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The Association of Health Risks With On-the-Job Productivity

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Learning Objectives

- Show the distribution of 12 designated health risk factors in this large population of employees, and take note of the most prevalent risk factors.
- Relate the presence and number of health risk factors to both self-reported limitation in four domains of work and overall scores on the Work Limitation Questionnaire (WLQ).
- Point out any associations between specific health risk factors and the number of risk factors on the one hand and, on the other, loss of productivity as estimated by WLQ scores.

Abstract

Objective: Decreased on-the-job productivity represents a large yet poorly characterized indirect cost to employers. We studied the impact of employee health risk factors on self-reported worker productivity (presenteeism). **Methods:** Using a brief version of the Work Limitation Questionnaire incorporated into a Health Risk Appraisal, 28,375 employees of a national company responded to the survey. The association between health risks and work limitation and each of the four domains was examined. Percentage of lost productivity also was estimated. **Results:** Ten of 12 health risk factors studied were significantly associated with self-reported work limitations. The strength of the associations varied between risks and the four domains of work limitation. Perception-related risk factors such as life dissatisfaction, job dissatisfaction, poor health, and stress showed the greatest association with presenteeism. As the number of self-reported health risk factors increased, so did the percentage of employees reporting work limitations. Each additional risk factor was associated with 2.4% excess productivity reduction. Medium and high-risk individuals were 6.2% and 12.2% less productive than low-risk individuals, respectively. The annual cost of lost productivity in this corporation was estimated at between \$99M and \$185M or between \$1392 and \$2592 per employee. **Conclusions:** Health risk factors represent additional causes of lost productivity. (J Occup Environ Med. 2005;47:769–777)

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Reduced on-the-job worker productivity, or presenteeism, represents a large indirect cost to employers. When examining the direct and indirect costs of poor employee health, one employer estimated that presenteeism comprises approximately 60% of the total cost whereas medical, pharmacy, absenteeism, and disability costs comprise the remaining 40%.¹ However, it is relatively difficult to assess the impact of presenteeism objectively, especially in complex knowledge-based work and service-industry jobs. A few researchers have reported the successful measurement of job productivity, and these include loom operators,² telephone customer service representatives,^{3,4} and insurance claim processors.⁵ The majority of studies have explored the relationship between self-reported measures of presenteeism and employer costs, primarily through the use of self-reported productivity measures.^{6–14} Several such questionnaires have been developed, including the Health and Performance Questionnaire (HPQ),^{9,15} the Work Limitations Questionnaire (WLQ),^{16,17} the Work Productivity and Activity Impairment questionnaire (WPAI),¹⁸ and the Stanford Presenteeism Scale.^{19,20} The focus of the studies is the impact of diseases such as migraine,²¹ seasonal allergies,^{4,22} and depression^{3,23–26} on worker productivity.

Because employee health risks and adverse health behaviors can lead to various diseases, examining the link between health risks and on-the-job productivity is an important step in assessing the total value of health.

Prior presenteeism and health risk research found that stress, diabetes, and being overweight were significantly associated with presenteeism.³ In that study, Burton et al³ were able to use an objective measure to evaluate telephone call center workers' productivity and to link health risk factors and disease states to direct and indirect measures of productivity. The vast majority of productivity loss associated with health risk was attributed to presenteeism, with smaller losses associated with scattered sick days and short-term disability absences. Furthermore, an important finding was that as the number of health risks increased, employees' productivity decreased.

One recent report examined the relationship between health risks and self-reported presenteeism and absenteeism. Boles et al⁶ used an on-line health assessment which included questions from the WPAI to assess worker productivity among 2264 employees of a large firm who were members of the corporation's fitness center. Although only 595 (26%) employees reported any limitation, the study found significant associations between several health risks and absenteeism as well as presenteeism. The authors listed several limitations of their study, including the assessment of presenteeism with a single question which may not be sensitive enough and the fact that the question has not been validated against other measures of productivity.

The purpose of the current study is to identify whether or not employees with more health risks self-report greater work limitation compared to employees with fewer health risks. In addition, the association between different health risk factors and the four WLQ domains of work limitation were explored. To accomplish this goal, a prospective study was designed that used the 8-question version of the WLQ, which is a validated presenteeism instrument.

Materials and Methods

The Worksite and Study Population

This study was conducted at one of the largest financial services companies in the United States. It is headquartered in the Midwest and has employees in more than 25 states. In the first quarter of 2004, this company employed approximately 72,000 people. About 70% of the employee population is female, with an average age of 38. Most employees do tasks such as accounting, receiving and sorting financial documents, telephone and in-person customer service, and other banking functions. The Medical Department of the company conducts periodic Health Risk Appraisal (HRA) mailings and provides educational feedback to HRA respondents. Starting in 2002, eight questions from the WLQ were incorporated into the HRA to assess employee's on-the-job work limitation.^{7,27} In July 2002, the HRA was sent to 73,456 employees; of these, 17,685 (24%) were returned. In February 2004, the HRA was sent to 71,362 employees. Of those, 20,494 (29%) were returned. As an incentive for completing the HRA in 2002, a Mayo Clinic self-care book (retail value \$16.95) was offered with the HRA mailing to employees. The incentive for the 2004 HRA was a pedometer (retail value \$12.95). As a result of participating in the HRA, employees were provided with an individualized report regarding their health risks and suggestions for health improvement.

To be included in the study, respondents had to provide demographic information, be between the ages 18 and 64, and have enough answers to provide calculated WLQ scores. As a result of these selection criteria, 6% of respondents were dropped from the study. Of the 28,375 employees who participated in either the 2002 or 2004 HRA and included in this study, 7026 (24.8%) participated in both HRAs. In the

case where individuals participated in both HRAs, their health risk and modified brief WLQ data were taken from the first HRA in which they participated.

Determining Health Risks

The HRA used was based on Healthier People, Version 4.0 (The Carter Center of Emory University, Atlanta GA, 1991) and enhanced in cooperation with the University of Michigan's Health Management Research Center (Ann Arbor, MI). Participants were asked about the presence of biological and lifestyle risks and various chronic diseases and health conditions.

The questions regarding health risks on the HRA concern lifestyle or behavioral factors (eg, cigarette smoking, use of alcohol, safety belt use), health or biological factors (eg, blood pressure, total and high-density lipoprotein cholesterol, height, and weight), and perceptual/psychological factors (eg, satisfaction with life or job, perception of health) that may predispose an individual to illness. Additional HRA questions inquired about the presence or absence of several chronic diseases. Biometric measurements, including blood pressure, height, weight, and total cholesterol, were all self-reported. A brief description of the criteria used to determine a respondent's health risk factors are listed in Table 1; a more detailed description of the criteria can be found in a previous study.²⁸

Assessing Work Limitations

The HRA included a modified version of the WLQ^{16,17} to assess health-related impacts on work performance. After testing with a focus group, 8 questions (2 from each work domain) which were most related to work in a financial industry were selected from the original 25 WLQ questions. Specific examples were given to clarify the question on employees' work related activities. These questions evaluated the percentage of time at work that an emo-

TABLE 1
Demographics and Health Risks of HRA Participants

	Total Participants (N = 28,375)		2002 Participants (N = 16,651)		New 2004 Participants (N = 11,724)	
	N	%	N	%	N	%
Demographics						
% Male**		26.9%		23.8%		31.2%
Average age (at time of HRA)		38.8 yr		38.9 yr		38.6 yr
Health risks						
Lifestyle						
Current smokers	2921	10.3	1693	10.2	1228	10.5
Physical activity (<1x/wk)*	8535	30.1	4867	29.2	3668	31.3
Safety belt usage (<90%)*	3109	11.0	1876	11.3	1233	10.5
Alcohol use (>14/wk)*	565	2.0	350	2.1	215	1.8
Use relaxation medication*	4462	15.7	2790	16.8	1672	14.3
Perception						
Life dissatisfaction*	8177	28.8	4677	28.1	3500	29.9
Poor physical health*	4719	16.6	2656	16.0	2063	17.6
Job dissatisfaction*	3723	13.1	2320	13.9	1403	12.0
High stress (score > 18)	9892	34.9	5826	35.0	4066	34.7
Biological						
High BP	5054	17.8	2975	17.9	2079	17.7
High Cholesterol	2284	8.1	1333	8.0	951	8.1
BMI ≥ 30*	7816	27.5	4492	27.0	3324	28.4
Number of Risks						
0 Risk	5780	20.4	3361	20.2	2419	20.6
1 Risk	6597	23.2	3890	23.4	2707	23.1
2 Risks	5570	19.6	3290	19.8	2280	19.4
3 Risks	4180	14.7	2491	15.0	1689	14.4
4 Risks	2779	9.8	1608	9.7	1171	10.0
5 Risks	1821	6.4	1070	6.4	751	6.4
6 Risks	1030	3.6	593	3.6	437	3.7
7 or more Risks	618	2.2	348	2.1	270	2.3
Average Number of Risks		2.16		2.15		2.17

*P < 0.01 comparing 2002 to 2004 participants, Logistic Regression adjusting for age and gender.

**P < 0.0001 comparing 2002 to 2004; χ^2 test.

tional or physical problem interfered with any of the following four work domains: time management (eg, work the required number of hours, start work on time); physical work activities (eg, repeat the same hand motions, use work equipment); mental/interpersonal activities (eg, concentration, teamwork); and output (eg, complete required amount of work, worked to capability). A list of the modified WLQ questions can be found in a previously published paper.²⁷ Employees were asked to base their responses on the previous 2 weeks of work and to rate any impairment on a 5-point scale with options of “none of the time (0%),” “some of the time,” “half of the time (50%),” “most of the time,” and “all of the time (100%).” Additionally the response option “does not apply

to my job” also was provided. The WLQ’s 2-week recall period has been shown to be a valid and reliable indicator of workplace limitations.¹⁷ Another report also states that the 2-week period is ideal compared with either a 4-week or 1-week recall period.²⁹

For each item, scores of 0, 1, 2, 3, and 4 were assigned to answers of “none of the time (0%),” “some of the time,” “half of the time (50%),” “most of the time,” and “all of the time (100%),” respectively. In this way, each score of 1 represents a 25% loss of self-reported productivity. The answer of “does not apply to my job” was considered a missing answer and as not having impairment for that item.

To calculate the score of each work domain, at least one of the two

items had to be nonmissing. The score was either the average of the two items if both items were answered or the score of the nonmissing answer. The overall average WLQ score was calculated by averaging the scores of four domains.

Scores from each work domain reflected the effects of different health risks. To estimate the productivity loss associated with specific health risks, the overall WLQ scores were used. The percentage of productivity loss was estimated directly by multiplying 25% and the difference of WLQ scores between individuals with and without the specific health risk.^{16,17}

Analysis

In our previous study,⁷ we showed a significant influence of the respon-

dents' age, gender, and certain self-reported medical conditions on their reporting in WLQ domains. The 2002 HRA was offered in July and the 2004 HRA was offered in February. Because the modified brief WLQ questions deal with the employee's last 2 weeks of work, a seasonal effect on work limitations was possible. Thus, the multiple logistic regression models used to study the relationship of health risks and each work domain as well as the overall work impairment included confounding factors such as age, gender, year of HRA taken, all other risks, and self-reported medical conditions. The medical conditions reported by participants on the HRA include: heart problems, diabetes, cancer, allergy, arthritis, asthma, back pain, depression, acid reflux, irritable bowel syndrome, and osteoporosis. Because WLQ scores consist of many zeros, data also were analyzed using the GENMOD procedure, with the negative binomial distribution option, controlling for age, gender, year of HRA, all other risks, and self-reported medical conditions. A regression model was constructed to analyze the significance of association between the number of risk factors (from 0 to 7 or more) and estimated percentage of excess productivity loss. All analyses were conducted using SAS 8.0 software (SAS Institute Inc., Cary, NC).

Results

Table 1 summarizes the demographics and health risks of the HRA participants in 2002, 2004, and for unduplicated participants in either year. For employees completing an HRA in both 2002 and 2004, the 2002 HRA was used in this study. Although a greater percentage of male employees participated in the HRA in 2004 than in 2002, 23.8% versus 31.2% respectively, the average age of participants was essentially the same, 38.9 years versus 38.6 years, respectively. The prevalence of a few individual risk factors was different between 2002 and

2004 participants while the average number of risk factors per employee was not significantly different (2.15 vs. 2.17). WLQ scores (not shown) for physical, mental, output domains, and the score of overall work limitation were not significantly different. Only the WLQ score for the time domain was significantly different ($P = 0.04$) for the 2002 and 2004 participants. The average age of the 28,375 respondents included in the study was 38.8 years and 73.1% were female, with an average of 2.16 health risks. More than half (63.2%) of all respondents fell into the low-risk category with zero to two risk factors. An additional 24.5% had three to four risk factors (medium risk), and 12.2% had five or more risk factors (high risk). The most prevalent health risks of this working population were high stress (35%), low physical activity (30%), life dissatisfaction (29%), and obesity ($BMI \geq 30$, 28%).

Figure 1 was constructed to illustrate the effect of health risk status on work limitations by showing the percent of the population reporting any work limitation in each of the four work domains and overall work limitation. Overall, 47% of employees reported some amount of work impairment. The figure shows that more employees reported work limitations in the mental and output domains, with relatively fewer re-

porting limitations in the time of physical domain. Employees in this industry report the least limitation in the physical domain. It also shows that for each of the work limitation domains, those individuals with a higher risk status have a higher percentage of people reporting work limitations.

Least-squares means of adjusted WLQ domain scores and the overall WLQ score, adjusting for age, gender, HRA participation year, all other health risks, and all reported medical conditions, were calculated using the GENMOD procedure for employees with and without each specific health risk. Table 2 displays the difference of adjusted WLQ scores by each individual health risk and work limitation domain. Except for heavy alcohol usage and high cholesterol, when compared with employees without the specific health risk, employees with all other health risks reported higher limitation scores in each work domain and in the overall work limitation score. Employees who reported using relaxation medication some of the time showed the highest score difference compared to employees who did not use or used rarely.

Adjusted WLQ scores are also shown by the number of health risks an individual reported (from zero to seven or greater). For each of the WLQ domains and the overall work

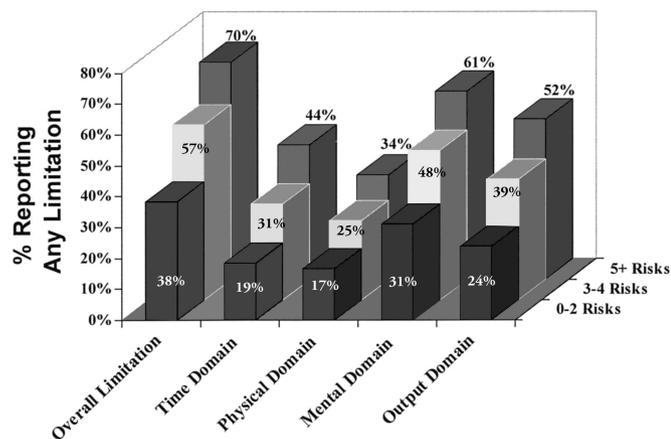


Fig. 1. Percentage of employees reporting any work limitation in four WLQ work domains and overall work performance for HRA participants with low, medium and high categories of health risk factors.

TABLE 2

Health Risks and Difference of Adjusted WLQ Scores for Employees With Health Risks Compared With Those Without the Specific Health Risk (*N* = 28,375 HRA Participants, Scores are Adjusted for Age, Gender, HRA Year, All Other Risks, and All Reported Diseases)

	Adjusted WLQ Score		WLQ Score	Difference of Adjusted Scores			
	With Risk	Without Risk		Work Limitation Domains			
				Time	Physical	Mental	Output
Health Risks							
Lifestyle							
Current smokers*	0.9450	0.8349	0.1101	0.1085	0.1208	0.0932	0.1337
Physical activity*	0.9271	0.8510	0.0761	0.0517	0.0911	0.0795	0.0861
Safety belt usage*	0.9562	0.8251	0.1310	0.1425	0.1484	0.1243	0.1315
Alcohol use	0.8516	0.9264	-0.0748	-0.0447	-0.0833	-0.0853	-0.0865
Use relaxation medication*	1.0718	0.7362	0.3356	0.3309	0.3338	0.3511	0.3395
Perception							
Life dissatisfaction*	0.9820	0.8035	0.1785	0.1788	0.0980	0.2104	0.2243
Poor physical health*	0.9275	0.8507	0.0768	0.0735	0.0681	0.0697	0.0861
Job dissatisfaction*	0.9492	0.8312	0.1180	0.1035	0.0483	0.1462	0.1335
High stress*	0.9738	0.8103	0.1635	0.1422	0.1473	0.1834	0.1910
Biological							
High BP*	0.9156	0.8617	0.0539	0.0342	0.0613	0.0552	0.0661
High cholesterol*	0.8167	0.9660	-0.1493	-0.1631	-0.1501	-0.1525	-0.1300
BMI ≥ 30.0*	0.9195	0.8580	0.0615	0.0744	0.0862	0.0385	0.0661
Number of Risks**							
0 Risks	0.4772		0.0000	0.0000	0.0000	0.0000	0.0000
1 Risk	0.5545		0.0773	0.0577	0.0728	0.0824	0.0953
2 Risks	0.6532		0.1760	0.1518	0.1577	0.1921	0.1939
3 Risks	0.7768		0.2996	0.2578	0.2607	0.3337	0.3379
4 Risks	0.8411		0.3638	0.3159	0.3188	0.3980	0.4062
5 Risks	0.9959		0.5187	0.4882	0.5005	0.5472	0.5444
6 Risks	1.0569		0.5796	0.5259	0.4517	0.6184	0.6899
7+ Risks	1.1337		0.6565	0.5879	0.5769	0.6775	0.7884

**P* < 0.05 comparing employees with and without that specific risk for WLQ score and for each WLQ domain, GENMOD procedure adjusting for age, gender, HRA year, all other risks, and all reported diseases.

***P* < 0.01 based on regression model of this trend of increasing WLQ scores with increasing risks, for WLQ score overall and each of the four domains.

limitation score was directly related to the number of risks. As the number of risk factors progressively increased from 0 to 7 or more there is a corresponding increase in the WLQ score. The trend of increasing work limitation for each additional health risk factor was found to be significant (*P* < 0.01) when tested with a regression model.

Table 3 shows an estimation of the productivity loss calculated from the impact on adjusted WLQ scores for the 12 risk factors. These estimates show that individuals at high risk for most individual risk factors (except alcohol and cholesterol) have excess productivity loss compared with those low-risk individuals. The estimated productivity decrement for the 10 risks ranged from 1.3% (high

blood pressure) to 8.4% (use relaxation medication). The risks most associated with lost productivity, compared with those do not have that particular risk, were use of relaxation medication, life dissatisfaction and high stress.

The same productivity loss estimation for employees with zero to seven and more risks is shown in Table 4. It shows that those individuals with zero risks have an estimated productivity loss of 11.9%. The third column shows the incremental loss (excess loss as compared with zero-risk employees) in productivity as risks increase. It was found that each additional risk factor was associated with a productivity loss of 2.4%. When comparing employees with different risk levels, the me-

dium-risk individuals (three to four health risks) report 6.2% excess productivity loss compared with low-risk individuals (zero to two health risks) and high-risk individuals (five or more health risks) report being 12.2% less productive than low-risk individuals.

Figure 2 shows a graphic representation of the estimated productivity loss attributable to excess health risks. The estimated excess lost productivity caused by excess risks shows 6.2% lost productivity for medium-risk individuals and 12.2% lost productivity for high-risk employees compared with the baseline of low-risk employees. It is calculated³² that the reported excess productivity loss of medium and high risk employees is 17% of the total self-reported pro-

TABLE 3

Health Risks and Estimated Excess Productivity Loss for Workers With a Health Risk Compared With Those Without the Specific Health Risk (WLQ Score Adjusted for Age, Gender, HRA Year, All Other Risks, and All Reported Diseases, and Four Domains Equally Weighted)

	Difference of Adjusted WLQ Scores	Estimated Excess Loss (%)
Health Risks		
Lifestyle		
Current smokers*	0.1101	2.8
Physical activity*	0.0761	1.9
Safety belt usage*	0.1310	3.3
Alcohol use	-0.0748	-1.9
Use relaxation medication*	0.3356	8.4
Perception		
Life dissatisfaction*	0.1785	4.5
Poor physical health*	0.0768	1.9
Job dissatisfaction*	0.1180	3.0
High stress*	0.1635	4.1
Biological		
High BP*	0.0539	1.3
High cholesterol*	-0.1493	-3.7
BMI \geq 30.0*	0.0615	1.5

* $P < 0.05$ comparing employees with and without that specific risk for WLQ score.

TABLE 4

Number of Health Risks and Estimated Excess Productivity Loss for Each Number and Category of Health Risk(s). (WLQ Score Adjusted for Age, Gender, HRA Year, and All Reported Diseases, and Four Domains Equally Weighted)

	Adjusted WLQ Scores	Estimated Productivity Loss (%)	Estimated Excess Loss (%)
Number of Risks*			
0 Risks	0.4772	11.9	0.0
1 Risk	0.5545	13.9	1.9
2 Risks	0.6532	16.3	4.4
3 Risks	0.7768	19.4	7.5
4 Risks	0.8411	21.0	9.1
5 Risks	0.9959	24.9	13.0
6 Risks	1.0569	26.4	14.5
7+ Risks	1.1337	28.3	16.4
Excess productivity loss per additional health risk			2.4
Risk Levels*			
0-2 Risks (low risk)	0.5888	14.7	0.0
3-4 Risks (medium risk)	0.8378	20.9	6.2
5+ Risks (high risk)	1.0787	27.0	12.2

* $P < 0.01$ based on regression model of this trend of increasing WLQ scores with increasing risks.

ductivity loss from 28,375 HRA participants in the study.

Discussion

This study used an easily administered, eight question brief version of the WLQ to measure limitations in the following four work performance

domains: time, physical, mental, and output. In this large population of HRA participants ($N = 28,375$), health risks were associated with self-reported presenteeism. Participants in the overall low-risk category (zero to two health risks) had the lowest WLQ score on each of the

four domains. As health risks increased to the medium-risk category (three to four health risks) and the high-risk category (five or more health risks), the WLQ score also progressively increased. Each additional risk factor was associated with a stepwise progression in the WLQ score on each of the four domains as well as the overall average limitation in productivity, even after controlling for medical conditions and a range of demographic factors.

The perception risk factors in particular (employee reporting of life dissatisfaction, poor physical health, job dissatisfaction and high stress) are significantly associated with presenteeism. For example, it is reasonable to anticipate workers who are not satisfied with their job would be less motivated to achieve optimal on-the-job productivity. Similarly, a worker who reports dissatisfaction with their life in general or one experiencing high stress will be less productive at work for jobs requiring communication, cognitive and interpersonal skills. Perceived poor physical health would be associated with work limitations especially for tasks requiring strength and manual dexterity.

Indeed, the perception health risks show some of the highest productivity loss estimates. The estimated work loss calculation shows that those who are dissatisfied with life report 4.5% lost productivity, those with high stress lose 4.1% of productivity, those dissatisfied with their job lose 3.0%, and those who report poor health lose 1.9% of their productivity. The vast majority of major employers offer Employee Assistance Programs (EAPs), which can educate employees on skills to decrease work/life stress. Masi and Jacobson³¹ reported that an employee assistance/work life program resulted in decreased stress levels, improved attendance and work performance, and improved relationships with supervisors and coworkers.

These findings suggest that the psychological or perception health risks often are associated with limi-

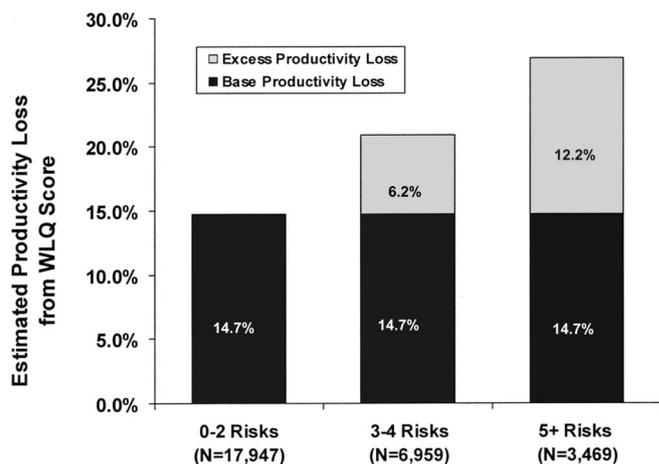


Fig. 2. Excess productivity loss associated with excess health risks as measured by the modified WLQ.

tations in workplace productivity. However, the bulk of research on the topic of presenteeism has thus far focused on lifestyle and biological health risks or diseases and chronic medical conditions.

Boles et al⁶ used the WPAI to assess limitations and also found high levels of presenteeism associated with the risk factors of “high stress” and “lack of emotional fulfillment.” In that case, employees with high stress reported 10.2% presenteeism (at work but not as productive) compared with 5.0% presenteeism among those who did not have high stress ($P < 0.001$). Similarly, those at risk for “lack of emotional fulfillment” reported higher presenteeism (10.2%) compared with those not at risk (5.4%, $P < 0.001$). Significant results also were found for the risk factors of poor diet, exercise, and body mass index but not cholesterol, overdue preventive visits, blood pressure, tobacco use, diabetes, or alcohol use. Their findings lend support to the notion that psychological variables are equally or even more related to presenteeism than the traditional biological and lifestyle risk factors.

In particular, the “use of relaxation medication” risk factor had a strong association with productivity loss in the current study. This risk factor has a reasonably high prevalence among the study population (15.7%). The

productivity loss estimates associated with use of relaxation medication were the highest of any risk factor: 8.4%. It is possible that employees use relaxation medication as a way to combat stress, which is a risk factor for 34.9% of the study population. Worksite health education programs that focus on stress coping mechanisms or techniques may be effective in helping employees deal with stress and therefore lessen the need for relaxation medication use. It is easy to see, however, how this risk factor might impact productivity. Depending on the type of relaxation medication used, employees may be sleepy or groggy while they are at work. This situation is not conducive to high levels of productivity.

Workers who smoke show 2.8% less productivity when compared with non-smokers. Likely explanations for these findings may be that such employees take more breaks than their peers to smoke during their workday or that smoking has resulted in poorer health in general. Physical health sequelae of smoking also might account for their higher loss of productivity than those without the risk. Using the Health and Work Questionnaire, Halpern et al³⁰ conducted a study on a moderate-sized sample ($N = 300$) of airline reservationists. The authors reported significant associations between smokers and increased absen-

teeism and presenteeism that were resolved after 4 years of quitting smoking. These former smokers’ work productivity actually approached that of the never smokers. Employers are well aware of the significant direct and indirect costs associated with cigarette smoking. The current study and the study by Halpern, but not the Boles et al study, provide evidence for the effect of smoking on presenteeism.

Physical inactivity was significantly associated with greater work limitation on each of the four WLQ domains, indicating effects of a lack of regular exercises are wide ranging and not limited to a single domain of functioning. The productivity loss estimated for physical inactivity is 1.9%. Several studies have shown that physical inactivity is related to absenteeism and other measures of missed work. In particular, Wright et al³² found that those workers who do not exercise regularly have a combined cost of time away from work of \$1088 compared to \$1005 for those who exercise regularly at least once a week ($P < 0.01$). These time-away-from-work expenses for an employer include the additional costs of scattered absences, workers compensation, and short-term disability absences. Jacobson and Aldana³³ reported a significant relationship between the number of days of exercise and illness-related absenteeism. Our findings demonstrate that physical inactivity also may be associated with reduced productivity while at work. Therefore, worksite fitness centers and exercise programs which encourage employees to achieve and maintain a high level of physical activity may be viewed as an investment to increase worker productivity.

Using the productivity loss estimation method, and setting zero risks as the base estimation, each additional risk factor was associated with a 2.4% loss in productivity. Given that the average number of risk factors is 2.16 for this entire study population, it can be calculated that health risk status results in \$2592 in lost productivity per employee per year: 2.16 health risks \times 2.4% \times \$50,000 av-

erage annual salary and benefits. If this cost is multiplied for the entire employee population ($N = 71,362$ in 2004), the estimated cost in lost productivity is \$185M annually. If the cost of the low-risk population (zero to two risks, average 1.0 risks) is assumed as the base then the excess risks are 1.16 and the cost of lost productivity caused by lost time on the job is estimated at \$1392 per employee per year and \$99M for the entire employee population. Both of these dollar estimates may be conservative estimates since the productivity of most companies is built upon a multiple of the cost of the wages paid to employee. Thus, the cost of lost productivity on the job could be two to five times the numbers obtained in the above calculations.

Many studies have reported that worksite health promotion programs can be effective in changing employee health risks.^{34–37} Furthermore, when improvements in health risks are made, research has shown a corresponding reduction in health care costs.^{38–41} Although data on changes in health risks over time related to changes in presenteeism are yet to be established, employers should consider a worksite health management program as an investment and a means of improving the health of their workforce which may in turn yield improved on-the-job productivity.

As is the case with most, if not all, worksite health promotion programs, participation in the HRA was completely voluntary. Although the HRA process is completely confidential, it is not anonymous. The age and gender demographics of the study group are similar to the entire corporation population but a somewhat smaller percentage of men participated in the HRA. Certain groups of employees may be underrepresented in the current study population; particularly those with health behaviors or conditions that they chose not to disclose. In this type of research, the Hawthorne effect is always a concern. That is, participants may report better answers simply because they

are being questioned and the employer is taking an interest in them. This may be especially true in questions dealing with workplace productivity. Nonetheless, the large body of research on health risks has shown that as health risks increase so do poor economic and human outcomes. The HRA has been shown to be an effective means of assessing a population's health risk level and can serve organizations in terms of evaluating the total impact of employee health.^{42–44} By incorporating this modified short form WLQ questionnaire—which can be completed in about one minute—to the HRA employers can also gain some insight of the impact of health on presenteeism.

One advantage of this study over previous work investigating health risks and presenteeism is the eight-question presenteeism scale with 2-week recall as opposed to the one question, 1-week recall utilized by Boles et al.⁶ This larger scale and longer recall period likely yield a more accurate assessment of presenteeism. As was noted earlier, a 2-week recall period was found to be advantageous compared to either a 1-week or 4-week recall.²⁹ Furthermore, this study includes data on nearly 30,000 employees. This compares with the sample size of 2264 workers in a previous study of presenteeism and health risk factors.⁶ The WLQ instrument has been validated in several types of work situations. Not only was it easily applied to this financial corporation population, but it could be tailored to match the job activities of a wide range of businesses.

In conclusion, this study demonstrated that self-reported health risks are associated with self-reported on-the-job work limitations (presenteeism) as measured by the WLQ. The relatively large sample size in this study of HRA participants in a financial services organization also provides for comparisons across different health risks reported by employees. The modified brief version of the WLQ—a concise self-report tool—can be incorporated into an

HRA and surveys across four different work domains which allows examination of different effects of health risks on presenteeism. We calculated that there is a 2.4% excess loss of productivity associated with each additional health risk factor. Since nearly 80% of employees in this study report at least one risk factor, the impact on actual work output may be quite large. The self-reported work limitations indicate that medium-risk and high-risk individuals have 6.2% and 12.2% more productivity loss than low-risk individuals. The annual cost of lost productivity in this corporation was estimated at \$99M to \$185M or between \$1392 and \$2592 per employee. Health management programs may be prioritized and their benefits evaluated by incorporating the WLQ into an HRA.

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