The Relationship Between Health Risks and Work Productivity

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We sought to provide evidence for the relationship between health risks and self-reported productivity, including health-related absence and impaired performance on the job. A cross-sectional analysis was implemented consisting of 2264 employees of a large national employer located in the Northeast. Participants responded to a health risk assessment and work productivity scale. Mean productivity loss was compared for individuals with different levels of risk factors using analysis of variance. Multivariate analyses, including logistic and linear regression, were used to determine the significance of health risks on productivity loss. Participants with more risk factors reported greater productivity loss ($P < 0.001$*). The odds of any productivity loss were most significant for individuals with diabetes (absenteeism) and stress (presenteeism). In conclusion, higher risks are strongly associated with greater productivity loss, and different risks are associated with absenteeism than with presenteeism.* (J Occup Environ Med. *2004;46: 737–745*)

The primary reasons U.S. employers provide health promotion and disease-prevention programs are to improve employee health, increase employee morale, and attenuate the rising costs of medical care.[1] Indeed, a substantial body of literature has established the relationship between health risks and medical care costs,[2,3] and a number of studies have provided evidence for a positive return on investment in health-promotion programs.[4] More recently, employers have begun to recognize and measure additional business value from healthy workers in terms of better productivity. This broader approach expands the value of employees' health—and the value of programs to improve health and reduce lifestyle risks to health—by quantifying their combined effect on medical costs, absences, work performance and turnover.[5]

Conceptually, a focus on productivity has great appeal. Studies of health conditions suggest that the average cost of illness from absenteeism can equal or exceed average cost for medical care. Yet, reductions in absenteeism reflect only one part of gains in workplace productivity.[6] Based on O'Donnell's conceptual model of human performance,[7] business can expect linkages between health, productivity and, ultimately, profits (Fig. 1). This model suggests that performance on the job is higher when employees are physically and emotionally able to work and have the desire to work. This leads to reduced absenteeism and presenteeism, which improves performance. Higher levels of performance lead to

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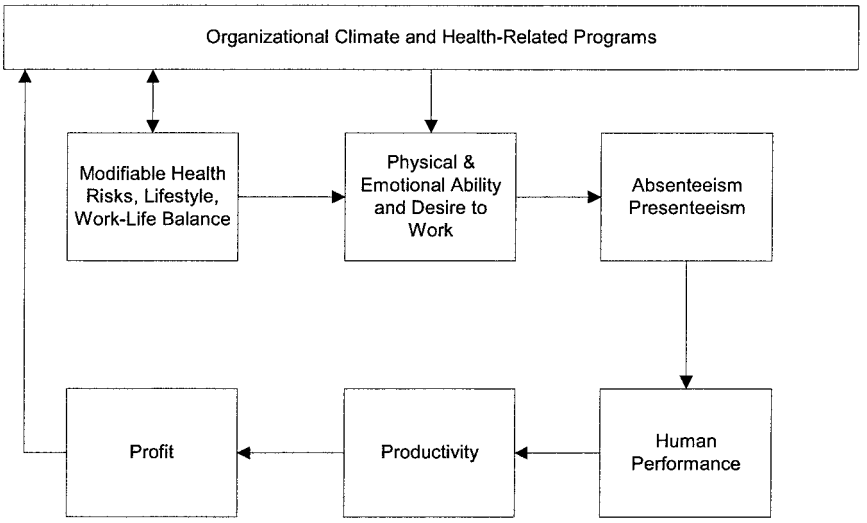

Fig. 1. Conceptual model of health and productivity.

higher levels of corporate productivity, which can in turn lead to higher profits. As Reidel et al[8] point out, positive worker health can lead to gains in improved quality of goods and services, greater creativity and innovation, enhanced resilience, and increased intellectual capacity.

One hypothesized influence on employee productivity is health risk status. Studies that have explored the relationship between the number and type of health risks or conditions and absenteeism have found stress, depression, and other mental health-related measures to be of significance.[8–11] High body mass index also has been shown to play a significant role in employee absenteeism.[8,12] Although relatively few studies have analyzed the relationship between health risks and presenteeism, one study found that a higher number of health risks corresponded to lower work performance.[12]

For worker productivity to become a more standard and routine outcome of health promotion programs, accepted measures of productivity must become more accessible. Objective measures, such as counting sick days, or productivity-measurement techniques, like piece rates or time and motion studies used in manufacturing environments, can be beneficial in determining statistical relationships with health risks and conditions, but they are difficult to obtain and not available uniformly across industries. Furthermore, productivity levels are dependent upon many factors, including market forces, seasonality, and corporate policies. Health is only one of these factors. Consequently, self-report measures are a promising way to gather data about employees' perceptions of how their health is influencing their ability to perform their jobs. Widely available information about the relationship between health and productivity will facilitate an expansion of the value of health promotion beyond focusing solely on health care costs. Such information can evolve if valid, reliable, brief self-report scales can become standard practice in health promotion evaluation.

In this study, self-reported measures of time missed from work because of health problems (absenteeism) and unproductive time while at work because of health problems (presenteeism) were obtained by including questions in a health risk assessment. An objective of the study was to measure associations between health risks and health-related absence and impaired performance on the job. Overall, several questions were of interest. First, which health risks are associated with absenteeism? Are they different than the health risks associated with presenteeism? Second, which health risks affect each productivity measure the most? Third, is having more health risks associated with more absenteeism or more presenteeism? Fourth, controlling for age, gender, and other factors known to impact productivity, does the relationship between health risks and productivity loss remain intact?

Methods

Sample

Data for this study were collected from 2264 employees who were members of corporate-sponsored fitness centers in seven locations throughout the United States plus all of the employees in one field site. Study participants were hourly and salaried employees who participated voluntarily and answered all questions on the health risk assessment and work productivity scale. This represents approximately 45% of the group eligible to participate (n = 5042). Participants were offered modest incentives to complete the health risk assessment. (Each participant who completed the health risk assessment was eligible to receive a stainless-steel mug. In addition, all names were entered in a random drawing to receive an additional incentive prize, such as a $100 gift check or gift basket of health and fitness-related items.)

Participants also had access to a variety of wellness programs and services offered through the company's employee benefits department. These offerings included online wellness programs and incentive campaigns; offline behavior change programs, such as workshops and nutritional counseling; ongoing communications on relevant health issues to promote employee health/wellness benefits; and a variety of fitness center services. Data were collected between February 2001 and September 2001.

Measurement

This study used an online health risk assessment tool (HRA) provided though WellMed, Inc. (now WebMD HealthCare Services Group) to collect self-reported health risk data. This HRA is a 20-question instrument that asks about chronic conditions, health status, demographics, biometric measures, and lifestyle (eg, smoking, exercise, diet). The questions were derived from a number of sources: Framingham Heart Study,[13] Carter Center Healthier People Health Risk Appraisal Version 4,[14] Stanford Heart Disease Risk Prevention Program,[15] and SF-36.[16] It uses proprietary algorithms and a weighting scheme to calculate a risk score that is indicative primarily of risk for coronary disease. The 11 health risks used in this study are poor diet, body mass index <18.5 or >24.9, high cholesterol, physical inactivity, excessive stress, overdue preventive visits, lack of emotional fulfillment, high blood pressure, tobacco use, diabetes or high blood glucose, and alcohol use. Table 1 provides definitions of what comprises a "high" risk in each risk area. Individuals were assigned a value "1" if the high-risk condition was met and "0" if the risk was absent.

Data on work productivity were obtained from the Work Productivity and Activity Impairment Questionnaire (General Health) (WPAI-GH) provided by Reilly Associates. The WPAI-GH is a public domain self-assessment tool that measures the percent of work time missed because of health problems, the percent of impairment while working because of health problems, the percent of overall work impairment because of health problems, and the percent of activity impairment because of health problems. The WPAI-GH has been assessed for construct validity and reproducibility,[17] but it has not been validated against other measures of productivity. The WPAI-GH contains six questions, five that are related specifically to workplace productivity. The recall time frame is the past seven days. The questions ask whether one is currently employed; the number of hours missed as a result of health problems; the number of hours missed because of other reasons (eg, vacation, holidays); the number of hours actually worked; how much health problems affect productivity while working; and how much health problems affect regular daily activities. The questions about how much health problems affect productivity and regular activities are rated on a 10-point scale from 0 (no effect on work) to 10 (health problems prevented the person from working). "Effect on productivity" was defined as any of the following: limited the amount of work the person could do, days the person accomplished less than he or she would like, or days the person could not do work as carefully as usual. For this study, absenteeism is defined as the percentage of time missed from work because of health problems. Presenteeism is defined as the percentage of time impaired while on the job (eg, decreased productivity and below-normal work quality).

All items were scored according to calculation rules specified by the developers of the instrument, and WPAI-GH outcomes were expressed as a continuous measure of percentages over the past week, with higher numbers indicating greater absence or impairment and less productivity. The percentage of time missed from work because of health problems was calculated as the number of hours missed because of health problems divided by the sum of the number of hours missed and the number of hours actually worked. The percentage of time impaired while on the job was calculated from the number chosen on the 10-point scale divided by 10.

TABLE 1
Risk Definitions

Risk Factor	Definition of High Risk*
Poor diet	Regularly eats fatty foods or regularly eats meals away from home; usually eats fewer than three servings of fruits and vegetables daily
Body mass index	<18.5 or >24.9
High cholesterol†	Told by a physician that cholesterol is high or total cholesterol value ≥ 240
Physical inactivity	No moderate or vigorous physical activity for at least 30 minutes four to five times per week
High stress	Sometimes or often feels stress and is not coping well
Overdue preventive visits	No preventive care visit in the past year for individuals older than age 50; no preventive care visit in the past year and has chronic condition regardless of age; no preventive care visit in the past 3 years for those younger than age 50
Lack of emotional fulfillment	Unhappy or uncertain about happiness in daily life
High blood pressure†	Told by a physician that blood pressure is high, taking blood pressure medication, or blood pressure $>$ 140/90 mm Hg
Tobacco use	Current or previous tobacco user
Diabetes or high blood sugar†	Diagnosed with either Type 1 or Type 2 diabetes, or fasting blood glucose level >110 or random blood glucose level >140
Alcohol use	Responds "yes" to one or more CAGE questions (tried to Cut down, gets Annoyed at others comments, feels Guilty, has Eye opener first thing in morning)

* Each risk factor is assigned a value of 1 if the definition is met; otherwise, it is assigned a value of 0.

† Self-reported lab values or clinical measures were given precedence over questionnaire responses if they were provided.

Analysis

The relationship between health risks and lost work productivity (absenteeism and presenteeism) was analyzed by addressing several key questions:

- How much productivity loss is experienced by individuals with health risks?
- Is having more total risks associated with more absenteeism or presenteeism?
- Do the relationships between health risks and lost productivity remain intact after controlling for age, gender, and other factors known to influence productivity?

The first question determined which health risks have a stronger relationship with lost productivity. This was analyzed with analysis of variance to compare mean productivity loss for individuals with each risk factor to individuals without each risk factor, while controlling for age, gender, high or low risk, and each of the other risk factors. A Bonferroni correction was calculated to adjust for cumulative type 1 error that results from multiple tests.[18] As more tests are conducted, the likelihood increases that one or more are significant due to chance (type 1 error).

A variable for total number of risks was constructed by counting risk factors, with possible values ranging from 0 to 11. A second variable for binary health risk (1 = "high," 0 = "low") was constructed by splitting the total health risk count at the median and classifying individuals as low risk (0 to 3 risks) or high risk (4 or more risks). In this study population, the distribution of total risks ranged from 0 to 9 with a median of 3.

For question 2, mean percentage of time missed from work (absenteeism) and time impaired while on the job (presenteeism) for each level of risk was calculated and graphed.

The main objective of the analysis for the third question was to estimate the relationships between risk status and productivity loss while controlling for confounding factors that may also influence productivity loss. Because many individuals reported no productivity loss during the prior week reference period, the data contain a large number of zero values. Of the 2264 individuals in the study, 2089 (92.3%) reported no absenteeism because of health problems in the previous 7 days, and 1669 (73.7%) reported no presenteeism because of health problems in the previous 7 days. To address the large number of zero values, we used a two-part model as described in Duan et al.[19] The first part of the model used multivariate logistic regression to estimate the relationships between health risks and the likelihood of incurring any productivity loss (recoded as 1 = any productivity loss and 0 = no productivity loss), controlling for confounding factors. The confounding factors included gender (1 = male, 2 = female); age group (1 = younger than 35, 2 = 35 to 44, 3 = 45 to 54, 4 = 55 and older); and binary total health risks (1 = high, 0 = low). Two logistic regression models were conducted, one with a 1,0 dependent variable for absenteeism and the other with a 1,0 dependent variable for presenteeism.

The second part of the model included an ordinary least squares (OLS) regression to show the relationship between health risks and productivity loss, again controlling for demographic and other risk factors for individuals who incurred any productivity loss. Two OLS regressions were conducted, one for absenteeism and another for presenteeism. Analyses were conducted with SPSS 11.5 (Chicago, IL). All statistics were evaluated at the 95% significance level ($P \leq 0.05$).

Results

The demographics and risk profile of the 2264 individuals in the study are shown in Table 2. Nearly three fourths were female and younger than the age of 45, which is similar to the demographic makeup of the company's general employee population, which is approximately 76% female. More than half of the study group reported poor diet and body mass index outside of the "healthy" range. Substantial proportions of the study group reported high cholesterol (47%), physical inactivity (45%), high stress (29%), and lack of emotional fulfillment (24%).

How Much Productivity Loss Is Experienced by Individuals With Health Risks?

Table 3 compares the mean percentage of lost productivity (absenteeism and presenteeism) for individuals with and without each risk factor, controlling for age, gender, high-low level of risk, and the other risk factors. For absenteeism, individuals with physical inactivity, high stress, and diabetes/high blood glucose had significantly greater time loss compared with individuals without these risks (at Bonferroni-corrected *P* values). The impact of health risks on presenteeism is more noticeable. Individuals with poor diet, "unhealthy" body mass index, physical inactivity, high stress, and lack of emotional fulfillment reported significantly higher impairment at work than individuals without these risks. Individuals with high stress and lack of emotional fulfillment reported the highest percentage of presenteeism compared with those without these risks, except alcohol users, which comprised only seven individuals. Individuals with high stress reported an average of 10% impairment compared with 5% reported by individuals without stress. Similarly, individuals with a lack of emotional fulfillment reported an average of 10% impairment compared with 5% reported by individuals without a lack of emotional fulfillment. Overall, the percentage of time lost to presenteeism was greater than time lost to absenteeism for each risk factor.

TABLE 2
Descriptive Statistics from the Study Sample (n = 2,264)

Measure	Count	Percent
Risk Category		
Poor diet	1,866	82.4
Body mass index <18.5 or >24.9	1,504	66.4
High cholesterol	1,065	47.0
Physical inactivity	1,010	44.6
High stress	662	29.2
Overdue preventive visits	668	29.5
Lack of emotional fulfillment	545	24.1
High blood pressure	367	16.2
Tobacco use	256	11.3
Diabetes/high blood sugar	67	3.0
Alcohol use	7	0.3
Age Group		
Younger than 35	838	37.0
35–44	805	35.6
45–54	471	20.8
55 and older	150	6.6
Gender		
Male	628	27.7
Female	1,636	72.3
Number of Health Risks		
0	45	2.0
1	200	8.8
2	419	18.5
3	510	22.5
4	451	19.9
5	336	14.8
6	182	8.0
7	97	4.3
8	22	1.0
9	2	0.1

Are More Total Risks Associated With More Lost Productivity?

There is a strong association between having more health risks and higher presenteeism. As shown in Fig. 2, the mean percentage of presenteeism rises for each level of cumulative health risks, ranging from 1.3% average presenteeism for individuals with zero risks to 25.9% presenteeism for individuals with eight risks. (There were an insufficient number of individuals with more than eight risks who also responded to the productivity survey to include in the analysis.) Absenteeism also increases as health risks accumulate, with a clear difference between low levels and high levels of risk, but the range is smaller (0.0% to 6.3%) and fluctuates among mid levels of risk.

Do the Relationships Between Health Risks and Lost Productivity Remain Intact After Controlling for Age, Gender, and Other Factors Known to Influence Productivity?

Table 4 shows that the odds of having any absenteeism as the result of health problems were significantly greater among employees with risks for physical inactivity and diabetes/high blood glucose ($P < 0.05$ in each case), controlling for other health risks and covariates. Among these risk factors, the likelihood for incurring any absenteeism was highest for diabetes (2.285, 95% CI = 1.167–4.474). None of the covariates was associated with higher odds of absenteeism. When the analysis was limited to employees who reported any absenteeism (n = 175), the model was not significant (P = 0.562).

Table 5 repeats the above analysis, but this time uses presenteeism because of health problems as the dependent variable. The odds of having any presenteeism were significantly greater among employees with poor diet, physical inactivity, high stress, and lack of emotional fulfillment ($P < 0.05$). Among these risk factors, the likelihood for incurring any productivity loss was highest for stress (2.085, 95% confidence interval 1.650–2.634), followed closely by lack of emotional fulfillment (1.928, 95% confidence interval 1.521–2.444). Among the covariates, females were significantly more likely to have any productivity loss.

When the analysis was limited to employees who reported any presenteeism (n = 595), presenteeism was significantly higher for high stress and lack of emotional fulfillment. Female gender and younger age were significant among the covariates.

Discussion

Data from this study indicate that employees report more time impaired at work than absence from work during any given workweek. Employees reported, on average, 1.8% absenteeism because of health reasons and 6.6% presenteeism because of health reasons. For the study group, the standard work week at the time of this study was 37.5 hours per week. This translates into an average of 41 minutes of absence and 2 hours and 29 minutes of lost performance per employee during the work week.

This study also showed that the number and type of health risks impact presenteeism differently than absenteeism. The data in Fig. 2 show a rather dramatic difference in presenteeism between low-risk individuals and high-risk individuals. Employees with the greatest number of risk factors reported being impaired while on the job more than a full workday (9.2 hours) compared with those with the fewest number of risks. Additionally, some health risks

TABLE 3
Mean Percentage Lost Productivity Comparison of Individuals With Risk Factor to Individuals Without Risk Factor (n = 2,264)*

Measure	% Absenteeism Because of Health			% Presenteeism Because of Health		
	With Risk Factor	Without Risk Factor	*P* Value	With Risk Factor	Without Risk Factor	*P* Value
Poor diet	1.88%	1.51%	0.163	6.95%	4.71%	0.010
Body mass index <18.5 or >24.9	1.99%	1.28%	0.107	7.05%	5.60%	0.047
High cholesterol	2.19%	1.37%	0.064	6.99%	6.17%	0.263
Physical inactivity	2.37%	1.26%	0.009	8.08%	5.34%	<0.001
High stress	2.47%	1.46%	0.033	10.23%	5.04%	<0.001
Overdue preventive visits	2.01%	1.65%	0.431	6.19%	6.71%	0.500
Lack of emotional fulfillment	2.19%	1.62%	0.236	10.21%	5.40%	<0.001
High blood pressure	1.92%	1.72%	0.718	7.76%	6.33%	0.117
Tobacco use	1.48%	1.79%	0.611	6.89%	6.52%	0.709
Diabetes/high blood sugar	4.24%	1.68%	0.023	9.25%	6.48%	0.137
Alcohol use	2.84%	1.75%	0.744	15.53%	6.53%	0.104

* Each mean adjusted for age, sex, high-low risk, and each of the other risk factors. Significance adjusted for multiple comparisons using the Bonferroni correction.

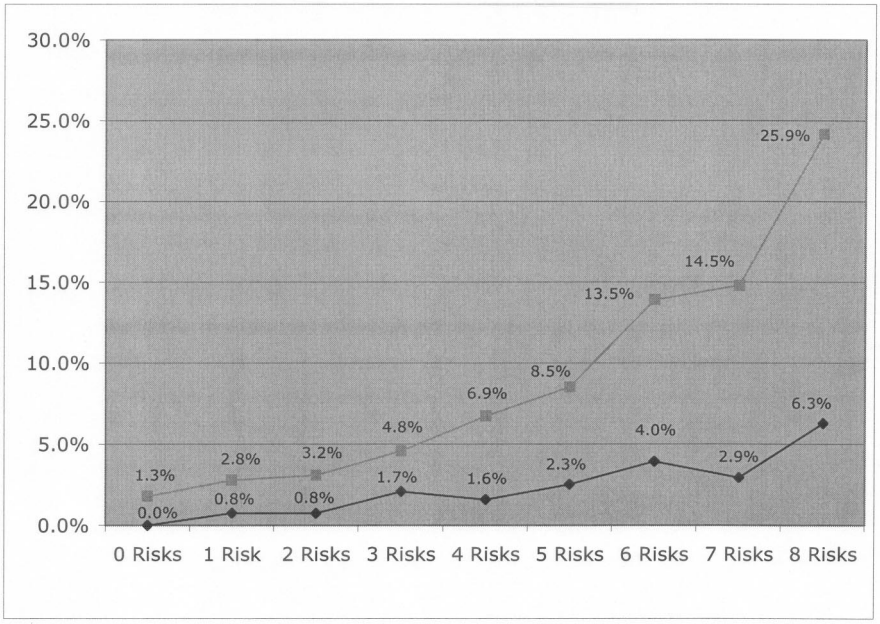

Fig. 2. Mean percentage lost productivity for each level of risk (n = 2264).

are associated more with presenteeism whereas others are associated more with absenteeism. The odds of reporting any presenteeism are highest for employees with high stress, a psychosocial health issue that has been implicated in other studies for its association with high health care costs and absenteeism.[1,2,11,20] For the smaller set of employees that reported some presenteeism, high stress and lack of emotional fulfillment are the only two significant risks after controlling for other risks and covariates. The odds of reporting any absenteeism are highest for those with diabetes/high blood glucose, a physical health condition requiring frequent medical care intervention for treatment of the disease and its complications. In addition, individuals with physical inactivity are significantly more likely to be both absent and impaired on the job compared with individuals without these problems.

This study did not provide direct support for the association between body mass index and absenteeism or presenteeism. However, these results do corroborate some findings in another study that analyzed two objective measures of absenteeism and one objective measure of presenteeism.[12] In that study, the individual risk factors of diabetes, unhealthy BMI and a measure they called General Distress, proved to be the most costly in terms of absenteeism and presenteeism.

The results of this study have implications for assessing the economic ramifications of unhealthy workers and evaluating the impact of health management interventions. The strong association between the number of risk factors and presenteeism warrants further investigation in other populations to investigate whether it is a causal relationship. If absenteeism and presenteeism can be changed with intervention, these outcomes may have value as standard elements in evaluation designs.

Although the results of this study support similar findings in other studies, some aspects make this contribution unique. First, most of the literature on health and productivity has used absence-related measures (eg, sick days, disability days, workers' compensation costs) as productivity out-

TABLE 4
Impact of Health Risks and Covariates on Odds of Having Any Absenteeism (Based on Logistic Regression Using the Whole Sample) and on % Absenteeism (Based on Least Squares Regression for Those Having Nonzero % Absenteeism)

	Relative Odds of Any Absenteeism 95% Confidence Interval and *P* Value from Logistic Regression (*n* = 2,264)			Coefficient, Standard Error, and *P* Value from Least Squares Regression of % Absenteeism (*n* = 175)		
	Odds Ratio	**(95% C.I.)**	***P* Value**	**Coefficient**	**(S.E.)**	***P* Value**
Risk variables						
Poor diet	1.781	(0.985–3.219)	0.056	0.291	(6.827)	0.966
Body mass index <18.5 or >24.9	1.259	(0.841–1.885)	0.263	5.180	(4.689)	0.271
High cholesterol	1.143	(0.786–1.661)	0.484	7.565	(4.388)	0.087
Physical inactivity	1.635	(1.139–2.348)	0.008	3.937	(4.412)	0.374
High stress	1.327	(0.912–1.931)	0.139	3.419	(4.243)	0.422
Overdue preventive visits	0.774	(0.524–1.143)	0.198	8.959	(4.479)	0.047
Lack of emotional fulfillment	1.230	(0.845–1.792)	0.280	4.191	(4.279)	0.329
High blood pressure	1.171	(0.767–1.789)	0.465	−1.542	(4.806)	0.749
Tobacco use	0.937	(0.577–1.522)	0.793	−3.328	(5.710)	0.561
Diabetes/high blood sugar	2.285	(1.167–4.474)	0.016	3.254	(7.286)	0.656
Alcohol use	3.994	(0.699–22.820)	0.119	−5.821	(17.637)	0.742
Control variables						
Gender				4.343	(4.967)	0.383
Male (referent category)						
Female	1.484	(0.987–2.231)	0.058			
Age group				−0.625	(2.093)	0.766
<35 (referent category)						
35 to 44	0.942	(0.655–1.355)	0.746			
45 to 54	0.749	(0.474–1.182)	0.214			
55+	0.664	(0.316–1.394)	0.279			
Total health risk				−13.260	(6.395)	0.040
Low (referent category)						
High	1.385	(0.799–2.401)	0.246			
−2 Log Likelihood chi-square or regression *F* statistic		1161.942			0.899	
P value for −2 log likelihood or regression *P* value		<0.001			0.562	
Nagelkerke *r* squared or adjusted *r* squared		0.073			−0.008	

comes. The use of presenteeism in this study adds support to the relatively few studies that have analyzed the impact of health on impaired performance at work. Second, although it is rather intuitive that employees with health problems are likely to be less productive than their healthier counterparts, the results of this study can assist with decisions about what types of health management programs to offer and to whom they should be targeted. Third, the potential productivity cost implications of health-risk related absence and presenteeism can be quite large. In this study, employees reported an average of about 3 hours and 10 minutes of total missed or impaired work time due to health reasons in a 1-week period. The respondents in this study population (2264) had an average hourly pay rate at the time of this study of $21.38, making the value of productivity loss $153,280 (more than $67 dollars per person).

Adding lost productive time to excess medical care costs provides a bigger economic target for employers considering health management interventions. This type of information could be useful to health promotion or occupational health professionals when justifying their program expenditures.

Limitations

Several limitations warrant attention when interpreting these findings. First, individuals in the study were members of a corporate-sponsored fitness center and responded voluntarily to a questionnaire. Although these findings represent the responses of several thousand participants, it is possible that the volunteers had a specific orientation toward health and work that is not generalizable to other workers in this–or another–work setting.

Second, although some self-report presenteeism scales have been validated against objective work outcome data, a direct conversion of WPAI-GH impairment scores to lost work is not yet available. Recent evidence about the WLQ (a different presenteeism scale) indicated that a 10% limitation at work due to health translated to a measured 4% to 5% reduction in work output.[21] Thus, a percentage point of how health problems affect productivity while working may not translate directly to a percentage of minutes. Consequently, conversion of time loss to

TABLE 5
Impact of Health Risks and Covariates on Odds of Having Any Presenteeism (Based on Logistic Regression Using the Whole Sample) and on % Presenteeism (Based on Least Squares Regression for Those Having Nonzero % Presenteeism)

	Relative Odds of Any Presenteeism 95% Confidence Interval and *P* Value from Logistic Regression (n = 2264)			Coefficient, Standard Error, and *P* Value from Least Squares Regression of % Presenteeism (n = 595)		
	Odds Ratio	**(95% C.I.)**	***P* Value**	**Coefficient**	**(S.E.)**	***P* Value**
Risk variables						
Poor diet	1.526	(1.119–2.080)	0.008	4.777	(2.737)	0.081
Body mass index <18.5 or >24.9	1.064	(0.839–1.350)	0.610	3.694	(2.037)	0.070
High cholesterol	1.095	(0.865–1.386)	0.453	1.702	(1.937)	0.380
Physical inactivity	1.641	(1.315–2.049)	<0.001	2.129	(1.902)	0.264
High stress	2.085	(1.650–2.634)	<0.001	4.469	(1.915)	0.020
Overdue preventive visits	1.034	(0.809–1.320)	0.791	−2.606	(1.994)	0.192
Lack of emotional fulfillment	1.928	(1.521–2.444)	<0.001	4.199	(1.878)	0.026
High blood pressure	1.275	(0.960–1.692)	0.093	2.134	(2.319)	0.358
Tobacco use	1.017	(0.743–1.393)	0.915	−0.829	(2.590)	0.749
Diabetes/high blood sugar	1.271	(0.724–2.230)	0.404	4.308	(4.369)	0.325
Alcohol use	3.743	(0.724–19.359)	0.115	0.901	(10.231)	0.930
Control variables						
Gender				5.194	(2.115)	0.014
Male (referent category)						
Female	1.430	(1.122–1.822)	0.004			
Age group				−2.823	(0.941)	0.003
<35 (referent category)						
35 to 44	0.884	(0.700–1.115)	0.296			
45 to 54	0.926	(0.703–1.219)	0.584			
55+	0.880	(0.574–1.350)	0.559			
Total health risk				1.420	(2.936)	0.629
Low (referent category)						
High	0.945	(0.668–1.336)	0.748			
−2 Log Likelihood chi-square or regression *F* statistic		2403.941			4.524	
P value for −2 log likelihood or regression *P* value		<0.001			<0.001	
Nagelkerke *r* squared or adjusted *r* squared		0.126			0.077	

dollars should be performed with caution.

Third, this scale of presenteeism is based on a single question, which may or may not be as sensitive to differences as other, longer scales. Although this result shows promising correlations with health risks, other scales should be tested as well. Fourth, the WPAI-GH asked about "health problems" and their impact on productivity rather than "health risks" and their impact on productivity. Although the psychometric properties of "health risks" and "health problems" were not tested, we assume that the two concepts behave similarly in an analysis of their relationship to productivity. Fifth, the OLS regression model for absenteeism was not significant, and we are not able to provide an interpretation of the results. A larger sample size would remedy the problem. Last, the purpose of these types of investigations is not to indicate the overall productivity level of workers. Instead, this study attempted to examine the component of work performance that workers perceive to be influenced by health factors.

Conclusions

This investigation suggests that employees who have more health risks will experience more absenteeism and presenteeism than employees with fewer risks. Some health risks have more influence on lost job performance than others. It is possible to estimate absenteeism and presenteeism because of health issues using a few questions added to an HRA. Such estimates may provide a valid basis for expanding the economic justification for health management programs.

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