MEDICAL CARE
Volume 41, Number 5, pp 649–659

Relationship of Employee-Reported Work Limitations to Work Productivity

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Background. Work limitation rates are crucial indicators of the health status of working people. If related to work productivity, work limitation rates may also supply important information about the economic burden of illness.

Objective. Our objective was to assess the productivity impact of on-the-job work limitations due to employees' physical or mental health problems.

Research Design. Subjects were asked to complete a self-administered survey on the job during 3 consecutive months. Using robust regression analysis, we tested the relationship of objectively-measured work productivity to employee-reported work limitations.

Subjects. We attempted to survey employees of a large firm within 3 different jobs. The survey response rate was 2245 (85.9%). Full survey and productivity data were available for 1827 respondents.

Measures. Each survey included a validated self-report instrument, the Work Limitations Questionnaire (WLQ). The firm provided objective, employee-level work productivity data.

Results. In adjusted regression analyses (n = 1827), employee work productivity (measured as the log of units produced/hour) was significantly associated with 3 dimensions of work limitations: limitations handling the job's time and scheduling demands (P = 0.003), physical job demands (P = 0.001), and output demands (P = 0.006). For every 10% increase in on-the-job work limitations reported on each of the 3 WLQ scales, work productivity declined approximately 4 to 5%.

Conclusion. Employee work limitations have a negative impact on work productivity. Employee assessments of their work limitations supply important proxies for the economic burden of health problems.

Key words: Work productivity; chronic disease and employment; disability; depression. (Med Care 2003;41:649–659)

An estimated 125.5 million adults in the United States have at least 1 chronic health problem, and 60% of the adults with chronic conditions are working age, 18 to 65 years old.[1] Approximately 18.5 million working-age adults in the United States have chronic conditions that prevent them from working for pay, limit the type or amount of work they perform, or make it difficult to find or hold a job.[2] Compared with other workers, those with chronic conditions are absent more, earn less,

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Supported by GlaxoWellcome, Inc.

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and are more likely to work in lower-paying or part-time jobs.[1]

Despite these employment problems, people with chronic conditions usually want to remain active and productive. Indeed, most working-age individuals with chronic conditions are employed.[1] However, the progressive, episodic nature of many chronic conditions practically guarantees that workers will experience employment problems at some time.

An important indicator of on-the-job performance problems is the work limitation rate. According to the most recent national estimates of partial work limitations, a measure of difficulty for people in the labor market, 3.6% of adults 18 to 44 years old and 7.2% of those 45 to 64 years old are limited in the amount or kind of work they can do.[3] A national survey of on-the-job performance difficulties found that work limitations occurred in 32% of the employed population.[4]

Work limitation rates offer compelling evidence about the health status of working people. Measured by self-report, rates indicate (from the workers' perspective) the degree to which health problems interfere with performing work activities. If work limitations are related to productivity loss, then they also contain important information about the economic burden of illness and can serve as a valuable economic indicator. However, at present, we lack accurate information concerning the productivity impact of work limitations.

We assess the productivity impact of work limitations within an employed population, hypothesizing that such limitations are related to decreased work productivity. The term *work limitations*, as we use it, is related to the concept of *disability*. According to the well known Institute of Medicine report on the subject, *disability* refers to "the expression of a physical or mental limitation in a social context—the gap between a person's capabilities and the demands of the environment."[5] Disability is the result of a complex interaction between a person's functional limitations (health-related restrictions on a person's ability to perform social role tasks and obligations) and the physical and social environment in which such performances occur.[6,7] Ideally, work limitations scales will reflect the results of this interaction.

To test our hypothesis, we use a validated self-report tool, the Work Limitations Questionnaire (WLQ), along with objectively measured employee work productivity data.[8–11] Previous studies have assessed the impact of health problems on work productivity using questionnaires that have not been objectively validated in this manner.[12]

Materials and Methods

Study Population

This study was conducted in 1998 at a nationally known durable goods distributor with a large retail mail-order operation. The firm employed approximately 4500 individuals and maintained a work productivity measurement system with employee-specific data.

The sample consisted of full-time and part-time employees from 2 departments and 3 jobs. We included customer services representatives from the 2 largest call centers within the customer service department (CSD). Also included were 2 groups within the returns department (RD), referred to as RD1 and RD2.

Customer service department representatives answer customers' phone calls and, with keyboard entry, input the information necessary to complete purchases and returns. RD1 and RD2 employees repair merchandise, package it, shelve it, and manage inventory. Because specific tasks within RD vary, it is important to analyze by job assignment.

Data Collection

We measured employee work limitations using a self-administered survey. To obtain a sufficiently large sample and variations in work demand levels, questionnaires were administered monthly during June, July, and August. Workload is heaviest during the fall and winter, but workload can vary year-round. In the summer, there may be multiple seasonal catalogs in circulation and different amounts of inventory remaining from each. These factors as well as customer demand and staffing level influence employee workload.

Initially, employees received a letter from the vice president of human resources (HR) informing them of this voluntary study, stating that it would be conducted during business hours, and encouraging participation. Employees were informed that they would not have to make up the time taken to complete the survey. The study reimbursed each department for employee time.

When surveys were administered, employees received a voucher to redeem at the company cafeteria. Additionally, employees participating in all 3 surveys were eligible for a $200 cash prize drawing, which was awarded at the end of the project.

To minimize work disruption, we attempted to survey employees during regularly scheduled monthly team meetings. (The last RD survey was distributed to employees at their workstations.) Managers and supervisors left the meeting rooms before each survey began, and HR personnel distributed the forms, described the protocol, and answered questions.

Each employee received a sealed name-labeled envelope containing a cover letter, consent form, questionnaire (with a pre-assigned numerical identifier code), and return envelope. The outer envelope was discarded, so only the investigators could decode the study identifiers.

Employees read the cover letter and the consent form before deciding whether to participate. They were asked to sign the consent form, complete the questionnaire, and seal all forms in the return envelope. All employees (respondents and non-respondents) were instructed to return their sealed envelopes to a study mail bin. The unopened questionnaires of employees not present on administration days also were returned to the mail bin. Mail bins were stored in HR and picked up by an investigator. This procedure, recommended by our Human Investigations Review Board, blinded management to the identity of survey respondents and non-respondents.

Measurement

A 94-item questionnaire was administered consisting of the WLQ and items assessing demographics, health status (eg, selected 36-item short-form health survey [SF-36] items, chronic conditions, and health risk factors), company health and safety communications, and perceived percent effectiveness on the job in the past 2 weeks.[13,14]

The WLQ's 4 scales supplied the main independent variables. The WLQ was designed to capture on-the-job disability, reflecting the outcome of a person's interaction with the work environment, and productivity loss. Each WLQ scale score is interpreted as the percentage of time in the previous 2 weeks that a person was limited in performing a specific class of job demands. These classes include time or scheduling demands (5 items), physical work demands (6 items), mental-interpersonal work demands (9 items), and output demands (5 items, Appendix A). The Time, Mental-Interpersonal, and Output scale items address the amount of time physical or emotional health problems made it difficult to perform specific demands. The Physical scale refers to the amount of time the employee was able to perform a demand without difficulty due to health problems. Scales response options are, "all of the time (100%)", "a great deal of the time", "some of the time (approximately 50%)", "a slight bit of the time", "none of the time (0%)", and, "does not apply to my job." Scale scores are computed as the mean of the non-missing responses and converted to 0 (not limited) to 100 (limited all of the time).

Although the WLQ has been validated within patient populations,[8–11] we assessed whether, in this sample, it met accepted standards for psychometric performance. Scale Cronbach α values were 0.84 or higher. Item-to-total scale score correlation coefficients (corrected for overlap) were between 0.56 and 0.93 (recommended minimum = 0.40). Scaling results suggested some overlap between the Output scale and certain items from the Time and Mental-Interpersonal scales. Less than 4% of all responses were missing.

Additional variables were employee age (18-39 years, 40-49 years, 50-59 years, 60+ years), gender (male or female), years of education (high school graduate or less, some college or more), number of chronic conditions (0, 1, 2, 3, 4 or more), survey administration month (June, July, or August), and job (CSD, RD1, RD2). We include "years of education" as a proxy for level of employee skill and training. The positions studied do not require specialized degrees, licenses, or certifications.

To ensure employee confidentiality, 3 months of productivity data files were provided for all employees (respondents and non-respondents). The availability of productivity, age, and gender data for non-respondents as well as respondents allowed us to test for non-response bias.

To facilitate the analysis of productivity, we selected weeks of productivity data that matched as closely as possible the time period covered in each survey. Productivity in CSD was indicated by the number of phone calls answered per employee per payroll hour (total number of calls answered in the 2-week period/the total number of hours worked within the period). The number of payroll

hours worked excluded work absences. For RD1 and RD2, productivity was provided in weekly aggregates as the rate of merchandise units processed per hour at that task. To create 2-week aggregate variables for RD1 and RD2 employees, we added the weekly number of units processed per hour and divided by 2.

Analysis

We generated survey response rates and, for the main variables, descriptive statistics such as means, standard deviations (SDs), and percentages. Differences among CSD, RD1, and RD2 were tested with χ^2, *t*-tests, and multivariate analysis of variance, as appropriate. Multiple linear regression was used to evaluate non-response bias.

To test the work limitations-work productivity hypothesis, we combined data across jobs (CSD, RD1, and RD2), locations, and administrations. The statistical analysis was performed using the robust regression procedure in STATA.[15]

Robust regression reflects the hierarchical structure of the data whereby employees are nested within multiple administrations and administrations are nested within multiple work locations. Standard multiple linear regression analysis ignores such intraclass correlation and thus can overestimate significance levels. Robust regression produces consistent standard errors when the residuals are not identically distributed and are not independent within cluster (e.g., administration). Robust regression also includes a procedure to limit the influence of only the most extreme values in the data.[16–18]

The dependent variable, units of output/hour was redefined for the analysis as the log of employee productivity (log units−log hours). The log helped make the productivity data commensurate among the jobs. Additionally, the log of productivity is easily interpreted as the log percent loss in productivity associated with a unit change in WLQ score. Log values also are not as greatly influenced by the minimum and maximum productivity values in the data.

We modeled the effects of the 4 WLQ scales on work productivity, controlling for employee age, gender, education, and job characteristics. The control variables may be related to work limitations or productivity. We included dummy variables for survey administration (June = 0 vs. July = 1 or August = 1), job (CSD = 1 vs. RD1 = 0 or RD2 = 0), age group (18-39 years = 0 vs. 40-49 years = 1, 50-59 years = 1, or 60+ years = 1), gender (male = 1 vs. female = 0), and education (high school or less = 1 vs. some college or more = 0).

A final model included these variables and interaction terms that could influence productivity (e.g., gender by job). Interaction terms were tested for variables that had statistically significant main effects in the first model ($P \leq 0.05$).

Following this analysis, we also assessed whether the relationship between work limitations and work productivity that we observed was the same for employees who suffered from depressive symptoms. Conditions such as depression may impact cognitive function and thus threaten the accuracy of self-reports. Stigma may also influence reporting in the workplace. Employers and others want to know that they can rely on self-reported work limitations even when employees have illnesses that can impair judgment or be stigmatizing.

"Depressive symptoms" was measured using an SF-36 Mental Health scale score of 52 or less and defined as a dummy variable (yes = 1 vs. no = 0).[19] This scale's items do not overlap with those included in the WLQ. However, the former uses a 4-week recall, in contrast to the 2-week timeframe of the WLQ and the productivity measure. This difference may reduce the coefficient for mental health in the productivity model.

The depression indicator was included in a model with age, gender, education, administration, and job (without the WLQ variables). Finding that job was significant, we also tested for a depression by job interaction.

Next, we added each of the WLQ scales to test whether work limitations effectively mediated the relationship of depression to productivity. A complete mediating effect would be suggested when the work limitations variables substitute for the illness's productivity effect. This is an indication of the accuracy of the self-reports. Alternatively, a partial mediating effect could occur, in which case depression and one or more WLQ scales are significantly associated with productivity. This result would suggest that employee assessments of work limitations are not fully or accurately capturing the effects of depression on productivity.

A final model tested whether depression had a modifying effect on reports of work limitations. A modifying effect would imply that the relationship between work limitations and productivity is in-

TABLE 1. Sample Characteristics

Variable	Total	Customer Service	Returns 1	Returns 2	*P*
N	1827	1551	118	158	
Female, %	78	79	74	64	0.0001
18–39 years, %	39	37	45	49	
40–49 years, %	35	36	29	29	0.5406
50–59 years, %	20	20	21	17	
60+ years, %	7	5	5	5	
High school graduate, %	46	32	58	49	0.0001
Some college or college degree, %	54	57	32	45	
Married, %	67	69	53	59	0.0001
No chronic conditions, %	13	14	15	6	
1 chronic condition, %	19	20	14	16	0.1205
2 or more conditions, %	68	67	71	78	
Depressive symptoms, %	15	14	18	23	0.0044
Any absences, %	19	19	—	—	—
Perceived effectiveness (maximum = 100%)					
% less than 50%	2	2	8	3	
% 50–80%	7	6	12	15	0.0003
% greater than 80%	91	92	81	82	

consistent (e.g., the relationship between self-reported data and productivity is different for depressed and non-depressed employees). To test for this modifying effect, we added interaction terms for depression and each WLQ scale. We hypothesized that WLQ scores are efficient mediators for the effect of depressive symptoms on productivity.

Results

Response Rate

A total of 2612 surveys were administered during the study's 3 waves; of these, 2245 were respondents (85.9%) and 367 were non-respondents (14.1%). Among the 945 employees responding, most (505, 53.4%) completed 3 administrations, 290 (30.7%) completed 2, and 150 (15.9%) completed 1.

The final analytic sample consisted of 1827 observations (81.3% of respondents). Of the 418 observations not included, 63 had ineligible job assignments, 235 had missing productivity data (indicating either absence from the work location or job reassignment), and 120 had 1 or more key survey variables missing.

Most of the 1827 respondents were female (78%), married (67%), and 18 to 39 years old (39%) or 40 to 49 years old (35%). Most (54%) had

TABLE 2. Employee Work Productivity

	Customer Service Calls/Hour		Returns 1 Units/Hour		Returns 2 Units/Hour	
	Mean	SD	Mean	SD	Mean	SD
June (CSD n = 601, RD1 n = 47, RD2 n = 75)	8.5	3.1	28.9	5.7	23.7	11.4
July (CSD n = 501, RD1 n = 42, RD2 n = 44)	9.2	3.1	26.4	4.8	24.6	11.9
August (CSD n = 449, RD1 n = 29, RD2 n = 39)	10.8	4.0	27.4	4.8	24.5	18.2
P	<0.0001		<0.0626			<0.0001

CSD = customer service department; RD = returns department.

TABLE 3. Work Limitations Questionnaire Scores by Administration and Department*†

	Customer Service		Returns 1		Returns 2	
	Mean	SD	Mean	SD	Mean	SD
June (CSD n = 601, RD1 n = 47, RD2 n = 75)						
Time scale	20.0	23.9	21.4	26.1	24.1	25.6
Physical scale	15.1	20.6	13.9	20.3	15.3	22.2
Mental-Interpersonal scale	17.6	21.1	20.7	22.9	19.7	18.6
Output scale	14.5	22.5	20.4	25.6	18.4	22.4
July (CSD n = 501, RD1 n = 42, RD2 n = 44)						
Time scale	17.4	23.5	25.6	26.3	19.4	23.3
Physical scale	12.9	19.3	13.0	17.8	8.5	15.2
Mental-Interpersonal scale	14.0	18.8	26.7	24.1	14.5	17.3
Output scale	10.8	17.9	21.9	25.3	15.2	20.9
Aug (CSD n = 449, RD1 n = 29, RD2 n = 39)						
Time scale	17.4	23.3	15.9	24.4	24.1	25.6
Physical scale	14.5	21.4	14.5	24.8	13.2	25.7
Mental-Interpersonal scale	13.8	18.9	19.2	20.2	18.7	17.2
Output scale	13.2	20.6	17.9	24.6	18.0	20.3

*The *P* values for the differences between months within CSD were 0.1116 (Time), 0.1989 (Physical), 0.0013 (Mental-Interpersonal), and 0.0121 (Output). Within RD1, they were 0.2971, 0.9512, 0.3201, and 0.8047, respectively. Within RD2, they were 0.5806, 0.2464, 0.3079, and 0.7260, respectively.

†The *P* values for differences between CSD, RD1, and RD2, controlling for month, were 0.1100 (Time), 0.6930 (Physical), 0.0001 (Mental-Interpersonal), and 0.0002 (Output).

CSD = customer service department; RD = returns department.

completed some college or were college graduates, and 46% completed high school only. There were statistically significant differences among the job groups with regard to gender ($P = 0.0001$), education ($P \leq 0.0001$), marital status ($P = 0.00001$), and percent with depression symptoms ($P = 0.0044$, Table 1).

Approximately 87% of the respondents reported 1 or more chronic health problems. CSD absences were recorded by the employer. The percentage of employees with any absence days was 19%.

Most employees (91%) rated their effectiveness on the job very high (more than 80%). Ratings in CSD were higher than ratings in either RD group ($P = 0.0003$).

Bias Caused by Non-response

We compared the 2245 respondents to 367 non-respondents and found no significant differences in age ($P = 0.1210$), gender ($P = 0.6858$), and productivity ($P = 0.0944$). Across all 3 months, CSD non-respondents had no more absences than did CSD respondents ($P = 0.0633$). Comparing the analytic sample (n = 1827) to the excluded portion (n = 418), we found no significant differences in age, gender, and productivity ($P = 0.883$, 0.1596, and 0.2903, respectively).

Within CSD and RD2, productivity increased significantly during the study period ($P < 0.0001$, respectively), while within RD1, it did not change ($P = 0.0626$, Table 2). In separate regression models for each job group, the survey month predicted productivity ($P \leq 0.0001$), but the interaction term for respondent status by month did not (administration by respondent, $P > 0.05$). Thus, the productivity trend in the analytic sample was unrelated to which employees participated.

Work Limitations Questionnaire Scores

Work Limitations Questionnaire scores indicated that employees were limited on the job approximately one fifth of the time in the prior 2 weeks, equivalent to 2 workdays. The mean level of work limitations varied little over time within department, but there were some differences between jobs (Table 3). Mean WLQ Time scale scores were 18.3 for CSD (SD = 23.6), 21.5 for RD1 (SD = 25.8), and 22.0 for RD2 (SD = 24.6, $P = 0.1100$). The Physical scale scores were 14.2 (SD = 20.4),

TABLE 4. Relationship of Self-reported Work Limitations to Employee Work Productivity

	Coefficient	Standard Error	t	$P > \|t\|$	[95% Confidence Interval]	
Returns 1	1.0272	0.0384	26.75	0.000	0.9519	1.1025
Returns 2	1.1022	0.0358	30.80	0.000	1.0320	1.1724
Time	−0.0013	0.0004	−3.00	0.003	−0.0021	−0.0004
Physical	−0.0014	0.0005	−3.20	0.001	−0.0023	−0.0001
Ment-Interp	0.001	0.0006	1.70	0.090	−0.0002	0.0023
Output	−0.0017	0.0006	−2.78	0.006	−0.0028	−0.0004
Age 40–49	−0.0105	0.0189	−0.55	0.580	−0.0475	0.0266
Age 50–59	0.0341	0.0224	1.52	0.128	−0.0099	0.0780
Age 60+	0.0563	0.0339	1.66	0.096	−0.0101	0.1227
Male	−0.0424	0.0224	−1.90	0.058	−0.0863	0.0015
Education	−0.0022	0.0133	−0.17	0.867	−0.0283	0.0239
July	0.0639	0.0191	3.35	0.001	0.0265	0.1013
August	0.2268	0.0198	11.46	0.000	0.1879	0.2656
Returns 1× Male	0.1426	0.0752	1.90	0.058	−0.0049	0.2902
Returns 2× Male	−0.2938	0.0611	−4.81	0.000	−0.4137	−0.1739
_cons	2.2220	0.0402	55.22	0.000	2.1435	2.3014

Robust regression estimates: N = 1827, F = 151.04, $P < 0.0001$, $R^2 = 0.277$. Variable definitions. The dependent variable is the log of employee units of output/hour. Job: customer service (0), returns 1 (1), returns 2 (1). Time = WLQ Time Demands, Physical = WLQ Physical Demands, Ment-Interp = WLQ Mental-Interpersonal Demands, Output = WLQ Output Demands. Age: 18 ≤ age ≤ 39 years (0), 40 ≤ age ≤ 49 years (1), 50 ≤ age ≤ 59 years (1), and 60 years or older (1). Gender: male (1), female (0). Administration: June (0), July (1), August (1). Education: high school or less (1), more than high school (0).

WLQ = Work Limitations Questionnaire.

13.7 (SD = 20.5), and 12.9 (SD = 21.5), respectively ($P = 0.6930$). The Mental-Interpersonal scale scores were 15.3 (SD = 19.8), 22.5 (SD = 22.7), and 18.0 (SD = 17.9), respectively ($P = 0.0010$). On the Output scale, the means were 12.9 (SD = 20.6), 20.3 (SD = 25.1), and 17.4 (SD = 21.4), respectively ($P = 0.0002$).

Productivity Model

Employee job assignment and survey month had the strongest relationships to productivity ($P \leq 0.001$, Table 4). There was also a significant effect for the gender by job interaction term ($P \leq 0.001$). However, after adjusting for these and other covariates, decreased work productivity was related to a greater amount of time spent on the job with limitations. Three WLQ scales were significant: Time ($P = 0.003$), Physical ($P = 0.001$), and Output ($P = 0.006$). The overall effect for all four WLQ scales was significant ($P \leq 0.0001$). The model was significant at $P < 0.0001$, $r^2 = 0.277$.

Accuracy for Depression

Depressive symptoms were present among 15% of employees. Mean WLQ scale scores for the subset of employees with symptoms were 36.7, SD = 24.1 (Time); 23.7, SD = 24.1 (Physical); 32.5, SD = 21.2 (Mental-Interpersonal); and 31.6, SD = 25.5 (Output). Corresponding scores for the non-depressed employees were lower: 15.9, SD = 22.5 (Time, $P < 0.0001$); 12.4, SD = 19.4 (Physical, $P \leq 0.0001$); 13.2, SD = 18.3 (Mental-Interpersonal, $P \leq 0.0001$); and 10.8, SD = 18.6 (Output, $P = 0.0001$).

Depressive symptoms were not significantly associated with lower productivity ($t = -1.44$, $P = 0.149$, Table 5). With the WLQ scales entered in the model, depression's relationship to productivity weakened ($t = 0.64$, $P = 0.525$), while the effects of the three

TABLE 5. Impact of Depressive Symptoms on Productivity

	Coefficient	Standard Error	t	$P > \|t\|$	[95% Confidence Interval]	
Returns 1	1.0306	0.0392	26.28	0.000	0.9537	1.1076
Returns 2	1.0754	0.0364	29.50	0.000	1.0039	1.1469
Age 40–49	−0.0092	0.0193	−0.48	0.632	−0.0471	0.0286
Age 50–59	0.0319	0.0230	1.38	0.167	−0.0133	−0.0770
Age 60+	0.0669	0.0346	1.93	0.054	−0.0010	0.1348
Male	−0.0375	0.0228	−1.64	0.100	−0.0823	0.0073
Education	−0.0029	0.0136	−0.22	0.827	−0.0296	0.0237
Depression	−0.0339	0.0236	−1.44	0.149	−0.0802	0.0122
July	0.0702	0.0194	3.61	0.000	0.0321	0.1083
August	0.2298	0.0202	11.40	0.000	0.1902	0.2693
Returns 1× Male	0.1087	0.0766	1.42	0.156	−0.0416	0.2589
Returns 2× Male	−0.3148	0.0624	−5.05	0.000	−0.4371	0.1925
_cons	2.1760	0.0401	54.24	0.000	2.0972	2.2545

N = 1827, F = 171.51, $P < 0.0001$, $R^2 = 0.268$. Variable definitions. The dependent variable is the log of employee units of output/hour. Job: customer service (0), returns 1 (1), returns 2 (1). Time = WLQ Time Demands, Physical = WLQ Physical Demands, Ment-Interp = WLQ Mental-Interpersonal Demands, Output = WLQ Output Demands. Age: 18 ≤ age ≤ 39 years (0), 40 ≤ age ≤ 49 years (1), 50 ≤ age ≤ 59 years (1), and 60 years or older (1). Gender: male (1), female (0). Administration: June (0), July (1), August (1). Depression symptoms: yes (1), no (0). Education: high school or less (1), more than high school (0).

WLQ = Work Limitations Questionnaire.

WLQ scales (Time, Physical, and Output) were significant (Table 6). Neither the main effects of depression nor the interaction terms for depression and WLQ scores were significant.

Discussion

The measurement of work limitations in public health and clinical research reflects an awareness that health problems have multiple consequences across a variety of domains of human action. Because of the value and meaning vested in work activity, work limitations are powerful indicators of social role disability, a key dimension of health status. Work limitations also describe the status of an individual's economic activity, but the meaning of the data for employed individuals has not been established.

Our study found that work limitations among employed individuals, as reported on the WLQ, measure aspects of productivity not captured by other explanatory variables. After controlling for key variables such as job characteristics, survey month, and employee demographics, work limitations remained significant, and the overall model explained 27.7% of the total variation in work productivity. The WLQ scales explained approximately 1% of this variation. Other studies within employee samples, addressing the relationship of specific types of chronic illnesses to work productivity, have found effects of a similar magnitude.[20,21]

We used regression coefficients for the three statistically significant WLQ scales to estimate the amount of productivity loss associated with a 10-point increase in scale score. The combined result was that, for every 10% increase in on-the-job limitations, total employee work productivity declined 4 to 5%.

We did not find that depression symptoms significantly influenced productivity despite large differences in mean WLQ scores of employees with and without symptoms. However, in CSD and RD1, productivity declined with symptoms, while in RD2, productivity increased. Results may reflect reporting inconsistencies, the need for a depression indicator based on established diagnostic criteria versus a general mental health scale score, and/or other factors.

Both the Health Objectives 2010 and the National Occupational Research Agenda stress the importance of reducing the total burden of chronic

TABLE 6. Impact of Depressive Symptoms on Productivity and Employee Assessments of Work Limitations

	Coefficient	Standard Error	*t*	$P > \|t\|$	[95% Confidence Interval]	
Returns 1	1.0272	0.0384	26.72	0.000	0.9518	1.1026
Returns 2	1.1013	0.0358	30.73	0.000	1.130	1.1716
Time	−0.0013	0.0004	−3.06	0.002	−0.0022	−0.0005
Physical	−0.0014	0.0005	−3.19	0.001	−0.0023	−0.0006
Ment-Interp	0.0010	0.0006	1.62	0.106	−0.0002	0.0022
Output	−0.0017	0.0006	−2.82	0.005	−0.0029	−0.0005
Age 40–49	−0.0096	0.0189	−0.51	0.613	−0.0468	0.0276
Age 50–59	0.0357	0.0226	1.58	0.114	−0.0086	0.0800
Age 60+	0.0566	0.0339	1.67	0.096	−0.0099	0.1231
Male	−0.0423	0.0224	−1.89	0.059	−0.0862	0.0016
Depression	0.0158	0.0249	0.64	0.525	−0.0329	0.0646
Education	−0.0019	0.0134	−0.15	0.881	−0.0282	0.0242
July	0.0637	0.0191	3.34	0.001	0.0263	0.1012
August	0.2265	0.0198	11.43	0.000	0.1876	0.2653
Returns 1× Male	0.1431	0.0753	1.90	0.058	−0.0046	0.2902
Returns 2× Male	−0.3002	0.0612	−4.90	0.000	−0.4202	−0.1801
_cons	2.2210	0.0405	54.86	0.000	2.1414	2.3002

N = 1827, F = 141.00, $P < 0.0001$, $R^2 = 0.277$. Variable definitions. The dependent variable is the log of employee units of output/hour. Job: customer service (0), returns 1 (1), returns 2 (1). Time = WLQ Time Demands, Physical = WLQ Physical Demands, Ment-Interp = WLQ Mental-Interpersonal Demands, Output = WLQ Output Demands. Age: 18 ≤ age ≤ 39 years (0), 40 ≤ age ≤ 49 years (1), 50 ≤ age ≤ 59 years (1), and 60 years or older (1). Gender: male (1), female (0). Administration: June (0), July (1), August (1). Depression symptoms: yes (1), no (0). Education: high school or less (1), more than high school (0).

WLQ = Work Limitations Questionnaire.

health problems.[22,23] Our results indicate that this burden includes lost productivity on the job. Productivity loss is already regarded as a serious problem for employers. For employees, however, their work limitations and resultant productivity losses may translate into decreased compensation, limited career opportunities, and lowered earnings due to premature retirement.

This study's results also indicate that, using the WLQ, employee assessments have a dual role as both health and economic indicators. WLQ scores could be cross-walked to generate productivity loss estimates. Quantifying how work limitations influence work productivity and, thus, the costs of illness will be useful for planning and evaluating disease or disability management programs, testing the outcomes of medical interventions, and crafting health policy.

This study's strengths are a large sample size; objective productivity data, including a service and manual occupation; data for non-respondents; a high response rate; multiple time points; and a validated measure of work limitations, the WLQ. Other available work limitations batteries include global items and coarse scales (assessing a limited range of limitation levels) and thus may result in type 2 error. A study weakness is that results may not be generalizable. This problem is difficult to overcome and requires gaining access to high-quality productivity data from a representative sample of occupations and industries. Access to such data has been limited. Finally, this study might have benefited from including more variables to test in our model, such as years of employee experience, coworker and supervisor support, and quality of the job technology. Omitted variables can lead to bias in results.

Protecting the quality of working life and economic well-being of chronically ill workers is a cornerstone of a progressive, proactive approach to

health and employment policy. Tools that bring the social and economic implications of health problems into sharper focus are essential to achieving this goal.

Acknowledgments

The authors gratefully acknowledge GlaxoWellcome, Inc., which supported this research. We also express our gratitude to the reviewers, whose comments helped to improve this presentation. The protocol was reviewed and approved by the Tufts-New England Medical Center Human Investigations Review Board. For information about the WLQ, please e-mail: wlq@tufts-nemc.org. The WLQ is available for noncommercial use on a royalty-free basis.

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APPENDIX A. TABLE 1. Sample Items From the Work Limitations Questionnaire

1. In the *past 2 weeks*, how much of the time did your physical health or emotional problems make it difficult for you to do the following?

	(Mark one box on each line a through e.)					
	All of the Time (100%)	Most of the Time	Some of the Time (About 50%)	A Slight Bit of the Time	None of the Time (0%)	Does Not Apply to My Job
a. do your work without stopping to take breaks or rests	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$
b. stick to a routine or schedule	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$
c. keep your mind on your work	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$
d. speak with people in person, in meetings or on the phone	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$
e. handle the workload	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$

Note: Items a and b are from the Time scale. Items c and d are from the Mental-Interpersonal scale. Item e is from the Output scale.

2. In the *past 2 weeks*, how much of the time were you ABLE TO DO the following without difficulty caused by physical health or emotional problems?

	(Mark one box on each line a and b.)					
	All of the Time (100%)	Most of the Time	Some of the Time (About 50%)	A Slight Bit of the Time	None of the Time (0%)	Does Not Apply to My Job
a. walk or move around different work locations (for example, go to meetings)	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$
b. use hand-held tools or equipment (for example, a phone, pen, keyboard, computer mouse, drill, hairdryer, or sander)	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_0$

Note: Items a and b are from the Physical scale.