function, physical role, mental role, social function, pain, energy, and mental health. Scales are scored so that higher scores reflect better health status. Common chronic medical conditions, such as diabetes, hypertension, coronary heart disease, arthritis, and lung problems, have a unique negative effect on scores.^{36,37} Summary measures can describe a physical component score (PCS) and a mental component score (MCS).^{38,39} Thus, rather than focusing on the specific diseases associated with increased morbidity, their effect on the individual patient’s health status was measured and controlled.

Depression. The Beck Depression Inventory (BDI) is a reliable and valid instrument used to measure depressive symptoms.⁴⁰⁻⁴² The abbreviated version includes 13 items weighted and summed to produce a total score.⁴¹ A score between 9 and 15 indicates moderate depression, and a score of at least 16 indicates severe depression. In our study, a BDI of 16 or higher was used to identify those patients with severe depression.

Dependent Variables

Medical center resource use for 1 year of care was determined through review of the comprehensive medical record by two physician reviewers, working together and discussing any questionable entries. The numbers of primary care visits, specialty clinic visits, emergency

department visits, hospitalizations, and laboratory, diagnostic, and radiological tests (diagnostic services) were tallied. Medical charges for all these services were obtained from the centralized institutional billing unit. Charges, used as a proxy for medical costs, were assigned to one of five categories: primary care clinics, specialty care clinics, emergency departments, hospitalizations (including outpatient surgery admissions), and diagnostic services. In addition, year-long totals for these five charge categories were calculated for each patient. Patients were given prepaid postcards on a quarterly basis on which to report medical care obtained elsewhere. We received some responses that indicated negligible out-of-system use, but the exact amount of such utilizations was not possible to evaluate. Therefore, we limited our analyses to the utilization and charges occurring within the system.

Statistical Analysis

Regression analysis was used to model the number of visits and tests, as well as medical charges, as linear functions of the patients' sociodemographic characteristics, health status, level of depression, BMI, alcohol abuse, and smoking behavior. The sociodemographic characteristics were used as control variables in the models and were not removed, even if they did not attain statistical significance. All possible interactions between BMI, alcohol abuse, and smoking were examined, but none proved to be statistically significant at a 0.05 level. The final models were all additive after logarithmic transformation of the number of visits and tests and medical charges.

Results

A complete data set was available for 506 study patients. The mean and median BMIs for this group were 29.78 and 27.99, respectively (both in the "overweight" category). A total of 204 (40.32%) patients were "obese," with BMI scores of 30 or more. There were 343 (67.79%) smokers and 39 (7.71%) patients meeting MAST criteria for problem drinking participating in the study.

The study population was 37.94% male and 62.06% female. The ethnic distribution was 62.85% white and 37.15% non-white. The patients had a mean age of 41.74 years and mean education of 12.62 years. Mean self-reported physical and mental health status scores were 40.39 and 43.96, respectively. These values are slightly below the established national means, which are both 50 (standard deviation=10) as measured by the physical and mental components of the MOS SF-36. The mean BDI score for patients was 5.66.

Descriptive results of the dependent variables, utilization of medical services, and associated charges are shown in Table 1.

Regression equations were estimated to relate the logarithm of health resource utilization of patients (number of visits and tests) and medical charges for all categories to obesity, alcohol abuse, and smoking, controlling for self-reported health status, depression, age, education, income, and gender (Tables 2 and 3). The patient variables—health status, depression, age, and gender—were frequently found to be related to the dependent variables in the regression equations.

Table 2 displays regression equations in which obesity, alcohol abuse, and smoking predict the mean number of visits and tests. Obesity was significantly related to the utilization of primary care ($P=.0044$) and diagnostic services ($P=.0209$). Alcohol abuse predicted the number of visits to the emergency department ($P=.0428$), as well as the use of diagnostic services ($P=.0038$). Smoking was also significantly related to two of the dependent variables of health care utilization: number of visits to specialty care clinics ($P=.0176$) and hospitalizations ($P=.0186$).

Table 3 shows the relation of obesity, alcohol abuse, and smoking to the medical charges related to health care resource utilization. Obesity was related to charges for primary care visits ($P=.0262$). Smoking was significant as a predictor of emergency department ($P=.0358$), hospitalization ($P=.0005$), and total charges ($P=.0179$). Approximately 17% of the variation in total medical charges during the study period was explained by physical health status ($P<.0001$), mental health status, depression, age ($P<.0001$), education, income, female gender ($P=.0122$), obesity, alcohol abuse, and smoking ($P=.0179$). Because the dependent variable is expressed in logs, exponentiation of the estimated coefficient for any of the indicator variables provides the percentage by which average total charges for those

Table 1

Descriptive Statistics for Resource Use and Charges*

| | Mean (SD) | Mean (Range) |
|-------------------------------------|----------------------|-------------------------|
| Health care service | | |
| Primary care clinic visits | 3.65 (3.17) | 3.00 (1–24.0) |
| Specialty care clinic visits | 2.59 (4.31) | 1.00 (0–26.0) |
| Emergency department visits | .29 (0.83) | 0.00 (0–8.0) |
| Hospitalizations | .18 (0.61) | 0.00 (0–6.0) |
| Diagnostic services | 8.95 (10.92) | 6.00 (0–90.0) |
| Type of charges (in dollars) | | |
| Primary care | 329.03 (290.82) | 250.25 (0–2,017.00) |
| Specialty care | 487.88 (1,361.90) | 49.75 (0–16,528.10) |
| Emergency department | 404.72 (1,488.79) | 0.00 (0–18,782.50) |
| Hospitalizations | 3,974.33 (17,912.80) | 0.00 (0–194,958.50) |
| Diagnostic services | 1,152.02 (1,920.21) | 456.75 (0–23,190.50) |
| Total charges | 6,347.58 (19,793.74) | 1,127.50 (0–203,234.50) |

* n = 506

Table 2

Standardized Estimates From Regression Equations in Which the Mean Numbers of Visits and Tests Are Explained by Obesity, Alcohol Abuse, and Smoking, Controlling for Physical and Mental Health, Depression, Age, Education, Income, and Gender (n=506)

| <i>Dependent Variable*</i> | <i>Independent Variables**</i> | <i>Standardized Estimate</i> | <i>P Value</i> | <i>R²</i> |
|----------------------------|--------------------------------|------------------------------|----------------|----------------------|
| Primary care clinic | Physical health status | -.0875 | .0589 | .1344 |
| | Mental health status | -.0181 | .7537 | |
| | Depression | .1160 | .0526 | |
| | Age | .2515 | <.0001 | |
| | Education | .0511 | .2507 | |
| | Income | -.0680 | .1360 | |
| | Female gender | .1079 | .0161 | |
| | BMI | .1215 | .0044 | |
| | Alcohol abuse | .0430 | .3202 | |
| | Smoking | -.0128 | .7700 | |
| Specialty care clinic | Physical health status | -.1231 | .0099 | .0820 |
| | Mental health status | .1238 | .0373 | |
| | Depression | .1088 | .0774 | |
| | Age | .1646 | .0003 | |
| | Education | -.0284 | .5358 | |
| | Income | .0223 | .6352 | |
| | Female gender | .0982 | .0334 | |
| | BMI | .0611 | .1634 | |
| | Alcohol abuse | .0687 | .1229 | |
| | Smoking | .1073 | .0176 | |
| Emergency department | Physical health status | -.1558 | .0015 | .0364 |
| | Mental health status | -.0167 | .7834 | |
| | Depression | -.0110 | .8615 | |
| | Age | -.0338 | .4668 | |
| | Education | -.0404 | .3892 | |
| | Income | -.0177 | .7120 | |
| | Female gender | .0683 | .1480 | |
| | BMI | .0293 | .5129 | |
| | Alcohol abuse | .0925 | .0428 | |
| | Smoking | .0797 | .0848 | |
| Hospitalization | Physical health status | -.1248 | .0099 | .0582 |
| | Mental health status | .0340 | .5714 | |
| | Depression | .0509 | .4143 | |
| | Age | .1586 | .0006 | |
| | Education | -.0578 | .2133 | |
| | Income | .0015 | .9750 | |
| | Female gender | -.0161 | .7305 | |
| | BMI | .0267 | .5629 | |
| | Alcohol abuse | -.0473 | .2943 | |
| | Smoking | .1078 | .0186 | |
| Diagnostic services | Physical health status | -.1172 | .0112 | .1409 |
| | Mental health status | .0204 | .7218 | |
| | Depression | .0886 | .1372 | |
| | Age | .1941 | <.0001 | |
| | Education | -.0599 | .1772 | |
| | Income | .0175 | .7007 | |
| | Female gender | .1798 | <.0001 | |
| | BMI | .0980 | .0209 | |
| | Alcohol abuse | .1252 | .0038 | |
| | Smoking | .0735 | .0924 | |

* Logarithm of number of visits and tests.

** All independent variables are baseline measurements.

BMI—body mass index

Table 3

Standardized Estimates From Regression Equations in Which Medical Charges Are Explained by Obesity, Alcohol Abuse, and Smoking, Controlling for Physical and Mental Health, Depression, Age, Education, Income, and Gender (n = 506)

| <i>Dependent Variable*</i> | <i>Independent Variables**</i> | <i>Standardized Estimate</i> | <i>P Value</i> | <i>R²</i> |
|----------------------------|--------------------------------|------------------------------|----------------|----------------------|
| Primary care clinic | Physical health status | -.1194 | .0106 | .1221 |
| | Mental health status | -.0504 | .3854 | |
| | Depression | .0345 | .5665 | |
| | Age | .2337 | <.0001 | |
| | Education | .0602 | .1798 | |
| | Income | -.0590 | .1988 | |
| | Female gender | .1393 | .0021 | |
| | BMI | .0954 | .0262 | |
| | Alcohol abuse | .7889 | .0703 | |
| | Smoking | -.0393 | .3735 | |
| Specialty care clinic | Physical health status | -.1265 | .0079 | .0877 |
| | Mental health status | .1501 | .0114 | |
| | Depression | .1257 | .0409 | |
| | Age | .1992 | <.0001 | |
| | Education | -.0156 | .7323 | |
| | Income | .0147 | .7529 | |
| | Female gender | .0993 | .0309 | |
| | BMI | .0451 | .3017 | |
| | Alcohol abuse | .0571 | .1986 | |
| | Smoking | .0572 | .2036 | |
| Emergency department | Physical health status | -.1544 | .0016 | .0453 |
| | Mental health status | -.0054 | .9295 | |
| | Depression | -.0226 | .7191 | |
| | Age | -.0445 | .3364 | |
| | Education | -.0547 | .2420 | |
| | Income | -.0378 | .4297 | |
| | Female gender | .0985 | .0364 | |
| | BMI | .0442 | .3220 | |
| | Alcohol abuse | .0393 | .3866 | |
| | Smoking | .0967 | .0358 | |
| Hospitalizations | Physical health status | -.1203 | .0127 | .0610 |
| | Mental health status | .4130 | .4912 | |
| | Depression | .0414 | .5057 | |
| | Age | .1390 | .0026 | |
| | Education | .0055 | .9064 | |
| | Income | -.0186 | .6945 | |
| | Female gender | .0025 | .9579 | |
| | BMI | .0684 | .1225 | |
| | Alcohol abuse | -.0327 | .4676 | |
| | Smoking | .1594 | .0005 | |
| Diagnostic services | Physical health status | -.1777 | .0001 | .1656 |
| | Mental health status | .0011 | .9841 | |
| | Depression | .0781 | .1834 | |
| | Age | .2612 | <.0001 | |
| | Education | -.0466 | .2864 | |
| | Income | -.0068 | .8796 | |
| | Female gender | .1316 | .0029 | |
| | BMI | .0397 | .3413 | |
| | Alcohol abuse | .0563 | .1851 | |
| | Smoking | .0757 | .0786 | |
| Total charges | Physical health status | -.2190 | <.0001 | .1697 |
| | Mental health status | .0512 | .3638 | |
| | Depression | .0829 | .1571 | |
| | Age | .2317 | <.0001 | |
| | Education | -.0245 | .5734 | |
| | Income | -.0265 | .5528 | |
| | Female gender | .1101 | .0122 | |
| | BMI | .0681 | .1022 | |
| | Alcohol abuse | .0426 | .3143 | |
| | Smoking | .1018 | .0179 | |

* Mean medical charges are in log-transformed dollars.

** All independent variables are baseline measurements.
BMI—body mass index

patients having that characteristic exceeds the average for those who do not. Thus, smokers had 10.15% higher charges for emergency department use, 17.28% higher hospitalization charges, and 10.72% higher total charges for utilization of health care services than nonsmokers. Table 4 provides a summary of the results displayed in Tables 2 and 3.

Discussion

As seen in earlier studies,²⁹⁻³¹ our regression equation results demonstrated the association of patient health status, depression, age, and gender with health care utilization. This highlights the rationale for controlling for these confounders in statistical analyses examining the relative effects of health risk behaviors in the use of medical resources. Using this approach, obesity, alcohol abuse, and smoking were all found to be significantly related to the use of health care services, even after health status, depression, and key sociodemographic variables were controlled.

Obese patients had significantly higher numbers of primary care visits and diagnostic services, as well as higher primary care clinic charges, over the study period. These patients may believe they are at increased risk for health problems that might be prevented or improved by more-frequent appointments with their primary care provider. In addition, physicians of obese patients, aware of the increased health risks related to obesity, might recommend more frequent visits and diagnostic testing. This differential utilization of medical services may take place in the absence of actual health status differences because it is motivated by perceived risk for health problems.¹⁵

Problem drinking predicted more-frequent emergency department visits, as well as greater numbers of diagnostic tests. These findings corroborate the work of other researchers who have found that heavy alcohol consumers are more likely to use acute medical services.^{21,22} The increased use of diagnostic testing for alcohol abusers may be coincidental to evaluation and treatment in the emergency department setting. It might also result from other medical encounters in which the physicians, cognizant of these patients' associated health risks and propensity for decreased medical care utilization, order more tests to monitor their patients who abuse alcohol.

Cigarette smoking was associated with greater numbers of specialty care clinic visits and hospitalizations. Smoking also significantly predicted subsequent medical charges. These findings support the work of others reporting that smoking imposes higher health care costs

Table 4

Summary of Obesity, Alcohol Abuse, and Smoking Significant Predictors of Health Care Utilization (Controlling for Physical and Mental Health Status, Depression, Age, Education, Income, and Gender)

| | <i>Obesity</i> | <i>Alcohol Abuse</i> | <i>Smoking</i> |
|---------------------------------------|-----------------|----------------------|-----------------|
| Number of primary care visits | <i>P</i> =.0044 | — | — |
| Number of specialty care visits | — | — | <i>P</i> =.0176 |
| Number of emergency department visits | — | <i>P</i> =.0428 | — |
| Number of hospitalizations | — | — | <i>P</i> =.0186 |
| Number of diagnostic services | <i>P</i> =.0209 | <i>P</i> =.0038 | — |
| Primary care clinic charges | <i>P</i> =.0262 | — | — |
| Specialty care clinic charges | — | — | — |
| Emergency department charges | — | — | <i>P</i> =.0358 |
| Hospitalization charges | — | — | <i>P</i> =.0005 |
| Diagnostic services charges | — | — | — |
| Total charges | — | — | <i>P</i> =.0179 |

on an annual basis, which can lead to greater costs over an individual lifetime.²³

The main objective of this study was to evaluate the relative effects of obesity, problem drinking, and smoking on the utilization of and associated charges for health care. Smoking appears to have the strongest association with increased costs (especially costs for emergency department visits and hospitalizations) than obesity or alcohol abuse. Smokers were found to have 10.72% higher total charges for their use of health care services than nonsmokers. In regression equations predicting total medical charges over 1 year, smoking was the only health risk behavior found to be a significant explanatory variable, in addition to diminished physical health status, increased age, and female gender.

Although few other studies have compared the relationship of health risk behaviors to direct medical care charges using empiric patient level data and appropriate statistical models, our results are consistent with those of Pronk et al, who found that over an 18-month period, current smokers had medical care charges 18% higher than "never smokers."²⁸ Similar to that study, however, we did not examine the indirect costs of smoking or its long-term effects on health and life expectancy.

Strengths of the study include the fact that BMI was calculated by actual patient weight and height measurements, rather than less-accurate self-reported information. Alcoholism was identified with the brief MAST, a standard screening tool. Patient health status

and depression were also evaluated with widely used instruments, allowing us to control for these important variables.

There were, however, a number of study limitations that should be noted. Our study was conducted at a university medical center with resident physicians. These physicians in training may have different practice patterns than more-experienced community physicians. Moreover, study participants may represent a different patient population than those cared for in the community. Self-reported physical health status scores for study patients were noted to be lower than the national mean. Finally, out-of-system utilization, based on patient memory, could not be quantified for inclusion in our analyses.

Conclusions

The economic burden of smoking is significant, even over the relatively short period of 1 year. Our study points out the association between smoking and total health care expenditures using individual patient data, while taking health status, depression, age, education, income, and gender into consideration. Only a portion of the variance in the utilization of health care services was explained by our models, and there is still a great deal we do not know about what influences visits and testing. Nevertheless, it would appear that physicians and health care organizations seeking to manage the costs of medical care should focus their attention on smoking prevention and cessation programs. Additional research on the long-term effects of smoking, in addition to obesity and alcohol abuse, is needed to further clarify the relationship of these three risk factors to the utilization and costs of health care resources.

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