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Bethany T. Gardner
Washington University School of Medicine in St. Louis

Ann Marie Dale
Washington University School of Medicine in St. Louis

Skye Buckner-Petty
Washington University School of Medicine in St. Louis

Linda Van Dillen
Washington University School of Medicine in St. Louis

Benjamin C. Amick III
Florida International University

See next page for additional authors

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Authors
Bethany T. Gardner, Ann Marie Dale, Skye Buckner-Petty, Linda Van Dillen, Benjamin C. Amick III, and Bradley Evanoff

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Bethany T. Gardner, OTD, OTR/L [1], Ann Marie Dale, PhD, OTR/L [1], Skye Buckner-Petty, MPH [1], Linda Van Dillen, PhD, PT [2], Benjamin C. Amick III, PhD [3], Bradley Evanoff. MD, MPH [1]

[1] Washington University School of Medicine, St. Louis, MO; Division of General Medical Sciences
[2] Washington University School of Medicine, St. Louis, MO; Program in Physical Therapy
[3] Washington University School of Medicine, St. Louis, MO; and Department of Health Policy and Management

Robert Stempel College of Public Health & Social Work, Florida International University, Miami, FL.

Correspondence to: Ann Marie Dale, Washington University School of Medicine, Division of General Medical Sciences, 4523 Clayton Avenue, Campus Box 8005, Saint Louis, MO 63110; Email: adale@dom.wustl.edu. Phone: 314-454-8470; Fax: 314-454-5113.

ABSTRACT

Objective: To assess construct and discriminant validity of four health-related work productivity loss questionnaires in relation to employer productivity metrics, and to describe variation in economic estimates of productivity loss provided by the questionnaires in healthy workers.

Methods: 58 billing office workers completed surveys including health information and four productivity loss questionnaires. Employer productivity metrics and work hours were also obtained.

Results: Productivity loss questionnaires were weakly to moderately correlated with employer productivity metrics. Workers with more health complaints reported greater health-related productivity loss than healthier workers, but showed no loss on employer productivity metrics. Economic estimates of productivity loss showed wide variation among questionnaires, yet no loss of actual productivity.

Conclusions: Additional studies are needed comparing questionnaires with objective measures in larger samples and other industries, to improve measurement methods for health-related productivity loss.

INTRODUCTION

The duration and cost of lost work time, often known as "absenteeism," are common measures of the burden of chronic health conditions. Yet these outcomes largely underestimate the true productivity costs of health conditions to employers, individual workers, and to society as a whole.[1-3] Studies of chronic health conditions offer compelling evidence that there are greater costs due to lost worker productivity, or "presenteeism," defined as workers who are able to continue working but at less than full ability, rather than to absenteeism.[1,4-8] One national survey of United States workers attributed 71% of all health-related lost productivity costs to presenteeism; the ratio of costs due to presenteeism versus absenteeism was 2.4:1.[1]

Lost time is readily apparent and its occurrence can be easily quantified. Lost productivity while working is more difficult to assess without measures of the quantity or quality of work. It may not be obvious when workers do not feel well, nor if their health affects their work productivity.[9-11] Production-based jobs may have explicit measures of worker output such as number of units produced for assembly workers or call log times for customer service representatives. Knowledge-based jobs rarely have explicit measures, and thus productivity may only be captured by worker surveys.[10]

A growing number of survey measures have been developed in recent years to indirectly measure health-related work limitations and difficulties performing regular job duties, yet there is no universally accepted best measure.[11-13] Four of the most commonly used measures include the Work Ability Index (WAI), Work Limitations Questionnaire (WLQ), Health and Work Performance Questionnaire (HPQ), and Work Productivity and Activity Impairment Questionnaire (WPAI). Developers of the WLQ, HPQ, and WPAI have contended that their measures may be used to provide economic estimates of reduced performance,[14-17] but the accuracy and appropriateness of these estimations has not been demonstrated. Several studies have directly translated workers' scores on the WLQ, HPQ, and WPAI into lost productivity estimates for a range of health conditions.[18-23] Despite several studies on the psychometric properties of each of these measures in various clinical and working populations,[12,14-17,24-36] most of them have not been validated against actual employer productivity metrics so their economic interpretation remains unclear.[11,13,37]

The true burden of many health conditions will continue to be greatly underreported without valid measures of both absenteeism and presenteeism. Measureable change in productivity that can be translated into costs may, for some purposes, be a more useful outcome for measuring the impact of workplace-based intervention programs than reduction in injury rates or lost days. In order for self-reported health-related productivity loss questionnaires to be used to predict economic outcomes, they must demonstrate acceptable construct validity against objectively measured employer productivity metrics. The primary objective of this study was to assess the construct and discriminant validity of four self-reported health-related work productivity loss measures in relation to employer productivity metrics in a generally healthy working population; the secondary objective was to describe the variation in the economic estimates of productivity loss provided by existing self-reported measures.

METHODS

Study participants were recruited from the billing department of a large, academic medical center; individual-level productivity metrics are routinely captured for many workers in this department. Workers (n=132) were invited to participate in the study by announcements at an employee staff meeting and by email invitations from the research team. An individualized encrypted link for an online survey was sent to each worker's work email address. Workers were given two opportunities to enroll in the study by completing a baseline survey in either August or October of 2014. All participants provided informed consent to participate in the study and were compensated for their participation. Workers were permitted by management to complete the online survey during regular working hours. The

Institutional Review Board of [redacted] provided the ethical approval of this study.

Data collection

The online survey collected information on demographics, physical symptoms and health status, and four standardized health-related work productivity loss questionnaires. Health-related productivity loss questionnaires included the Work Ability Index (WAI),[38,39] Work Limitations Questionnaire (WLQ),[29,30] Health and Work Performance Questionnaire (HPQ),[14,15] and Work Productivity and Activity Impairment Questionnaire (WPAI).[17] Health status data was collected using the Patient Health Questionnaire-15 (PHQ-15). We created 6 versions of the online survey to limit response bias which could be caused by presenting the productivity loss questionnaires in the same order to all participants. The PHQ-15 was always presented first to prime participants to think about their physical health symptoms before reporting on their health-related productivity loss. The WAI was presented next on all survey versions because it also includes an item in which participants identify their current health conditions. The order of the remaining 3 productivity loss questionnaires (WLQ, HPQ, and WPAI) was randomized.

Measures

Patient Health Questionnaire-15 (PHQ-15)

The Patient Health Questionnaire was originally developed to assess mental disorders in medical populations. The PHQ-15 is a shortened 15-item questionnaire to assess physical symptoms associated with somatoform disorders. We used the PHQ-15 as a physical symptom checklist, with higher scores indicating worse health. Respondents rate how much they have been bothered by each symptom during the past 4 weeks on a three-point scale from 0=not bothered, 1=bothered a little, to 2=bothered a lot. The total score is calculated as the sum of each item score, ranging from 0-30. We omitted one item from the original PHQ-15, "Pain or problems during sexual intercourse," due to the sensitivity of this question with participants completing the online survey at work. This item was considered as missing for all participants. The total PHQ-15 score can be prorated to account for missing items.[40] If 4 or more of the 15 items are missing, a total score cannot be calculated.

Work Ability Index (WAI)

The WAI is an 11-item questionnaire, including a list of health conditions and ten questions covering 7 unique dimensions of work ability. The WAI was designed to measure an individual's perceptions of their current and future work ability for the purposes of workplace screening programs and early intervention, as well as for use in return to work planning following injury or illness. The total WAI score ranges from 7-49, with higher scores indicating better work ability. All items must be complete in order to calculate the total score.[38,39]

Work Limitations Questionnaire (WLQ)

The WLQ is a 25-item questionnaire designed to measure the impact of health conditions on work activity limitations. Workers rate their level of difficulty in performing specific job demands due to physical or mental health problems in the past 2 weeks. The 25 items comprise 4 work limitation subscales: time management, physical, mental-interpersonal, and output. Each item is rated for the percentage of time that the worker had difficulty performing the activity on a scale from 1= "difficult none of the time (0%)," to 5= "difficult all the time (100%)". Items rated as "does not apply to my job" were coded as missing according to the developers' recommendations. The developers' scoring rules allow for up to 50% missing item scores within each subscale. In the original version of the WLQ, the physical demands scale has reversed scoring, where respondents rate the percentage of the time that they felt *able* to perform each work activity, rather than the percentage of time they had *difficulty*. Previous studies have suggested that respondents may miss the difference in the reversed scoring for the physical scale; higher between scale and scale-total WLQ score correlations have been shown by using the same answer options as the other WLQ subscales.[3,25,26,28,33] After reviewing the literature and consulting with the developers of the WLQ, we used the reverse scoring with the "*difficulty"* answer options for the physical scale, for consistent scoring across all of the subscales. In this study, we calculated the WLQ productivity loss score and the 4 subscale scores according to the developers' instructions.

Health and Work Performance Questionnaire (HPQ)

The HPQ was designed to measure the workplace costs of health-related decreased job performance, sickness absence, and work-related injuries. The "absolute presenteeism" scale consists of a single item on which respondents rate their overall job performance on the days worked in the past 7 days, on a scale from 0=worst performance, to 10=top performance. To calculate absolute presenteeism, single-item responses are multiplied by 10, such that scores range from 0 (total lack of performance during time on the job) to 100 (no lack of performance during time on the job), as described by the developers.[14,15]

Work Productivity and Activity Impairment Questionnaire (WPAI)

The WPAI was designed to measure absenteeism, presenteeism, and daily activity impairment attributable to health problems. Presenteeism is assessed by a single item on which respondents rate how much health problems affected their productivity while working during the past seven days on a 0 to 10 scale, where 0=health problems had no effect on my work and 10=health problems completely prevented me from working. The single-item score is multiplied by 10 and expressed as the percentage of impairment while working as described by the developers.[17]

Employer productivity metrics

The participating billing department calculates individual-level productivity metrics on a monthly basis. Employer productivity metrics were obtained for each worker to correspond to the month during which they completed the baseline survey for this cross-sectional study, either August or October 2014. Within this department, there are 10 unique workgroups, each with similar but varying measures of worker output, such as the number of patient accounts processed, number of invoices per accounts processed, or number of payments posted per month. To reduce within month variability, we calculated productivity metrics at the monthly-level. Each worker has a daily production goal for the number of pieces of work he or she is expected to process on average over a month. We calculated individual worker productivity as the “percent of the monthly productivity goal attained” as follows: Average daily worker output/Daily production goal x 100. The percent of productivity goal attained ranges from 0 to over 100; scores below 100 indicate that the monthly goal was not met, whereas scores above 100 indicate that the goal was exceeded. To ensure confidentiality of study participants, employer productivity metrics were obtained for all employees (survey respondents and non-respondents). Actual work hours were also obtained from timesheets for all employees for the months corresponding to survey administration.

Data Analysis

All statistical analyses were conducted using *SPSS* version 20 and *SAS* version 9.4.

Description of the sample and of the self-reported productivity loss measures

All self-reported productivity loss questionnaire scores were transformed to 0-100 point scales for easier comparison, with lower scores indicating greater productivity loss. We calculated descriptive statistics (means, medians, standard deviations, interquartile ranges) for the study population and for each measure. We also assessed the floor and ceiling effects of the four health-related work productivity loss measures (WAI, WLQ and subscales, HPQ, WPAI) in this working population, which were considered to be present if more than 15% of the population achieved the highest or lowest possible score on each measure[41]. Cronbach's alpha coefficients were calculated to assess the internal consistency of the multi-item self-reported productivity loss measures (WAI, WLQ, and WLQ subscales) in this population, considering a Cronbach's alpha of greater than 0.70 to be acceptable and 0.90 or higher to be excellent.[42] We also tested for order effects among the three measures that were randomized in the survey (WLQ, HPQ, WPAI), using the ANOVA procedure in SAS.

Construct and discriminant validity

We evaluated the construct and discriminant validity of the self-reported work productivity loss measures by means of hypothesis testing, stating the expected relationships among measures. The following hypotheses were tested:

1. At least moderate positive correlations were expected between the WAI, WLQ, HPQ, and WPAI. These self-reported measures were designed to evaluate similar constructs of health-related work productivity, and thus should be correlated.
2. Moderate positive correlations were expected between each of the self-reported measures and the employer productivity metrics. Workers who self-reported greater health-related productivity loss were expected to show more difficulty meeting their work productivity goals, as measured by the employer productivity metrics.
3. Workers with worse health, as reported on the PHQ-15, were expected to report more health-related work productivity loss on the questionnaires than workers with better health. Although we expected relatively low levels of health-related productivity loss in this study population of workers performing sedentary office work, we expected that workers with a

greater number of health complaints, as indicated by the total PHQ-15 score, would report greater productivity loss than those with fewer health complaints.

We tested hypotheses 1 and 2 using Spearman rank correlations because the data were not normally distributed. We considered correlation coefficients of 0 to 0.19 to be “very weak”, 0.20 to 0.39 “weak”, 0.40 to be 0.59 “moderate”, 0.60 to 0.79 “strong”, 0.80 to 1.0 “very strong”[43]. We tested hypothesis 3 by examining statistical differences between groups of workers based on their health status. According to the PHQ-15 instruction manual, scores of 5, 10, and 15 points represent mild, moderate, and severe levels of symptoms, respectively. We defined cases as having a moderate level of physical symptoms defined by a cut-point of 10 or higher on the PHQ-15. We assessed the differences between cases and non-cases for each self-reported productivity loss measure using the Wilcoxon rank-sum test. We also explored the differences among cases and non-cases on employer productivity metrics.

Economic interpretation of the self-reported measures

To assess the variation in the economic interpretations provided by the self-reported measures from an employer’s perspective, we calculated the lost work time estimates provided by three of the self-reported measures (WLQ, HPQ, WPAI). The WAI was excluded from this analysis as its score was not designed to be readily translated to lost hours estimates. This analysis was limited to workers with complete data for the WLQ, HPQ, WPAI, and employer productivity metrics (n=47). For the WLQ, which uses a 2-week recall period, lost work hours were calculated by multiplying the percentage of productivity loss score by the actual hours worked in the 14 days prior to the survey date. For the HPQ, the single-item score for absolute presenteeism was subtracted from 100 to obtain the percentage of lost productivity; this percentage of lost productivity was multiplied by the number of hours worked in the past 14 days. For the WPAI, lost work hours were estimated by multiplying the percentage of impairment while working by the hours worked in the past 14 days. The HPQ and WPAI each use a 1-week recall period, however, we wanted to compare productivity loss estimates for the same recall period across all measures. Thus, we used the 1-week loss estimates to estimate loss over a 2-week period, using methods similar to those of Zhang et al.[27] Median salaries by job title were provided by the employer. Cost estimates of health-related productivity loss were calculated by multiplying the mean and median number of lost work hours obtained from each questionnaire by the median hourly salary for each worker's job title. We also estimated lost hours and cost estimate due to productivity loss using the employer productivity estimates, using two different estimates for the employer productivity metrics. First, we used the group level mean and median percent of productivity goal attained across all workers based on the employer-determined productivity goals. Second, we limited the percent of productivity goal attained to 100% since all of the questionnaires had a maximum score of 100. We estimated lost hours and costs according to the employer productivity metrics using the same methods as for the questionnaires, using workers' actual work hours and median hourly salaries.

RESULTS

Description of the analysis sample and the measures

All workers employed in the department were invited to participate in the study (n=132); 93 (70%) completed a baseline survey in either August (n=77) or October 2014 (n=16). Among the 93 workers who completed surveys, 62 (67%) were employed in departments that measured employer productivity metrics; the remaining 31 workers were employed as managers, supervisors, or in areas without measured productivity and were not included in the present analyses. Four additional workers were excluded from the analysis sample, 2 of whom were missing employer productivity metrics and 2 who were newly hired workers and did not yet have productivity goals. The 58 workers in the analysis sample were predominately female (88%), with a mean age of 43.2 years (SD=10.2), and a mean tenure of 7.2 years (SD=7.8) in their current job (Table 1). The majority of workers (64%) reported that they had been diagnosed with at least 1 health condition by a physician. Descriptive statistics for each measure are also presented in Table 1, including median scores and interquartile ranges. We found no statistically significant differences among the mean scores of the WLQ, HPQ, WPAI, due to the order in which they were administered. Scores on all self-reported productivity loss measures demonstrated right skewness, representing a low level of health-related productivity loss. All multi-item measures (WAI, WLQ, WLQ subscales) showed acceptable internal consistency; the WLQ, HPQ, and WPAI showed ceiling effects in this relatively healthy working population (see Table, Supplemental Digital Content 1).

Construct and discriminant validity

As stated in hypothesis 1, at least moderate correlations were expected among the 4 self-reported health-related productivity loss measures (WAI, WLQ, HPQ, WPAI). Correlations among the four self-reported questionnaires were moderate to strong, ranging from 0.51 to 0.70 (Table 2). The WLQ showed the strongest association with the WAI and WPAI (both r=0.70, respectively).

As stated in hypothesis 2, we also expected at least moderate correlations between the self-reported measures and the objectively measured employer productivity metrics; however, the WAI, HPQ, and WPAI were only weakly correlated with the employer productivity metrics (0.20-0.35). The WLQ overall productivity loss score showed only moderate correlations with the employer productivity metrics (0.46).

We expected that workers with more health complaints would report greater health-related productivity loss than workers with fewer health complaints, as stated in hypothesis 3. Results of Wilcoxon rank-sum tests showed statistically significant differences ($p \leq 0.05$) between cases and non-cases on three of the four questionnaires, the WAI, WLQ, and WPAI (Table 3); however, the HPQ showed no significant differences between cases and non-cases, and thus failed to meet our hypothesis.

We also explored whether cases would show greater productivity loss on employer productivity metrics versus non-cases. The median "percent of productivity goal attained" exceeded 100% for both cases and non-cases, indicating no actual productivity loss among either group; the difference between groups was not statistically significant.

Comparison of cost estimates of lost productivity

Estimates of lost hours and costs due to health-related lost work productivity as calculated from the self-reported measures and employer productivity metrics are presented in Table 4. The mean number of lost work hours over a 2-week period ranged from 2.4 hours (SD 2.9) according to the WLQ to 11.4 hours (SD 17.8) according to the WPAI. The mean costs corresponding to these lost hour estimates showed considerable variation as well, ranging from $42.66 (SD 52.44) for the WLQ to $206.62 (SD 320.13) for the WPAI. The employer productivity metrics showed no loss of productivity when the mean "percent of productivity goal attained" for the cohort was allowed to exceed 100%. However, when the "percent of productivity goal attained" was limited to 100%, the mean lost hours estimate was 0.9 hours per worker (SD 2.3) at a cost of $15.28 (SD 41.35).

DISCUSSION

Health-related productivity loss estimates varied widely among 4 commonly used questionnaires. Although our findings show some support for the comparability of these self-reported measures, correlations with employer productivity metrics were generally quite low. Workers with more health complaints reported greater health-related productivity loss than healthier workers, but employer productivity metrics showed no differences in workers' ability to meet their objective productivity goals. The economic estimates of productivity loss provided by simple cost calculations from the self-reported measures showed wide variation among the three different questionnaires, yet no loss according to actual workplace productivity.

Health-related productivity loss estimates vary widely across questionnaires. Self-reported health-related productivity loss was low in our study population of relatively healthy workers, although estimates varied among questionnaires, ranging from median scores of 0-15% loss. In another study of a general working population, Ozminkowski et al. showed similarly low levels of productivity loss, ranging from 4.9% productivity loss among workers using the WLQ versus 6.9% from the Work Productivity Short Inventory.[32] Other studies in more impaired clinic populations have shown greater levels of health-related productivity loss, and more varied estimates loss when comparing self-reported questionnaires head-to-head in the same study population[3,10,44-46]. In a study of workers with osteoarthritis or rheumatoid arthritis, Zhang et al. found productivity loss estimates ranging from 19% using the WLQ, to 31% using the HPQ, and 58% using the WPAI.[27]

Previous studies have reported only low to moderate correlations among these four measures, supporting some core conceptual differences among them.[25,27,47,48] If two measures evaluate the same construct, strong correlations should be expected between them[49]. Correlations among the self-reported measures were stronger in our cohort than previous studies have reported, showing moderate to strong (r=0.51-0.70) relationships between measures. The WLQ showed strong correlations with the WAI and the WPAI, indicating that they are measuring more similar constructs, yet the questionnaire comparisons producing lower correlations suggest some divergence in the underlying concepts measured or poor reliability and validity in this population. Most previous studies using these measures have been conducted in more impaired clinical populations, whereas our study population was a generally healthy, active working population. The performance of these measures may vary based upon the population in which they are used, thus it is important to evaluate an instrument's measurement properties in the population of interest.

Few studies have compared productivity loss estimates derived from self-reported questionnaires to actual records of employer productivity metrics as employer metrics can be difficult to obtain.[10,16] However, in order to interpret scores on the self-reported measures as being representative of workplace productivity, construct validity should be evaluated in relation to employer-measured productivity. In our study, the overall WLQ productivity loss score was moderately correlated with the employer productivity metrics (r=0.46), providing some evidence of construct validity. The WAI, HPQ, and WPAI were only weakly correlated with the employer productivity metrics (0.34, 0.35, and 0.20, respectively), providing little evidence that they accurately captured workplace productivity as measured by this employer.

Workers with more health complaints on the PHQ-15 reported significantly more productivity loss on the WAI, WLQ, and WPAI, yet these differences were not observed on the employer productivity metrics. The study population was a relatively healthy cohort of existing workers who were gainfully employed. Health problems may have had less of an impact on workers' measured productivity due to the low physical job demands of these office jobs; or workers' perceptions of the impact of their health on their productivity may have been overestimated in this workforce where productivity goals are monitored. The HPQ was not a sensitive measure for discriminating between cases and non-cases in this population. This result is not surprising as the HPQ does not directly ask workers to rate the effects of their health on their current performance, but is rather a global rating of one's "overall" performance on the days worked.

Despite relatively few validation studies of the self-reported measures, many studies have directly translated the scores of health-related productivity loss from these questionnaires to estimate the cost of lost work time by multiplying a percentage of productivity loss by worker salaries.[18-23] All self-reported measures tested in our study overestimated the actual productivity loss measured in our cohort. Consistent with the findings of Zhang et al.,[27] the WLQ provided the lowest mean lost hours and cost estimates; the WPAI showed the highest mean estimates but the lowest median estimates. The lack of correlation between the self-reported measures and the employer productivity metrics, and the wide variation in economic estimates provided by different instruments, show that significant caution should be exercised in interpreting the results of studies that directly translate worker-perceived productivity loss into cost estimates of actual productivity loss. Such methods may not be appropriate in many working populations.

Limitations

One limitation of our study was the small sample size which may limit the generalizability of our study findings; however, our results clearly show the need for additional, larger studies to validate self-reported health-related productivity loss questionnaires against employer productivity metrics. Demographic information was not available for non-respondents, so we were not able to test for non-response bias. We do not know whether participation was biased toward higher or lower performing workers in relation to concerns about study participation having an effect on their ability to meet productivity goals. In addition, the sickest workers may have been less likely to participate if they were absent from work due to health reasons when our survey was conducted, or have other concerns related to participation. Offering workers the opportunity to complete the survey at two different points in time may have reduced the likelihood of non-response bias. Another limitation was the difference in recall periods between measures; the WLQ used a 2-week recall period whereas the HPQ and WPAI used a 1-week recall period. In order to compare productivity loss cost estimates between measures, we assumed that health was relatively stable in this working population and scaled the 1-week productivity loss estimates from the HPQ and WPAI to match the 2-week recall period of the WLQ, similar to the methods of Zhang et al [27]. Although this was done to match the recall periods between measures, the costs of productivity loss for the HPQ and WPAI may have been either over- or underestimated.

Another limitation is the between-group variation in work tasks and productivity goals which may have led to lower agreement between the self-reported questionnaires and employer productivity metrics. Productivity goals may have been set differently by the supervisors for each participating work group or have been more difficult to attain for certain groups of workers. In addition, this employer proactively develops action plans to help workers who have difficulty meeting their productivity goals, thus workplace productivity is tightly controlled. Even in a group of workers with measured productivity, these metrics did not account for the quality of work output, which is a large component of productivity in addition to the quantity of work performed. Measures of worker output that are directly related to the company's income rather than relating productivity loss to worker salaries may have provided a better economic translation of the productivity loss measures.[50,51]

Strengths

The major strength of this study is that it is one of few to obtain both self-reported questionnaires and employer productivity metrics. Several previous studies have suggested that there are likely underlying conceptual differences between the self-reported questionnaires which have led to varied levels of agreement between them,[10,27,32,44] but few studies have compared productivity loss estimates derived from self-reported questionnaires to employer productivity metrics.[10,16] Despite the limitations in the employer productivity metrics and the study design, the self-reported measures showed far from perfect correlations and wide variation in estimating productivity loss. The self-reported health-related productivity measures consistently over-estimated actual productivity loss in our study.

Conclusions

Estimates of the indirect costs of chronic health conditions, including lost work productivity, are of tremendous importance to workers, employers, and society. Significant resources have already been dedicated by researchers, clinicians, and employers to develop measures of the effects of health on work performance and productivity. This study highlights the urgent need for additional validation studies and better cost models, as simple translation of questionnaire scores are unlikely to give accurate estimates of lost productivity costs in many jobs and industries. Agreement between questionnaire estimates of lost productivity and actual productivity measures was low in these billing office workers with closely monitored productivity; importantly, costs estimated by three commonly used questionnaires varied widely. Additional studies are needed to compare questionnaires with objective measures to see if these findings hold true in larger samples and in other industries, and to continue to improve measurement methods for health-related productivity loss. To date, there are insufficient data to indicate which of these estimates offers the most accurate measure of worker productivity and how these questionnaires perform in different industries and worker populations.

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Supplemental Digital Content 1.docx

Table, Supplemental Digital Content 1
Distribution of scores on and internal consistency of each self-reported health-related productivity loss questionnaire (n=58)

Measure	Missing n (%)	Mean (SD)	n (%) with lowest possible score	n (%) with highest possible score	Cronbach's alpha
Work Ability Index (WAI)	1 (2)	83.9 (13.6)	0 (0)	7 (12)	0.77
Work Limitations Questionnaire (WLQ)[a]	9 (16)	96.6 (4.1)	0 (0)	10 (20)	0.94
Time management scale [a]	7 (12)	84.1 (18.6)	0 (0)	17 (33)	0.89
Physical scale [a]	8 (14)	86.9 (20.4)	0 (0)	26 (52)	0.97
Mental-interpersonal scale [a]	6 (10)	88.1 (13.4)	0 (0)	13 (25)	0.92
Output scale [a]	6 (10)	87.5 (19.3)	0 (0)	28 (54)	0.94
Health and Work Performance Questionnaire (HPQ)[a,b]	2 (3)	88.6 (10.9)	0 (0)	18 (32)	n/a
Work Productivity and Activity Impairment Questionnaire (WPAI)[a,c]	1 (2)	84.2 (25.8)	0 (0)	34 (60)	n/a

[a] All self-reported productivity loss questionnaires were transformed to 0 to 100 scales with lower scores indicating greater productivity loss.
[b] Absolute presenteeism scale.
[c] Impairment while working due to health.

Table 1 Descriptive characteristics of the study population (n=58)

Characteristic	**mean (SD)**
Age, years (n=50)	43.2 (10.2)
Body mass index, kg/m2 (n=53)	34.0 (8.8)
Job tenure, years	7.2 (7.8)
	n (%)
Gender	
Female	51 (88)
Male	3 (5)
Missing	4 (7)
Highest level of education completed	
High school or equivalent	7 (12)
Technical school	6 (10)
Some college	36 (62)
College graduate	5 (9)
Missing	4 (7)
Number of health conditions reported	
No health conditions	20 (34)
1 health condition	15 (26)
2 health conditions	0
3 health conditions	11 (19)
4 health conditions	0
5 or more health conditions	11 (19)
Missing	1 (2)
	median (IQR)
Self-reported measures	
Patient Health Questionnaire-15 (PHQ-15) (range 0-30)[a] (n=58)	6.4 (5.6)
Work Ability Index (WAI)[b] (n=57)	84.5 (17.9)
Work Limitations Questionnaire (WLQ)[b,c] (n=49)	98.3 (4.8)
Time management scale[b] (n=51)	90.0 (25.0)
Physical scale[b] (n=50)	100.0 (25.0)
Mental-interpersonal scale[b] (n=52)	91.7 (16.0)
Output scale[b] (n=52)	100.0 (20.0)
Health and Work Performance Questionnaire (HPQ)[b,d] (n=56)	90.0 (20.0)
Work Productivity and Activity Impairment Questionnaire (WPAI)[b,e] (n=57)	100.0 (20.0)
Employer productivity metrics	
Percent of monthly productivity goal attained (range 0-no limit) (n=58)	111.4 (34.7)

[a] Higher scores indicate worse health.
[b] All self-reported productivity loss questionnaires were transformed to 0 to 100 scales with lower scores indicating greater productivity loss.
[c] Productivity loss score.
[d] Absolute presenteeism scale.
[e] Impairment while working due to health.
SD, standard deviation; PHQ-15, Patient Health Questionnaire-15.

Table 2 Correlations among self-reported health-related work productivity loss measures and employer productivity metrics (n=58)

	WAI[a] (n=57)	WLQ[a] (n=49)	WLQ Time [a] (n=51)	WLQ Physical [a] (n=50)	WLQ Mental [a] (n=52)	WLQ Output [a] (n=52)	HPQ[a,b] (n=56)	WPAI[a,c] (n=57)	Percent of goal attained (n=58)
Self-reported productivity loss questionnaires									
WAI [a]	---								
WLQ[a]	0.70**	---							
WLQ Time[a]	0.75**	0.91**	---						
WLQ Physical[a]	0.56**	0.75**	0.62**	---					
WLQ Mental[a]	0.67**	0.91**	0.87**	0.57**	---				
WLQ Output	0.66**	0.87**	0.76**	0.63**	0.72**	---			
HPQ[a,b]	0.62**	0.55**	0.57**	0.44**	0.56**	0.57**	---		
WPAI[a,c]	0.67**	0.70**	0.64**	0.61**	0.52**	0.61**	0.51**	---	
Employer productivity metrics									
Percent of goal attained	0.34**	0.46**	0.45**	0.30*	0.34*	0.45**	0.35**	0.20	---

*p < 0.05 (2-tailed), **p < 0.01 (2-tailed).

[a] All self-reported productivity loss questionnaires were transformed to 0 to 100 scales with lower scores indicating greater productivity loss.

[b] Absolute presenteeism scale.

[c] Impairment while working due to health.

WAI indicates Work Ability Index; WLQ, Work Limitations Questionnaire; HPQ, Health and Work Performance Questionnaire; WPAI, Work Productivity and Activity Impairment Questionnaire.

Table 3 Comparison of cases with moderate levels of physical symptoms (cut point at 10 points on the PHQ-15) and non-cases on the self-reported health-related productivity loss questionnaires and employer productivity measures (n=58)

Measures	**Cases (n=14)**	**Non-cases (n=44)**	***p***
Self-reported health-related productivity loss questionnaires			
WAI[a]			
n	14	43	
Median (IQR)	70.8 (22.9	89.3 (17.9)	<0.001
WLQ[a]			
n	10	39	
Median (IQR)	93.4 (8.1)	98.6 (3.8)	0.004
WLQ Time			
n	11	40	
Median (IQR)	70.0 (45.0)	94.4 (20.0)	0.005
WLQ Physical			
n	10	40	
Median (IQR)	66.9 (46.9)	100.0 (9.6)	0.004
WLQ Mental			
n	11	41	
Median (IQR)	83.3 (23.4)	91.7 (13.9)	0.008
WLQ Output			
n	11	41	
Median (IQR)	80.0 (30.0)	100.0 (15.0)	0.002
HPQ[a,b]			
n	14	42	
Median (IQR)	90.0 (10.0)	90.0 (20.0)	0.137
WPAI[a,c]			
n	14	43	
Median (IQR)	65.0 (70.0)	100.0 (10.0)	0.001
Employer productivity metrics			
Percent of monthly productivity goal attained			
n	14	44	
Median (IQR)	106.5 (25.4)	112.5 (45.5)	0.260

[a] All self-reported productivity loss questionnaires were transformed to 0 to 100 scales with lower scores indicating greater productivity loss.
[b] Absolute presenteeism scale.
[c] Impairment while working due to health.
PHQ-15, Patient Health Questionnaire-15; WAI, Work Ability Index; IQR, interquartile range; WLQ, Work Limitations Questionnaire; HPQ, Health and Work Performance Questionnaire; WPAI, Work Productivity and Activity Impairment Questionnaire.

Table 4 Lost hours and cost estimates due to health-related productivity loss in the past 2 weeks (Limited to subjects with complete data for all measures, n=47)

	All workers (n=47)		Cases only (PHQ-15 score≥10 pts) (n=9)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Self-reported measures				
WLQ				
Score	96.6 (4.1)	98.3 (4.7)	92.6 (6.1)	94.3 (9.4)
Lost hours [a]	2.4 (2.9)	1.2 (3.1)	5.0 (4.6)	2.9 (6.7)
Cost, USD [b]	$42.66 (52.44)	$21.91 (60.75)	$89.89 (83.24)	$51.63 (119.96)
HPQ				
Score	88.5 (11.4)	90.0 (20.0)	84.4 (10.1)	90.0 (15.0)
Lost hours [a]	8.1 (8.1)	7.1 (13.9)	10.8 (7.6)	8.9 (12.2)
Cost, USD [b]	$146.50 (145.43)	$128.34 (252.66)	$193.88 (135.68)	$158.86 (219.13)
WPAI				
Score	83.0 (26.4)	100.0 (20.0)	50.0 (32.0)	40.0 (60.0)
Lost hours [a]	11.4 (17.8)	0 (14.9)	33.6 (22.9)	42.2 (40.9)
Cost, USD [b]	$206.62 (320.13)	$0 (277.41)	$602.32 (410.61)	$757.99 (734.48)
Employer productivity metrics				
Group-level average for all workers				
Percent of monthly productivity goal attained	123.2 (30.5)	112.0 (43.7)	107.5 (13.0)	100.3 (20.9)
Lost hours [a]	0 (0)	0 (0)	0 (0)	0 (0)
Cost, USD [b]	$0 (0)	$0 (0)	$0 (0)	$0 (0)
Group-level average for all workers, limited to 100%				
Percent of monthly productivity goal attained	98.8 (3.0)	100.0 (0)	98.9 (1.9)	100.0 (1.9)
Lost hours [a]	0.9 (2.3)	0 (0)	0.8 (1.4)	0 (1.4)
Cost, USD [b]	$15.28 (41.35)	$0 (0)	$14.13 (25.60)	$0 (0)

[a] Lost hours= % of productivity loss estimate from each measure x actual work hours during 2-week recall period

[b] Cost= Lost hours x worker salary

SD, standard deviation; IQR, interquartile range; WLQ, Work Limitations Questionnaire; USD, United States dollars; HPQ, Health and Work Performance Questionnaire; WPAI, Work Productivity and Activity Impairment Questionnaire.