The Relationship of Body Mass Index, Medical Costs, and Job Absenteeism

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Objectives: To assess the relationship between body mass index, as categorized by the recently released guidelines of the NHLBI, and health care costs and absenteeism in a sample of municipal workers. _Methods_: A cross-sectional study was employed that compared the obesity-related health care costs and absences of normal and overweight/obese city workers. _Results_: While accounting for age, gender, race, smoking behavior, and educational attainment, BMI predicted both average annual health-care costs and work absence hours. _Conclusions_: The NHLBI guidelines for overweight and obesity effectively predicted absences and health care costs.

***Key words*: obesity, medical expenses, absenteeism**

Am J Health Behav 2003;27(4):456-462

Health care expenditures and absenteeism are critical challenges for employers. Medical expenditures on American employees and dependents exceed $900 billion annually and are escalating.[1] Obesity plays a role in these important issues and is thought to cost Americans directly and indirectly an estimated $99.2 billion annually, and this cost is expected to rise. Direct and indirect absenteeism costs are believed to be as high as $25 billion per year.[2] Accordingly employers are attempting to identify factors affecting health care costs and absenteeism and to develop intervention strategies to minimize them.

Relationships between an individual's health risks and behaviors, quality of life, morbidity and mortality, and health care costs have been studied. It has been demonstrated that employees who have one health risk or who engage in one risky behavior also tend to have other health risks.[3] Further, workers with fewer health risks and employees who engage in health-promoting behaviors report fewer and less costly medical claims and fewer work-related absences.[4-8] Middle-aged individuals with low risk for cardiovascular disease have significantly reduced Medicare costs during their older ages.[9] Obesity is a commonly identified health risk, and it has been demonstrated to associate with increased morbidity and mortality and consequently with elevated health care expenditures.[10,11] It is estimated that obesity-related medical conditions are responsible for between 5 and 8% of total health care expenditures in the United States.[2,12] Burton et al[13] demonstrated a positive relationship between obesity and health care costs for bank employees. Employees "at risk" for incurring excess

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health care costs, as defined by "high" body mass indices, sustained an average excess in medical claims of $2326 per year as compared to employees whose body mass index (BMI) was considered to be "not at risk." BMI is a commonly used assessment of obesity, although it is not a direct measure of fatness, and it is calculated by dividing body mass, measured in kilograms, by the square of height in meters.[14]

The following 3 studies document a relationship of work absenteeism and obesity. Burton et al[13] found that employees at risk for obesity incurred twice as many sick days as the nonobese incurred, amounting to an average of $863 per employee in excess lost work time and lowered productivity per year. Narbro et al[15] estimated that in comparison to nonobese women, obese Swedish females took 1.5 to 1.9 times as many sick days over a one-year period as their nonobese counterparts did. Leigh[16] also determined that being overweight significantly predicted absenteeism in a large cross-section of employees across the United States. Recently the National Heart, Lung and Blood Institute (NHLBI) created revised guidelines to define weight "as underweight, normal, overweight or obese." The NHLBI based these categories on data demonstrating increased morbidity from hypertension, type 2 diabetes, stroke, gallbladder disease, osteoarthritis, sleep apnea, and several cancers, as well as increased mortality resulting from BMIs greater than 25. It is reasonable to hypothesize that those with BMIs greater than 25 would also have higher health care costs and be absent from work more frequently than would those with BMIs less than 25.[17] Such information would be of interest to those who employ and insure workers. The present study assesses the association of obesity, as measured by BMI, with selected health care costs that are potentially associated with obesity, and absenteeism while controlling for selected confounders. Gender,[13] smoking,[18] and age[19] were accounted for in these procedures because they have been shown to affect health care expenses. Educational attainment was also included in the models because those with higher education levels have been shown to be more apt to engage in healthy lifestyles[20] that affect health care costs. Ethnicity was also included in the regression models.

METHOD

Sample and Setting

The study sample was permanent employees of a city government in a large metropolitan area in the southwestern United States. The city has approximately 13,000 full-time employees and 2000 temporary workers. Roughly 70% of the employee population is male, and 53% are minority group members. Approval to conduct the study was obtained from the institutional review board of the university where the research originated, and informed consent was received from each participant. Participants were assured that data would remain confidential, and no risks were identified.

Instrumentation

Participants completed a paper-and-pencil questionnaire that included the following self-reported variables: age, height, weight, educational attainment, and smoking behavior. Information regarding ethnicity and gender were obtained from city databases. Educational attainment was dichotomized, separating college graduates from noncollege graduates. Health care expenditures and absences were gleaned from a city database. Employees had the option of enrolling in a PPO or an HMO. Because of an administrative decision, investigators were allowed to access only the health care costs of those choosing the HMO option. Hours of work absence and health care expenditures were averaged over the number of years that data were available for each participant. Because recruitment occurred in 3 phases, there is the possibility that participants were asked to complete the survey more than once. However, no one completed more than one survey.

A pilot test was administered to 50 volunteers with the purpose of detecting unclear directions, ambiguously worded questions, and potential problems in administering the questionnaire. Minor changes were made in the questionnaire as a result of the pilot testing. Data from pilot questionnaires were excluded from the larger study.

Data Collection

Data were collected via 3 distinct efforts. The first effort involved randomly mailing questionnaires and consent forms to 1300 employees at their work

Table 1
Sample Population Demographics in Comparison to City Employee Population

Variable	Study Sample	City Workforce
N	506	12,626
Gender		
Males (n=319)	60.9%	70.2%
Females (n=205)	39.1%	29.8%
Race		
Nonminority (n=290)	55.3%	46.9%
African American (n=160)	30.5%	33.3%
Hispanic American (n=58)	11.1%	17.2%
Asian Pacific Islander(n=11)	2.1%	1.5%
American Indian/Other (n=5)	1.0%	1.1%

addresses. During the second stage an additional 2000 questionnaires and consents were randomly mailed to employees. Finally, because of disappointing response rates, a researcher visited work sites and requested participation in person. Those agreeing to participate, regardless of recruitment method, completed the questionnaires and consent forms and subsequently returned them to the principal investigator (M.S.).

Participant names were supplied to a city benefits department employee, and that person retrieved health care expense and absenteeism information on participants from benefits and personnel databases for the years 1993 through 1998. Health care cost information included the number of claims, type of claim, diagnosis related to each claim, and fee charged per claim. However, only fees charged per claim and diagnosis information were used for this study. Costs known to associate with obesity were totaled and then averaged for each full year from which data were available on individual participants. The health care costs used in this study were those classified as neoplasms, metabolic and blood problems, mental disorders, and circulatory conditions, all of which have been demonstrated to associate with obesity.[21] Absenteeism was defined as the average number of hours a participant was absent from work each full calendar year that data were available.

Table 2
Characteristics of Participants by 3 BMI Categories

	<25 normal	BMI25-30 overweight	>30 obese
n	133	226	147
Age (s.d.)	41.4 (9.7)	43.6(9.3)	43.0(8.6)
Female (%)	57.1	27.1	62.6
Race White (%)	59.4	73.0	50.3
College Degree (%)	58.6	53.5	40.8
Current Smoker (%)	12.0	10.6	9.7

Data Analysis

Descriptive statistics were used to assess age, gender, ethnicity, educational attainment, health care costs, and absence hours. Participants were placed into one of 3 BMI classifications as identified by the NHLBI.[17] Those with BMIs less than 25 were considered to be "normal"; those with BMIs greater than 25 but less than 30 were classified as "overweight"; and those with BMIs greater than or equal to 30 were labeled "obese" regardless of age or gender. There were 2 underweight participants, with BMIs less than 18.5, whose data were included with the normal group for analysis purposes.

Because of the positive skew of health care expenditures, data were analyzed using logistic regression. The dichotomous dependent variables for logistic regression procedures separated those with highest 25% of health care costs from all other participants and the lowest 25% of absences from the remaining 75% of subjects. In this study the highest one quarter of health care expenditures were those with more than $340 in average annual health care costs, and the lowest one fourth of absences, with an average of 4 or fewer hours of absence per year. BMI was entered into the equations as an ordinal variable with 3 rankings: normal, over-

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Table 3
Mean Annual Health Care Costs and Average Annual Days Absent by BMI Rank

BMI	Health Care Costs ($) n	mean + std	(%<$340)	Absent (Hrs) n	mean + std	(%<4hr)
<25	68	$114 ± 276	91.4	121	27.21 ± 26.87	29.8
25-30	124	$573 ± 1251	72.0	207	30.35 ± 32.28	29.0
≥30	74	$620 ±1535	66.5	143	35.52 ± 31.30	16.1
Total	266			471		

weight, or obese. Analysis of variance and chi-square were used to assess selected group differences. Statistical significance was set at P<0.05 for all tests. The Statistical Package for the Social Sciences[22] was used for all analyses.

RESULTS

Sample

Participants were recruited for this study from the population of employees within the municipal workforce. Of the original 1300 potential participants, 127 consented to participate and returned completed questionnaires. Two hundred forty surveys with completed consent forms and usable questionnaires were garnered in the second effort, and the principal investigator recruited 208 more participants in the third stage of recruitment. Of the 3500 employees asked to participate in the study, 577 (16.4%) did so. Data from 71 of the returned surveys were excluded for the following reasons: lack of a signature on the consent (n=10), incomplete surveys (n=47), and temporary employment status (n=14).

Medical claim data on the correctly completed surveys were accessible on 269, and absenteeism information was available on 487 participants. Numbers vary slightly in some analyses because of the listwise deletion procedure employed by the statistical package. Selected demographic comparisons of the city's workforce and the sample are presented in Table 1. Approximately 61% of participants were male. Females and nonminority employees completed a slightly higher proportion of surveys than would be anticipated if the sample reflected the gender and ethnic compositions of the city's work force. The mean participant age was 42.8±9.2 years with a range of 19 to 68 years. The average BMI for the sample was 27.9±5.0. Normal-weight participants constituted 26.2 % (133/506) of the sample.

Analysis of variance identified no significant differences between those with health care cost information and those without, with regard to BMI ($F(1,504)=.013$, $P=.908$). Those with health care information were, however, found to be significantly older $F(1,504)=29.89$, $P<.001$, as they averaged 45.23±7.95 years old, and those without those data were 40.84±9.1 years of age. Chi-square analysis revealed no differences in gender, χ^2 (1,504)=3.1, P=.08, and educational attainments, χ^2 (1,N=242)=1.36, P=.242, but a higher proportion of those with health care cost information were of nonminority ethnicity, χ^2 (1,N=242)=17.3, p≤.001. Characteristics of the sample and selected differences by the 3 BMI categories are presented in Table 2.

Table 3 shows health care cost and absenteeism rates for employees by the 3 BMI categories. For the sample, the mean annual health care cost was $474±1204 with average for men of $466±1179 and for women of $490±1261. The average absence rate was 31.12±30.78 hours, with a range of 0 to 180 hours per year.

The lone significant predictor of health-care costs was BMI. As seen in Table 4, age, gender, race, educational attainment, and smoking all failed to predict obesity-related health care costs. The odds of an obese person's being assigned to the high health-care cost groups were 4.1 times greater than for those in the normal BMI group.

Results of the logistic regression predicting inclusion in the lowest 25 or upper 75% of absences are presented in Table 5.

Table 4
Prediction of Health Care Costs: Lowest 75% and Upper 25%

Variable	Odds Ratio	Odds Ratio 95% CI	P-value
BMI	1.90	(1.17, 3.07)	.009
Age	1.04	(.998, 1.08)	.060
Gender	0.75	(.370, 1.53)	.432
Education	1.80	(0.911, 3.54)	.091
Race	1.41	(.699, 2.83)	.399
Smoking	.567	(.175, 1.84)	.344

Table 5
Prediction of Absences: Lowest 25% and Upper 75%

Variable	Odds Ratio	Odds Ratio 95% CI	P-value
BMI	1.37	(1.068, 1.967)	.017
Age	1.03	(1.005, 1.057)	.018
Gender	0.61	(0.334, 0.882)	.014
Education	2.21	(1.498, 3.713)	<.001
Race	0.85	(.481, 1.184)	.220
Smoking	1.91	(736, 3.770)	.220

In this analysis BMI, age, gender, and BMI all significantly predicted assignment to the expected absence groups.

DISCUSSION

The current study provides evidence indicating that one's BMI classification predicts assignment to high health-care cost and high-absence groups. This result is important, as it is clear that obesity and overweight in the United States population is becoming more prevalent.[23] Current data suggest that the largest difference in average health care costs appear to occur between the normal and overweight groups, and a smaller increase is evident between the overweight and obese groups. This finding suggests that in order to decrease health care costs, efforts to transform the overweight and obese to normal weights should be taken. However, a longitudinal investigation has demonstrated that lost weight and lowered BMI, from a high-risk classification to a normal-risk level, did not produce reduction in all cause mortality.[24] Specific longitudinal investigations concerning health care costs and absenteeism will be necessary to determine whether changing one's BMI status produces positive changes. The reverse of our findings has been demonstrated, as it has been found that even small weight gains can produce unhealthy consequences, and recommendations for diet and exercise modifications are suggested.[19]

It is interesting to note that smoking status did not significantly predict absenteeism rates or health care costs. Others have shown estimated average lifetime medical costs for a smoker to exceed those of nonsmokers by over $6000.[18] However, a recent study found obesity to influence medical costs more than do smoking and alcohol consumption.[25] Education also failed to predict assignment to the high or low health-care expenditure groups. This finding is unanticipated as the Surgeon General's Report[25] concludes that those with higher education levels more frequently engage in protective health behaviors such as physical activity and dietary modifications. Those with high educational attainments also tend to more readily respond to appeals from health professionals to modify lifestyle-related behaviors such as smoking and weight control and are in general more health prevention oriented than the less educated.[26]

Gender did not predict health care costs as has been seen elsewhere.[13] This could be because only costs related to obesity were used in this study. Gender differences in absences were also expected, but did not materialize, as women tend to have more episodes of illness and physician contacts than men had. This relationship has been shown to persist, even after women have completed their reproductive years.[27]

Absence data indicate that BMI is predictive of being assigned to low or high absences groups. This finding is in agreement with others[13] and produces further evidence indicating that it is important for employers to assist employees with efforts to decrease above-normal BMIs.

Age and gender also were significant predictors of absence group. It was expected that age would influence absences, because as people age many diseases and illnesses occur with greater frequency

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and severity.[20] Although education plays only a part in determining one's socioeconomic status (SES), it is often related to the components of SES that include prestige, wealth, and power. It has long been known that because of the pervasiveness of SES in many aspects of life, and because it has a strong impact on morbidity,[18] absence rates can potentially be affected by education.

As with all investigations, the present study has certain limitations. Because of the poor response rates, the composition of the sample is concerning. However, the current data are similar to Centers for Disease Control (CDC) reports[28] in regard to BMI distribution, as the CDC, using NHANES data, reports that 27% of the US population is obese, which is similar to the 29% in the current sample. NHANES data estimate that 35% of the US population in 1999 was overweight whereas 44% of this study's participants were overweight, or about 9% above what might be expected if the study sample reflected the NHANES sample. However, it appears that the current sample may represent the Dallas, Tex, population in terms of BMI, as a lay publication utilizing government data sources, including the Behavioral Risk Factor Surveillance System to determine obesity, found Dallas residents to be the fifth most obese among people in America's 50 largest cities.[29] Additionally, body weight was assessed by self-report. Some researchers question the reliability and accuracy of self-report. However, others have concluded that self-reporting weight is a feasible method of data collection.[13]

The multiple efforts necessary to recruit participants is concerning. Because it is unknown if participants were recruited in the first, second, or third phase, no comparisons could be made between groups, as the sample could differ by recruitment method. The current sample also differs from the US population in terms of smoking rates, as about 10% of study participants smoked, a prevalence that is known to be lower than the overall rates in the city of Dallas, which are 24.2% for men and 14.5% for women.[30] Further, over 50% of respondents were college graduates, whereas census data on Dallas County, Tex, which has slightly different boundaries than the City of Dallas, indicates that 14% of adult residents, age 25 years and older, are college graduates.[31] Additionally, all cross-sectional studies are susceptible to validity threats.

Present data support the NHLBI classifications for obesity and overweight in that they predicted membership in a high health-care cost and high annual-absence group. Future research, using prospective study designs, will be needed before cause- and-effect inferences can be drawn regarding the relationship of BMI, health care costs, and absenteeism. ■

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