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Predictors of Obesity in Michigan Operating Engineers

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Abstract

Blue collar workers are at risk for obesity. Little is known about factors associated with obesity in Operating Engineers, a group of blue collar workers. Therefore, a cross-sectional survey was conducted to determine variables related to obesity among Operating Engineers (heavy equipment operators). Operating Engineers (N=498) were recruited during their three-day safety courses to participate in the study. Bivariate and multivariate analyses were conducted to determine differences in personal and behavioral factors between obese and non-obese participants. Approximately 45% of the Operating Engineers screened positive for obesity and another 40% were overweight. Multivariate analysis revealed that younger age, male sex, higher numbers of self-reported comorbidities, not smoking, and low physical activity levels were significantly associated with obesity among Operating Engineers. Operating Engineers are significantly at risk for obesity. Workplace interventions that have been successful in other studies should be implemented to address the obesity epidemic among Operating Engineers in Michigan.

Keywords

Obesity; Overweight; Blue Collar; Health Behaviors; Workplace

Introduction and Background

According to the Centers for Disease Control (Centers for Disease Control and Prevention, 2010), more than one-third of American adults are obese, defined as a body mass index (BMI) greater than or equal to 30 kg/m², with rates doubling between 1980 and 2008. The health consequences of obesity and overweight are significant and are associated with approximately 300,000 deaths annually in the nation (U.S. Department of Health and Human Services, 2001). Additionally, increased risk of cardiovascular disease, stroke, hypertension, type 2 diabetes, cancer, and respiratory disorders are associated with being overweight and obese. The costs of being overweight and obese are estimated to be \$147 billion in the year 2008 (Centers for Disease Control and Prevention, 2010). Medical expenses for obese employees are estimated to be 42% higher than for a person with a healthy weight (Centers for Disease Control and Prevention, 2010) with the cost of obesity among U.S. full-time employees estimated to be \$73.1 billion (Neovius, Johansson, Kark, & Neovius, 2009). Neovius et al (2009) found obesity to be related to higher rates of sick leave, thus influencing the health and productivity levels of workers. Another review found

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Disclosure

The authors declare that there is no conflict of interest.

obesity to be associated with work performance as well as health care costs and occupational diseases (Centers for Disease Control and Prevention, 2010; Schulte et al., 2007). Moreover, a review by Schulte et al. (2007) suggests that obesity may influence the relationship between workplace exposure to occupational contaminants, musculoskeletal disorders, and health outcomes.

Obesity has been linked to a variety of factors including many demographic factors; those who are male, middle-aged, non-white, and without a college education are also more likely to be obese (Li et al., 2009; Proper & Hildebrandt, 2010; Williams et al., 2007). Furthermore, type of occupational group appears to be responsible for variances in the BMI profiles (Proper & Hildebrandt, 2010). Communities that had a higher percentage of blue-collar workers tend to have larger numbers of obese people in a small-area estimation study in Massachusetts (Li et al., 2009).

Those who are overweight or obese are also more likely to have more medical comorbidities and those with medical comorbidities are more likely to have pain, which is also associated with obesity (Schulte et al., 2007; Wright et al., 2010). However, the relationship between pain and obesity was diminished after adjusting for depression suggesting that depression may contribute to the association between obesity and pain disorders (Wright et al., 2010). Depression, has been shown to be associated with obesity in many studies, and decreases in depression have been linked to weight reduction (Ali, Rasmussen, Monash, & Fuller, 2009; Beydoun & Wang, 2009; Elder et al., 2011; Leventhal et al., 2010; Onyike, Crum, Lee, Lyketsos, & Eaton, 2003).

Other health behaviors are also associated with obesity including cigarette use, alcohol intake, fruit intake, vegetable intake, fried food intake, physical activity and sleep. Research suggests that those who smoke have lower rates of obesity (Lahti-Koski, Pietinen, Heliovaara, & Vartiainen, 2002; Leventhal et al., 2010), although, cigarette smoking also moderates the association between major depression and obesity (Leventhal et al., 2010). Moderate alcohol intake (1–2 drinks per day) is also associated with lower rates of obesity (Arif & Rohrer, 2005; Lahti-Koski et al., 2002; Wannamethee & Shaper, 2003). However, the increased caloric intake associated with heavier alcohol intake may contribute to obesity (Arif & Rohrer, 2005; Lahti-Koski et al., 2002; Wannamethee & Shaper, 2003). Yet, severe alcoholism may be inversely related to obesity due to nutritional deficits associated with extreme alcohol intake (Lahti-Koski et al., 2002).

It is well known that frequent intake of fruits and vegetables (Beresford et al., 2007; Schroder, 2009; Williams et al., 2000) and low intake of fried foods is negatively associated with obesity (Schroder, 2009; Williams et al., 2000). Fruit consumption alone has been associated with weight loss and lower BMI in obese individuals (Schroder, 2009). Blue-collar workers are less likely to have recommended fruit and vegetable intake compared to white collar workers which puts them at higher risk for obesity (Beydoun & Wang, 2009). Furthermore, poor quality diets, which are common among blue collar workers are associated with reduced physical activity which is associated with increased BMI (Beydoun & Wang, 2009; Kaewthummanukul & Brown, 2006; Trost, Owen, Bauman, Sallis, & Brown, 2002). Leisure time physical activity in particular is associated with decreased BMI but unfortunately, blue-collar workers rank among the lowest in leisure time physical activity (Caban-Martinez et al., 2007; Lahti-Koski et al., 2002; Trost et al., 2002). Finally, reduced amounts of sleep are associated with obesity, possibly due to hormonal changes and metabolic disturbances (Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005; Vorona et al., 2005). Fatigue that results from lack of sleep may interfere with physical activity and more time awake may result in more food intake (Vorona, et al., 2005). However, an extra 20 minutes of sleep per night is associated with decreased BMI (Vorona

et al., 2005). In a recent randomized controlled trial that examined the effect of baseline sleeping patterns on weight loss results, sufficient sleep time significantly predicted weight loss success (Elder et al., 2011).

Overall, the causes of obesity are complex; social, economic, individual, and environmental factors contribute to the obesity epidemic (Centers for Disease Control and Prevention, 2010; U.S. Department of Health and Human Services, 2001). Furthermore, there is a disparity between the prevalence of obesity in blue collar workers compared to white collar workers and recent research suggests that occupational and sector specific strategies to prevent obesity are warranted (Proper & Hildebrandt, 2010). Little is known about one group of blue-collar workers, Operating Engineers (heavy equipment operators) and the factors that are associated with obesity in this population. This information will be useful to inform obesity interventions in this population. Hence, the purpose of this study was to determine variables that explain obesity among Operating Engineers.

Methods

Design, Sample and Procedure

A cross-sectional design was used to determine predictors of obesity among Operating Engineers. During the winter of 2008, a convenience sample from approximately 12,000 Operating Engineers was recruited during their 3-day safety training courses. Engineers were recruited until a quota of 500 participants was obtained. The instructors of the safety training courses explained the study to the participants, distributed the study packets, and collected completed surveys in sealed envelopes. Participants received a \$10 gasoline gift card for completing the survey. Almost all (90%) of the Operating Engineers who were asked to participate agreed and returned the survey. Two of the surveys returned were incomplete and dropped from the analysis, resulting in a final sample size of 498.

Measures

Dependent Variable

BMI was calculated by the investigator using self-reported weight and height. BMI, which is calculated by dividing body weight in kilograms by the square of height in meters, is an accepted measure for assessing excess body weight. A BMI greater than 25 and less than 30 was considered overweight and a BMI greater than 30 was considered to be obese.

Independent Variables

Standard questions on demographics were asked, including age, sex, race, marital status, and educational level that have been used in prior studies by the research team.

Depression and Medical Co-morbidities—Depression was measured using the Center for Epidemiologic Studies/Depressed Mood Scale (CES-D); a score of 16 or more is typically considered to be depressed (Radloff, 1977). Medical comorbidities were measured using a validated self-report instrument (Mukerji et al., 2007) and classified into none versus one or more for the multivariate analyses. Pain was measured by the pain scale of the well known SF-36 (Ware, 1993).

Tobacco and Alcohol Use—Tobacco use was measured by asking respondents whether they were current, never, or former smokers (or users of other tobacco products). Problem drinking was measured using the well known Alcohol Use Disorders Identification Test (AUDIT); a score of eight or more on the AUDIT indicates problem drinking (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993).

Fruit/Vegetable Intake and Physical Activity—Questions from the Willett Food Frequency Questionnaire, a validated questionnaire, were used to assess the number of servings of fruits, fried foods, and vegetables consumed by the participants (Willett et al., 1985). Physical activity during the previous year was assessed using a validated six-question measure that assessed time spent doing different types of activities and creates a total physical activity score based on the duration and intensity of the activities reported (Norman, Belloc, Bergstrom, & Wolk, 2001).

Sleep—Sleep was assessed using validated questions from the Medical Outcomes Survey (MOS); which measures sleep disturbances, sleep quality and sleep adequacy. Scores ranged from 0 to 100, with higher scores indicating better sleep quality. The population mean of adults visiting a medical clinic has been reported at 72 (Hays, Martin, Sesti & Spritzer, 2005).

Data Analysis

Bivariate analyses were conducted using t-tests and chi-square tests. Prior to constructing a final multivariate model, Pearson correlation coefficients were examined to determine multicollinearity among independent variables. Since fruit intake was highly correlated with vegetable intake ($r > .50$, $p = .000$), only vegetable intake was included in the final multivariate model.

Multivariate logistic regression analyses were conducted for the final model. Using the rule of 10 subjects per factor for regression analysis, there was sufficient power to include over 20 variables, since 224 of the 498 participants were obese. Values of $p < .05$ were considered to be significant. Analyses were performed with SPSS for Windows, version 17.0.

Results

Univariate Analysis Describing the Sample

The description of the demographic and health characteristics of this population can be found in Table 1. The mean age was 43 (range 18–70 years), most were male (92%), white (92%), married (68%), and had a high school education or less (61%). The majority of Operating Engineers surveyed were overweight (40%) or obese (45%). Several medical comorbidities were present in this population of Operating Engineers, including hypertension (26%), arthritis (19%), lung disease (8%), diabetes (7%), heart disease (6%) and cancer (5%). Almost 47% scored positive for depressive symptoms. About 42% were current tobacco users and 33% scored positive for problem drinking.

About 30% indicated they ate one fruit serving per week or less, 56% ate 2–7 servings of fruit per week, and only 14% ate two or more servings per day. About 17% indicated they ate one serving of vegetables per week or less, 66% ate 2 to 7 servings per week, and only 17% ate two or more servings per day. Only 8% ate deep fried foods daily or almost daily. The median physical activity score was about average at 41.8. The mean sleep score was 70.3 and the mean number of hours slept per night was 6.8. Over 40% were interested in both nutrition and exercise counseling.

Bivariate Analyses Showing Differences between Obese and Non-obese Participants

The results of t-test and chi-square analyses for differences between participants by obesity status revealed that sex, marital status, self-reported comorbidities, smoking, fried food intake, and physical activity were significantly associated with obesity. Those who were obese were more likely to be male ($p = .002$), married ($p = .023$), have one or more

comorbidities ($p = .000$), be non-smokers ($p = .049$), eat more fried foods ($p = .013$), and be less physically active ($p = .021$). There were no differences in age, race/ethnicity, educational level, pain, depression, alcohol problems, vegetable and fruit intake, and sleep quality between the obese and the non-obese.

Multivariate Analyses Showing Predictors of Obesity

Table 3 shows the logistic regression analyses of the personal, psychological, and behavioral predictors of obesity. Age, sex, self-reported comorbidities, smoking, and physical activity were significantly related to obesity among Operating Engineers. For every increase in five years of age, Operating Engineers were 14% less likely to be obese (OR = .86, 95% CI .76, .97, $p = .014$). Females had 74% decreased odds of being obese (OR = .26, 95% CI .08, .83, $p = .022$). Those who had one or more comorbidities had 2.16 times greater odds of being obese compared to those who did not self-report any comorbidities (OR = 2.16, 95% CI 1.37, 3.42, $p = .001$). Moreover, smokers were 44% less likely to be obese compared to non-smokers (OR = .56, 95% CI .35, .88, $p = .012$). Higher physical activity had a negative relationship to obesity; for every five point increase in physical activity, Operating Engineers were 23% less likely to be obese (OR = .77, 95% CI .63, .95, $p = .014$). While marital status and fried food intake differed between obese and non-obese participants in the bivariate analyses, these factors were not significant in the multivariate analysis, although fried food intake did remain marginally significant ($p < .08$).

Discussion

Obesity rates among Operating Engineers in this study are almost twice as high (45%) as population norms as 28.8% of adults in Michigan are obese (Trust for America's Health, 2009), and an additional 40% were overweight placing them at high risk for obesity-related comorbidities. Consistent with other studies (Ali et al., 2009; Schulte et al., 2007), Operating Engineers in this sample who reported comorbidities were more likely to be obese. However pain, often associated with comorbidities and obesity (Schulte et al., 2007; Wright et al., 2010), was not associated with obesity among Operating Engineers, perhaps because this was a relatively young population (mean age=43 years). Depression was not significantly associated with obesity in this sample. Depression has been shown to be associated with BMI more so among women, but less so among men (Beydoun & Wang, 2009), and this population was 92.3 percent male. Nonetheless, depression scores in both obese and non-obese participants were around 47%, while population norms for depression are approximately 21% (Radloff, 1977). Depression often impedes behavior change (Onyike et al., 2003) and treatment for depression among those that are obese may increase motivation for weight loss.

Contrary to the literature, the older Operating Engineers in this study were less likely to be obese (Li et al., 2009; Proper & Hildebrandt, 2010). The reason for this finding is unclear, but may be explained by older, obese workers leaving the work force early due to the physical demands of the job. While race and educational level predict obesity in many studies (Li et al., 2009; Proper & Hildebrandt, 2010), they did not predict obesity in this study. Race and educational level are often markers for socioeconomic status (SES) (Proper & Hildebrandt, 2010), however, the participants in this study were unlikely to vary much on SES as they were all in the same job classification. Also, there were few minorities in the study, so the study may have been underpowered to detect this difference. The literature shows that being married is associated with low levels of physical activity and that among male employees, those who performed strenuous leisure-time activity were likely to be unmarried (Kaewthummanukul & Brown, 2006). While marriage was significant in the bivariate analysis, it was no longer significant in multivariate analyses suggesting that factors other than marriage are stronger contributors to obesity in this population.

While eating fried foods marginally predicted obesity, unexpectedly, neither fruit nor vegetable intake was significantly associated with obesity, albeit the relationship of vegetable intake with obesity was in the expected direction, with those in the lowest category of vegetable intake being more obese. Among both obese and non-obese participants, fruit and vegetable intake were low, with over half eating less than five fruits per week, and just over one-third eating at least one vegetable per day. In Michigan, 78.7% of adults do not consume the recommended five servings a day of fruits and vegetables (Michigan Department of Community Health Bureau of Epidemiology Chronic Disease Section, 2008). Physical activity scores of 41.8 were similar to other populations of men aged 44–78 that scored 40.8 using the same instrument (Norman et al., 2001).

Similar to other studies (Lahti-Koski et al., 2002; Leventhal et al., 2010), smokers were less likely to be obese as smoking increases the metabolic rate, decreases metabolic efficiency, and decreases caloric absorption (Chiolero, Faeh, Paccaud, & Cornuz, 2008). Problem drinking rates were almost three times higher in both obese and non-obese Operating Engineers than population norms of 7 to 13%, depending on the measure used (Hasin, Stinson, Ogburn, & Grant, 2007), yet, problem drinking was not associated with obesity in either direction in this population. Nonetheless, curbing the high rates of problem drinking and the associated excess calories may be one of several strategies to reduce obesity among Operating Engineers

Practice Implications

The relationship between obesity and comorbidities, sedentary activity, and poor dietary habits among Operating Engineers puts this population at risk for prediabetes, type 2 diabetes, as well as cardiovascular disease. In Michigan, it is estimated that about 2 million adults have prediabetes, and only 18% are aware they have it (Michigan Department of Community Health, 2008). Moreover, Michigan has high rates of cardiovascular disease at 221 deaths per 100,000 compared to 191 per 100,000 nationally (The Henry J. Kaiser Family Foundation, 2010). These findings suggest the need for nutritional counseling and physical activity interventions among Operating Engineers.

While a recent review has found that worksite nutrition and physical activity interventions may be of modest benefit (Anderson et al., 2009; Verweij, Coffeng, van Mechelen, & Proper, 2011) other literature supports emphasis on behavioral interventions that combine healthy eating with a structured approach to increasing physical activity in the workplace setting. For example, in a recent work-based weight loss intervention that combined face to face counseling, tailored feedback and a web-based component, significant weight loss effects, decreases in blood pressure and increases in physical activity were obtained (Morgan et al., 2011). Worksite weight loss interventions have been shown to be feasible and successful with other blue collar groups and thus should be tested and implemented among Operating Engineer worker groups (Morgan et al., 2011).

Limitations

Since this was a cross-sectional design, the findings from this study cannot determine causation. The results were also based on the data from Operating Engineers solely in Michigan; therefore the results are not generalizable to Operating Engineers in other geographic areas. Self-reported measures of height and weight were used to calculate BMI, and may not be as accurate as direct measures of height and weight or measures of central obesity such as waist circumference.

Conclusion

The rates of obesity among Operating Engineers were twice as high as Michigan population norms, placing them at high risk for obesity-related morbidities and mortalities. Obese Operating Engineers were more likely to be older, male, non-smokers, have one or more comorbidities, eat more fried foods, and be less physically active. Fortunately, Operating Engineers are interested in nutrition and physical activity counseling. The workplace offers the potential to provide a structured environment to address the obesity epidemic among Operating Engineers in Michigan.

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Table 1

Baseline Demographics and Health Characteristics of Operating Engineers (N=498)

	Mean (SD)	Range
Age (N=476)	42.9 years (9.4)	18–70 years
BMI (N=478)	30.3 (5.8)	17.5–58.3
	N	Percentage
Sex (N=482)		
Male	445	92.3
Female	37	7.7
Race (N=472)		
White	436	92.4
African American	15	3.2
Other	21	4.4
Marital Status (N=485)		
Married	329	67.8
Separated/Widowed	80	16.5
Never Married	76	15.7
Educational Level (N=485)		
High School or Less	295	60.9
Less than 4 years of college	190	39.1
Weight (N=478)		
Obese (BMI ≥ 30)	213	44.6
Overweight (BMI 25–29.9)	192	40.2
Normal (BMI 18.5–24.9)	71	14.8
Underweight (BMI < 18.5)	2	0.4
Type of Comorbidity		
Cancer (n=477)	24	5.0
Lung (n=472)	39	8.3
Heart (n=476)	26	5.5
Hypertension (n=475)	122	25.7
Stroke (n=464)	8	1.7
Psychiatric (n=470)	32	6.8
Diabetes (n=470)	32	6.8
Arthritis (n=466)	87	18.7
Other (n=470)	28	6.0
Tobacco Use Status (N=487)		
Current Smoker (Population 22%)	206	42.3
Former Smoker	118	24.2
Never Smoker	163	33.5
Alcohol Problem (AUDIT ≥ 8 and drank in past 1 year, N=476)	156	32.8
(Population 10%)		
Significant Depressive Symptoms on CESD (N=470)	220	46.8

	Mean (SD)	Range
	Median	Range
Median Physical Activity Score (N=472) (Normal Population Median = 40.8)	41.8	29.1–61.5
	Mean (SD)	Range
Mean MOS SLEEP Score (N=487) (Population Mean for Medical Clinic = 72)	70.3 (17.4)	0–100
Mean Hours of Sleep per Night (N=484)	6.8 (1.3)	2–12
	N	Percentage
Servings of Fruit (not counting juices) (N=485)		
None to 2–4 per week	266	54.8
5–6 per week or more	219	45.2
Servings of Vegetables (not counting salad or potatoes) (N=485)		
None to 1 per week	55	17.5
2–4 per week	122	25.2
5–6 per week	90	18.6
1 per day or more	188	38.8
How often do you eat deep fried food? (N=485)		
None to 1 per week	270	55.7
2–4 per week or more	215	44.3
Interested in receiving health services for :		
Nutrition Counseling (N=433)	184	42.5
Exercise Counseling (N=424)	188	44.3

Table 2

Multivariate Logistic Regression Analyses (Odds Ratios) Showing Personal, Psychological, and Behavioral Predictors of Obesity Among Operating Engineers

	OR	95% CI	P-value
Age (in five year increments)	.862	.764 – .973	.016
Female	.263	.083 – .827	.022
White	1.653	.673 – 4.060	.273
Married	1.331	.818 – 2.164	.250
High school or less	1.195	.769 – 1.858	.428
SF-36 Pain	.997	.986 – 1.008	.589
Self-reported Medical Comorbidities	2.167	1.370 – 3.426	.001
Depression	.966	.604 – 1.543	.888
Smoking	.550	.349 – .868	.010
Alcohol Problem	.912	.566 – 1.471	.706
Vegetable intake			.382
0 – 1 per week	1.208	.593 – 2.461	.602
2 – 4 per week	.729	.401 – 1.324	.299
5 – 6 per week	.743	.394 – 1.403	.360
1 per day or more (Ref.)	1	1	
Fruit intake			.574
0 – 2–4 per week	.867	.526 – 1.428	
5–6 per week or more	1	1	
Fried Food Intake			.076
0 – 2–4 per week	.678	.441 – 1.041	
5–6 per week or more	1	1	
Physical Activity (in 5 point increments)	.769	.624 – .947	.013

Significant p-values (p<0.05) delineated in bold