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Factors Associated With Health-Related Quality of Life Among Operating Engineers

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Abstract

Background: Because health-related quality of life among blue-collar workers has not been well studied, the purpose of this study was to determine factors associated with health-related quality of life among Operating Engineers.

Methods: With cross-sectional data from a convenience sample of 498 Operating Engineers, personal and health behavioral factors associated with health-related quality of life were examined.

Results: Multivariate linear regression analysis revealed that personal factors (older age, being married, more medical comorbidities, and depression) and behavioral factors (smoking, low fruit and vegetable intake, low physical activity, high body mass index, and low sleep quality) were associated with poor health-related quality of life.

Conclusions: Operating Engineers are at risk for poor health-related quality of life. Underlying medical comorbidities and depression should be well managed. Worksite wellness programs addressing poor health behaviors may be beneficial.

Health-related quality of life is a measure of perceived health, based on multidimensional constructs including physical, mental, and social domains.¹ Among working populations, health-related quality of life has predicted absenteeism (employees are absent from the job), presenteeism (employees are at the job but impaired due to a health problem), work ability and productivity, morbidity, and subsequent mortality.^{2,3} Because health-related quality of life measures what patients experienced as a result of their medical care, it has been widely

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used as an outcome in health care studies, such as clinical trials and research about effectiveness and quality of care.⁴ A number of demographic and health behavioral factors related to health-related quality of life have been studied. Those who are young, male, non-Hispanic, married, and of higher educational levels have been shown to have better quality of life.^{3,5} Medical comorbidities, including various cancers, cardiovascular diseases, and depression, have been found to have detrimental effects on health-related quality of life even when controlling for demographic variables and health behaviors, such as smoking and drinking alcohol.^{6,7} Among health behavioral factors, smoking,^{6,8–10} alcohol problems,¹¹ unhealthy diet (a low intake of fruit and vegetables and a high intake of fried foods),¹² physical inactivity,^{13,14} a high body mass index (BMI),^{15–17} and poor sleep quality^{18,19} have been shown to be associated with poor health-related quality of life.

Although health-related quality of life varies depending on occupational groups,^{20,21} most of the previous studies did not differentiate health-related quality of life between white-collar workers and blue-collar workers. Furthermore, few studies focused on blue-collar workers. Blue-collar workers were less likely to eat a healthy diet or have the recommended fruit and vegetable consumption than white-collar workers,²² and ranked among the lowest in leisure time physical activity level.²³ Hence, the purpose of this study was to determine the factors associated with health-related quality of life among one group of blue-collar workers, namely Operating Engineers (heavy equipment operators), using the Health Promotion Model as a theoretical framework. The Health Promotion Model asserts that health behaviors, particularly when integrated into a healthy lifestyle, result in improved health, enhanced functional ability, and better quality of life.²⁴ On the basis of the Health Promotion Model, personal factors (age, sex, race, marital status, educational level, medical comorbidities, and depression) and behavioral factors (smoking, problem drinking, diet, physical activity, BMI, and sleep quality) were hypothesized to be associated with health-related quality of life.

METHODS

Design

This study is a cross-sectional correlational design. The dependent variable was health-related quality of life. Potential variables associated with health-related quality of life included personal factors, including biological, sociocultural, and psychological factors, and behavioral factors. Institutional Review Board approval was received from the University of Michigan. Because the survey was anonymous, informed consent, which would have identified participants, was not required.

Setting and Sample

The setting was Operating Engineers Local 324 Training Center, which services 16,000 workers from the entire state of Michigan. A convenience sample (N=500) was recruited from those that came to either a 3-year apprentice certification course or an 8-hour Hazardous Materials (HAZMAT) refresher course provided during the winter of 2008. Two respondents were dropped from the analysis due to incomplete data, leaving a final sample size of 498. The response rate was 90%.

Procedure

The study was explained to either the 3-year apprentice certification course or the 8-hour HAZMAT course attendees by the course instructor. The anonymous survey packets including a study information sheet, health survey, and return envelope was distributed. Once the attendees completed the survey, the instructor collected it in sealed envelopes. Each participant who completed the survey received a \$10 gasoline gift card. The sealed envelopes were then returned to the study team.

Measures

Dependent Variables—Health-related quality of life was measured by the Medical Outcomes Survey Short Form-36 (SF-36).²⁵ The 36-item questionnaire contains eight subscales of health status: physical functioning, role limitations resulting from physical (role physical)/emotional (role emotional) health problems, bodily pain, general health perception, vitality, social functioning, and mental health index. These eight scales are aggregated to a physical component scale and a mental component score. The physical component scale is composed of four physical health scales (physical functioning, role physical, bodily pain, general health perception), whereas the mental component scale is composed of four mental health scales (vitality, social functioning, role emotional, mental health index).

Independent Variables

Personal Factors Related to Health-Related Quality of Life.: Demographic factors included age, sex, race, marital status, educational level, and job experience. Self-reported medical comorbidities were collected by survey (cancer, lung disease, heart disease, high blood pressure, stroke, psychiatric problems, diabetes, and arthritis).²⁶ These conditions were then totaled to calculate the number of medical comorbidities. Being depressed was assessed using 16 or higher scores of the Center for Epidemiologic Studies Depression Scale.²⁷

Health Behaviors Related to Health-Related Quality of Life.: Smoking status was determined by a self-report on the basis of a 30-day prolonged abstinence measure.²⁸ If participants currently smoked cigarettes or had quit within the last month, they were categorized as smokers. If participants had quit more than 1 month before taking the survey or had never used tobacco products, they were categorized as nonsmokers. Alcohol problems were measured using scores of 8 or higher on the Alcohol Use Disorder Identification Test.²⁹ Selected questions from the validated Willet food frequency questionnaire were used to assess the average number of servings they ate of fruit, fried foods, and vegetables.³⁰ Physical activity was measured as the score of the Physical Activity Questionnaire.³¹ Body mass index (weight in kilograms divided by the square of height in meters) was calculated on the basis of self-reported height (without shoes) and weight. Sleep was measured by the Medical Outcomes Study sleep scale.³²

Analyses

Descriptive statistics (means and frequencies) were computed for all variables; t tests were used to compare health-related quality of life scores among Operating Engineers to the general population norms. To determine the association of independent variables with the SF-36 among Operating Engineers, bivariate analyses were conducted using Pearson's correlations and Spearman rho correlations according to the level of variables and distributions.

In multivariate analyses, all the variables that showed significant relationships to the SF-36 in bivariate analyses were entered into 10 multiple linear regression models. Using the rule of 10 subjects for each independent variable,³³ 498 participants gave sufficient power to conduct multivariate analyses with 13 independent variables. Because depression and mental health are a similar concept, depression was eliminated from the five mental health regression models (vitality, social functioning, role emotional, mental health index, and mental component scale). The regression assumptions were examined for all 10 models: independence of residual errors, normally distributed errors, homoscedasticity, and linearity. When constructing regression models, multicollinearity among independent variables was examined by using tolerance and variance inflation factor. Having either tolerance less than 0.01 or variance inflation factor exceeding 10 was considered multicollinearity.³⁴ Values of $P < 0.05$ were considered to be significant. Analyses were performed with the SPSS for Windows (version 17.0; Chicago, IL).

RESULTS

Descriptions of the Sample

The sample ($N = 498$) has been described in detail in a prior paper.³⁵ In summary, the mean age was 43, and the majority of the participants were male (92.3%), white (92.4%), married (67.8%), and of high school or lesser degree (60.8%). Almost half (46.8%) screened positive for depressive symptoms, and 32.8% scored positive for problem drinking. Almost 29% smoked cigarettes or quit within 1 month at the time of the survey. The majority were overweight with BMI between 25.0 and 29.9 (40%) or obese with BMI equal to 30.0 or higher (45%). Physical activity (mean = 42.7) and sleep quality (mean = 70.3) were about average when compared to population norms of 40.8³¹ and 72,³² respectively.

Bivariate and Multivariate Analyses

When comparing scores from Operating Engineers to general population norms,²⁵ health-related quality of life in role physical ($t = 2.9$, $P = 0.004$), vitality ($t = 2.2$, $P = 0.025$), and role emotional ($t = 5.4$, $P = 0.000$) were higher among Operating Engineers, whereas bodily pain ($t = -4.2$, $P = 0.000$), general health perception ($t = -5.7$, $P = 0.000$), and social functioning ($t = -2.0$, $P = 0.044$) were lower.

In the bivariate analyses, increased age, being depressed, smoking, alcohol problems, and higher BMI were related to poorer health-related quality of life on at least one or more of the 10 scales of the SF-36 (eight scales plus two component scales), whereas being white, having higher vegetables and fruit intake, more physical activity, and higher sleep quality

were related to better health-related quality of life on at least one or more of the scales (Table 1). After reviewing the bivariate analyses, with 10 scales of the SF-36, 10 regression models were constructed. Ten regression models explained 20% to 44% of variance in health-related quality of life among Operating Engineers. Older age, being married, being depressed, more medical comorbidities, smoking, diet low in fruit, lower physical activity, and poor sleep quality were associated with poor health-related quality of life. Body mass index was significant and had an ambidirectional relationship with health-related quality of life (Table 2).

More specifically, older Operating Engineers had lower physical functioning ($\beta = -0.18$, $P = 0.000$), role physical ($\beta = -0.16$, $P = 0.003$), bodily pain ($\beta = -0.13$, $P = 0.011$), role emotional ($\beta = -0.12$, $P = 0.017$), and physical component scale ($\beta = -0.15$, $P = 0.003$) scores. Those who were married had lower bodily pain ($\beta = -0.12$, $P = 0.012$), general health perception ($\beta = -0.10$, $P = 0.029$), vitality ($\beta = -0.09$, $P = 0.046$), mental health index ($\beta = -0.09$, $P = 0.028$), and physical component scale ($\beta = -0.11$, $P = 0.034$) scores than those who were not married. Depression was tested with only five physical health scales and were related to poorer health-related quality of life in physical functioning ($\beta = -0.13$, $P = 0.012$), role physical ($\beta = -0.17$, $P = 0.002$), and bodily pain ($\beta = -0.11$, $P = 0.035$). As expected, the number of medical comorbidities was negatively associated with all health scales except for social functioning and role emotional (physical functioning, $\beta = -0.16$, $P = 0.003$; role physical, $\beta = -0.13$, $P = 0.014$; bodily pain, $\beta = -0.24$, $P = 0.000$; general health perception, $\beta = -0.29$, $P = 0.000$; vitality, $\beta = -0.22$, $P = 0.000$; mental health index, $\beta = -0.20$, $P = 0.000$; physical component scale, $\beta = -0.24$, $P = 0.000$; and mental component scale, $\beta = -0.13$, $P = 0.003$).

Smokers had lower scores in the physical functioning ($\beta = -0.11$, $P = 0.038$), general health ($\beta = -0.15$, $P = 0.001$), and physical component scale ($\beta = -0.14$, $P = 0.008$) than nonsmokers. Surprisingly, alcohol problems were not associated with any of the SF-36 scales in this study. Those who ate fruit zero to two to four times per week had lower scores on general health perception ($\beta = -0.11$, $P = 0.022$), vitality ($\beta = -0.12$, $P = 0.008$), role emotional ($\beta = -0.12$, $P = 0.021$), mental health index ($\beta = -0.12$, $P = 0.005$), mental component scale ($\beta = -0.12$, $P = 0.007$) than those who had one per day or more. As expected, higher physical activity was related to higher scores on physical functioning ($\beta = 0.10$, $P = 0.040$). Body mass index, unexpectedly, had ambidirectional relationships with health-related quality of life. Body mass index had negative relationships with two physical health scales (physical functioning score, $\beta = -0.17$, $P = 0.001$; physical component score, $\beta = -0.17$, $P = 0.001$), and a positive relationship with mental component score ($\beta = -0.10$, $P = 0.019$). Sleep quality was the strongest factor related to health-related quality of life as better sleep was positively associated with all 10 scales of the SF-36.

DISCUSSION

Health-related quality of life in role physical, vitality, and role emotional were higher among Operating Engineers than the general population, whereas bodily pain, general health perception, and social functioning were lower. High levels of depression, smoking, and

problem drinking found in this group might play a significant role in poor health-related quality of life among Operating Engineers.

Among the personal factors, age, medical comorbidities, and depression were significant. As shown in many other studies,⁵⁸ age was associated with decreased health-related quality of life. However, unlike other studies,⁵ marriage was negatively associated with health-related quality of life. Because marriage is a marker for social support,³⁶ which has been shown to improve health-related quality of life, the inverse relationship between marriage and health-related quality of life in this study is perplexing. The unexpected finding may be related to other confounders (eg, financial stress may be more severe among those who are married with dependents than those who are not married) associated with quality of life, but not examined in this study. Thus, more research is needed to identify clear relationships between marriage and poor health-related quality of life among Operating Engineers.

Consistent with previous studies, the number of medical comorbidities was related to all of the physical health scales (physical functioning, role physical, bodily pain, general health perception), two mental health scales (vitality, mental health index), as well as both component scales (physical component scale and mental component scale) in the regression analyses. Similarly, depression, examined in only five physical health scales, showed negative associations with three physical health scales (physical functioning, role physical, bodily pain). Given that almost half of the Operating Engineers screened positive for depression, in addition to the negative impact of depression on health-related quality of life, depression interventions may be beneficial in this population.

Among the behavioral factors, smoking, diet, physical activity, BMI, and sleep quality were significant. As has been shown in other studies, smoking was associated with deteriorating physical health scales⁸ and smoking rates were high in this population (29%) compared with the general population (19%),³⁷ suggesting the need for worksite smoking interventions. Surprisingly, problem drinking was not associated with any of the health-related quality of life scales despite the fact that problem drinking rates in this population were about three times higher than population norms.^{38,39} Given the fact that treatment costs of problem drinking make up more than 1% of gross national product in both high-income and middle-income countries,⁴⁰ interventions for problem drinking may not only improve the long-term health-related quality of life, but also save money at the national level. Alcohol screening and brief interventions^{41,42} and community programs such as Alcoholics Anonymous⁴³ have been shown to be effective in improving alcohol outcomes.

Similar to other studies, higher fruit intake was associated with better health-related quality of life¹² and an alarmingly low percentage (14%) of Operating Engineers ate more than one serving of fruit per day, suggesting the need for interventions to address nutritional intake. Physical activity was positively related to a physical health scale (physical functioning), but not to the mental health scales, which supports the findings of previous studies.^{13,44,45} About 40% of the Operating Engineers were overweight and 45% were obese, suggesting the need for diet and physical activity interventions. Different than expected, BMI had ambidirectional relationships with the SF-36 scales as higher BMI was related to poor physical health scales (physical functioning and physical component scale), and also related

to better mental health, perhaps because some obese individuals adapted to mental health conditions despite limited physical health.¹⁷

Although the mean sleep scores were similar to population norms,³² poor sleep quality was the strongest factor in deteriorating health-related quality of life among Operating Engineers, with a stronger relationship with the mental health scales than physical health scales. This is in line with prior studies showing that poor sleep quality was associated with declining mental functioning.¹⁹ Given the negative impact of smoking,^{46,47} problem drinking,^{48,49} and depression⁵⁰ on sleep quality, the high prevalence of all three of these behaviors/disorders in this population is likely to influence sleep quality. Poor sleep is particularly problematic among this population as Operating Engineers drive heavy equipment all day and poor sleep may contribute to worksite accidents. Considering the negative effects of poor sleep quality on health-related quality of life as well as on society, such as high absenteeism, work accidents, and decreased productivity,^{51,52} interventions and treatments to improve sleep quality are needed.

Although most of the personal factors (eg, age and medical comorbidities) associated with health-related quality of life are unchangeable, interventions such as worksite wellness programs are likely to improve the health behavior factors associated with health-related quality of life. For example, Kelly⁵³ found that self-testing workplace stations, in which employees were able to self-test blood pressure and body weight, were useful in 13 workplaces with various sizes. Employees determined to be high risk after the initial visit were more likely to revisit and reduce the health risks, whereas the health risks of other employees who did not visit were not changed or increased. The self-testing workplace stations may encourage employees to modify their unhealthy behaviors; thus, if combined with other wellness programs (such as smoking cessation, diet, and physical activity interventions), the wellness programs may produce even better outcomes. Milani and Lavie⁵⁴ found that the worksite intervention, consisting of smoking cessation, fitness counseling, nutritional education, weight control, and treatment for drug and alcohol addiction, produced better health outcomes, resulting in more than half of high-risk workers being converted to a low-risk status, as well as enhanced health-related quality of life.

In addition to the health effects, changes in risky health behaviors resulted in increases in productivity (reduction in absenteeism and presenteeism).⁵⁵ As a result, interventions promoting worksite health are cost-effective by reducing total medical claim costs and improving productivity. A meta-analysis documented the cost-effectiveness of worksite wellness programs addressing weight loss, smoking cessation, and multiple risky health behaviors; worksite wellness programs reduced medical costs by about \$3.27 for every dollar spent on wellness programs and absenteeism costs by about \$2.73 for every dollar spent.⁵⁶ Thus, wellness programs can produce both health and cost benefits. Given the negative effects of engaging in any health risky behavior, such as high medical expenditures, high absenteeism and presenteeism, and productivity loss,^{57,58} worksite interventions to modify the risky health behaviors can not only increase the health of employees but also improve the bottom line for the company.

There are several limitations to this study. Because this study was designed to be cross-sectional, the findings cannot determine causal relationships. Rather than causal relationships, the significant factors should be interpreted as being associated with health-related quality of life among Operating Engineers. The results were also based on the data from Operating Engineers in Michigan; therefore, the findings may not be generalizable to Operating Engineers in other geographic areas. Health-related quality of life did not differ according to sex and educational levels because the sample was fairly homogeneous with most being white males of similar socioeconomic level. All of the survey data were based on self-report without clinical verification, which may bias the results, such as smoking, alcohol problems, and weight. The Willett food frequency questionnaire may result in recall bias and misclassification bias, albeit these biases are likely to attenuate the associations toward the null.⁵⁹

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TABLE 1.
Bivariate Relationship Between Personal Factors and Health Behaviors and SF-36 Health-Related Quality of Life Scales

	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Age ^a	-0.22 ^{**}	-0.17 ^{**}	-0.14 [*]	-0.03	-0.01	-0.00	-0.12 [*]	-0.03	-0.20 ^{**}	0.02
Sex (female) ^a	-0.01	0.03	0.02	-0.04	-0.07	-0.01	-0.06	-0.06	0.02	-0.07
Race (white) ^a	0.03	0.02	0.04	0.02	-0.03	0.02	0.09 [*]	0.07	0.00	0.05
Marital status (married) ^a	-0.08	-0.04	-0.06	-0.03	-0.02	0.00	-0.02	-0.01	-0.08	0.01
Education (high school or less) ^a	-0.04	-0.06	-0.02	-0.08	-0.01	-0.04	-0.07	-0.01	-0.06	-0.02
Number of medical comorbidity ^a	-0.23 [*]	-0.22 [*]	-0.33 ^{**}	-0.37 ^{**}	-0.33 ^{**}	-0.21 ^{**}	-0.18 ^{**}	-0.31 ^{**}	-0.32 ^{**}	-0.25 ^{**}
Depressed ^a	-0.13 ^{**}	-0.24 ^{**}	-0.24 ^{**}	-0.25 ^{**}						
Smoking ^a	-0.09	-0.03	-0.07	-0.15 ^{**}	-0.01	-0.01	-0.04	-0.05	-0.11 [*]	-0.01
Alcohol problems ^a	-0.03	-0.03	-0.10 [*]	-0.07	-0.07	-0.05	0.00	-0.08	-0.07	-0.05
Vegetable intake ^b	0.11 [*]	0.07	0.06	0.06	0.16 ^{**}	0.16 ^{**}	0.10 [*]	0.16 ^{**}	0.05	0.18 [*]
Fruit intake ^a	0.05	0.07	0.08	0.11 [*]	0.16 ^{**}	0.12 ^{**}	0.07	0.12 ^{**}	0.06	0.13 ^{**}
Physical activity ^a	0.15 ^{**}	0.14 [*]	0.05	0.10 [*]	0.03	0.02	0.08	0.03	0.15 ^{**}	0.00
BMI ^a	-0.21 ^{**}	-0.11 [*]	-0.10 [*]	-0.15 ^{**}	-0.06	-0.02	-0.03	-0.02	-0.22 ^{**}	0.03
Sleep quality ^a	0.20 ^{**}	0.29 ^{**}	0.38 ^{**}	0.44 ^{**}	0.53 ^{**}	0.42 ^{**}	0.38 ^{**}	0.58 ^{**}	0.24 ^{**}	0.56 ^{**}

BMI, body mass index; BP, bodily pain; GH, general health perception; MCS, mental component score; MH, mental health index; PCS, physical component score; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; SF-36, Medical Outcomes Survey Short Form-36; VT, vitality.

* $P < 0.05$

** $P < 0.001$.

^a Pearson's correlation coefficients.

^b Spearman correlation coefficients.

TABLE 2.
Multivariate Linear Regression Analyses Showing Predictive Values of Personal Factors and Health Behaviors and SF-36 Quality of Life Scales

	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Age	-0.183 ^{**}	-0.155 [*]	-0.126 [*]				-0.120 [*]		-0.152 [*]	
Marital status (married)			-0.122 [*]	-0.098 [*]	-0.086 [*]			-0.091 [*]	-0.105 [*]	
Depressed	-0.131 [*]	-0.165 [*]	-0.107 [*]							
Number of medical comorbidities	-0.157 [*]	-0.132 [*]	-0.238 ^{**}	-0.286 ^{**}	-0.215 ^{**}			-0.196 ^{**}	-0.242 ^{**}	-0.133 [*]
Smoking	-0.109 [*]			-0.151 ^{**}					-0.138 [*]	
Alcohol problems										
Vegetable intake										
None to 1 per week										
2-4 per week										
5-6 per week										
1 per day or more (Ref)										
Fruit intake										
None to 2-4 per week				-0.108 [*]	-0.119 [*]		-0.117 [*]	-0.122 [*]		-0.119 [*]
1 per day or more (Ref)				0	0		0	0		0
Physical activity	0.104 [*]									
BMI	-0.165 [*]								-0.166 [*]	0.103 [*]
Sleep quality	0.140 [*]	0.233 ^{**}	0.264 ^{**}	0.357 ^{**}	0.499 ^{**}	0.442 ^{**}	0.408 ^{**}	0.552 ^{**}	0.151 [*]	0.566 ^{**}
R ²	0.209	0.195	0.251	0.359	0.386	0.242	0.212	0.435	0.228	0.416

* P < 0.05

** P < 0.01.

BMI, body mass index; BP, bodily pain; GH, general health perception; MCS, mental component score; MH, mental health index; PCS, physical component score; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; SF-36, Medical Outcomes Survey Short Form-36; VT, vitality.