Productivity Loss Due to Presenteeism Among Patients with Arthritis: Estimates from 4 Instruments

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ABSTRACT. ***Objective.*** To estimate and compare lost work hours attributable to presenteeism, defined as reduced productivity while working, in individuals with osteoarthritis (OA) or rheumatoid arthritis (RA), according to 4 instruments.

Methods. In our prospective study, 250 workers with OA (n = 130) or RA (n = 120) were recruited from community and clinical sites. Lost hours due to presenteeism at baseline were estimated using the Health and Labor Questionnaire (HLQ), the Work Limitations Questionnaire (WLQ), the World Health Organization's Health and Work Performance Questionnaire (HPQ), and the Work Productivity and Activity Impairment Questionnaire (WPAI). Only those respondents working over the past 2 weeks were included. Repeated-measures ANOVA was used to compare the lost-time estimates, according to each instrument.

Results. Of the 212 respondents included in the analyses, the frequency of missing and "0" values among the instruments was different (17% and 61% for HLQ, 8% and 5% for WLQ, 1% and 16% for HPQ, 0% and 27% for WPAI, respectively). The average numbers of lost hours (SD) per 2 weeks due to presenteeism using HLQ, WLQ, HPQ, and WPAI were 1.6 (3.9), 4.0 (3.9), 13.5 (12.5), and 14.2 (16.7). The corresponding costs for the 2-week period were CAN$30.03, $83.05, $284.07, and $285.10. The differences in the lost-hour estimates according to instruments were significant ($p < 0.001$).

Conclusion. Among individuals with arthritis, estimates of productivity losses while working vary widely according to the instruments chosen. Further research on instrument design and implications for a standardized approach to estimate lost time due to presenteeism is needed. (J Rheumatol First Release July 1 2010; doi:10.3899/jrheum.100123)

Key Indexing Terms:
PRESENTEEISM ARTHRITIS PRODUCTIVITY ECONOMICS EMPLOYMENT

The total cost or economic burden attributable to diseases is usually separated into direct healthcare-related costs and indirect costs due to productivity losses[1]. Typically the focus of policymakers has been on direct costs, because they are used in economic evaluations of different interventions to make healthcare resource allocation decisions. Less attention is paid to indirect costs because most national guidelines for economic evaluations of healthcare interventions relegate them to unimportance for healthcare funding decision-making. This tends to penalize diseases such as arthritis in which the burden of disease due to indirect costs is relatively high. It also means that the high societal costs of disease and interventions other than healthcare treatment are often ignored in managing chronic illness. In 1998, the

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societal economic costs of arthritis in Canada were over CAN$4.4 billion, with 80% of these being attributable to unemployment and underemployment[2]. Similarly, a 2009 audit report for the UK notes that rheumatoid arthritis (RA) alone costs the National Health Service around £560 million a year in healthcare costs, while the cost to the economy of sick leave and work-related disability was £1.8 billion[3]. In 2003, the total costs attributable to arthritis and other rheumatic conditions in the United States was about US$128 billion ($80.8 billion in direct and $47.0 billion in indirect costs)[4].

Within the indirect cost estimation literature, productivity losses have been measured primarily according to days absent from work, reduced work hours, and job loss[5,6,7,8]. However, increasing evidence shows that presenteeism, based on the concept of reduced productivity while working, may be the dominant source of productivity losses[9,10] and needs to be properly measured. Among people with arthritis, it has been estimated that presenteeism accounts for 41% (CAN$4,724 per person per year) of total productivity losses, which exceeded losses due to job loss/change (37%), decreased work hours (12%), or absenteeism (10%)[9]. This is all the more important when one recognizes that the true cost-effectiveness of expensive therapies that reduce the indirect costs will remain underestimated in the absence of their proper measurement.

A number of self-reported instruments are available for measuring health-related difficulties with workplace tasks, work limitations, or work impairments. Although these instruments were not originally developed to quantify presenteeism, they are increasingly being used for that purpose[11,12,13,14,15]. However, many challenges remain in terms of identifying an optimal or ideal approach to measure and value presenteeism. A recent review revealed 14 different instruments that have been used or have been thought to have potential for costing[15], although these approaches often measure presenteeism from unique perspectives, and comparability between methods is currently unclear. Only a few studies have directly compared the time-loss estimates from different instruments, and they revealed low correlations among instruments[6,7,16,17]. Meerding, *et al*[7] and Ozminkowski, *et al*[17] also found that the estimates from instruments have different associations with health indicators and job characteristics.

Our objective was to compare the lost-hour estimates and associated monetary valuation of productivity loss due to presenteeism among workers with osteoarthritis (OA) or RA according to the Health and Labor Questionnaire (HLQ), the Work Limitations Questionnaire (WLQ), the World Health Organization's Health and Work Performance Questionnaire (HPQ), and the Work Productivity and Activity Impairment Questionnaire (WPAI), and to examine whether the estimates had similar associations with worker characteristics. These 4 instruments were chosen because of their frequent application and strong evidence of validity in arthritis and/or musculoskeletal disorders[15]. Most importantly, these instruments were also thought to have good potential to translate presenteeism into a monetary value for economic estimations of the burden of illness. To date, no studies have specifically focused on comparing the time-loss estimates according to these 4 instruments and examining their associations with workers' demographic, job, and disease characteristics.

MATERIALS AND METHODS

Study design. Individuals with a diagnosis of OA or RA and aged between 18 and 65 years were recruited from 3 rheumatology centers: 2 tertiary-level clinics in urban teaching hospitals in Toronto, and the patient registry for a multidisciplinary and multilevel (primary and tertiary) care center in Vancouver. After providing written consent, respondents completed screening questionnaires to determine disease type and work status. Only individuals who had been working for pay in the previous month were eligible. At baseline, the WLQ, WPAI, HPQ, HLQ, and other work outcome questionnaires were administered to all respondents in the same order. All eligible individuals were subsequently reassessed at 3 different timepoints (3, 6, and 12 months). A total of 250 respondents (OA, n = 130; RA, n = 120) were eligible. The cohort has been documented in detail[18]. For this report, only the cross-sectional baseline data were used.

Instruments. The HLQ was designed to collect quantitative data on the connections among illness, treatment, and work performance[16,19]. The developers state that the instrument can provide estimates of production losses (costs). Reduced productivity at work is quantified by a single question asking how many extra hours individuals would have to work to catch up on tasks they were unable to complete in normal working hours due to health problems in the past 2 weeks.

The WLQ was originally developed to measure the effect of chronic diseases and treatment on work performance[20,21,22]. It is a 25-item questionnaire asking about the frequency of difficulty over the past 2 weeks over 4 domains of work: time management, physical demands, mental-interpersonal, and output demands. A WLQ Productivity Loss Index is calculated as a weighted sum of the 4 domain scores (out of 100), and then it is converted into a relative measure, indicating percentage of productivity loss due to health problems relative to the healthy worker's norm[23]. Thus, the number of lost hours due to presenteeism is calculated by multiplying the percentage of productivity loss by the number of hours an individual worked.

The HPQ was designed to assess the indirect workplace costs of health-related reduced job performance, sickness absence, and injuries from work-related accidents[24,25]. Respondents are asked to rate their overall performance on the days they worked during the past 7 days on a scale of 0–10, with 0 indicating total lack of performance during time on the job and 10 indicating no lack of performance during time on the job[24,25,26]. We assumed that the ideal work performance was at 100%. Presenteeism was assessed as reduced work performance as a percentage below 100% and the implied loss in hours of work estimated by multiplying this by the number of hours worked.

The WPAI was developed as a self-reported quantitative assessment of the amount of absenteeism, presenteeism, and daily activity impairment attributable to health problems[27,28]. The impairment while working due to health problems in the past 7 days is measured on a scale of 0–10. The score is expressed as the percentage of impairment while working due to health, with higher scores indicating greater impairment. The number of lost hours due to presenteeism is estimated by multiplying the percentage of impairment by the number of hours worked.

Analysis. Productivity loss due to presenteeism was quantified by the number of lost hours due to reduced productivity at work during the past 2 weeks according to the 4 instruments. Hourly wage was obtained from the 2006 labor force survey of Statistics Canada[29]. Based on the human capital (HC) approach[5,30], the cost of presenteeism was then calculated by multiplying the number of lost hours by the average hourly wage for different age, sex, working status (full-time vs part-time), and occupations defined using the National Occupational Classification (NOC). Only those who reported working hours in the past 2 weeks were included in the analysis because actual working hours were needed to calculate lost hours for the WLQ, HPQ, and WPAI.

Univariate statistics were used to describe the characteristics of the participants. These characteristics include sociodemographic information, occupation type based on the NOC, current work status, and duration, type and self-reported severity of arthritis (1, very mild to 7, very severe), general health status[31], the number of medical problems other than OA and RA[32], pain visual analog scale score (0–100), and Health Assessment Questionnaire (HAQ) score[33,34].

Univariate statistics were calculated for each of the 4 lost-hour estimates due to presenteeism. Frequencies of "lost hour estimates = missing," "0," and "> 0", respectively, were also presented. Repeated-measures ANOVA was used to compare the lost-time estimates across instruments. Multiple pairwise comparisons between instruments were performed with Bonferroni correction. Agreement between instruments was assessed using the intraclass correlation coefficient (ICC) with a 2-way mixed effect model so that the subject effect was random and the instrument effect was fixed[35]. Bland-Altman plots were used to examine patterns of interinstrument agreement[36,37].

Because of the skewed data, we used the Wilcoxon rank-sum test (2 groups) or the Kruskal–Wallis test (3 groups) on differences in lost-hour estimates due to presenteeism among groups defined by participant characteristics. To measure the association of lost hours due to presenteeism with HAQ, pain, or arthritis severity, a simple logistic regression model was first applied using "lost hours due to presenteeism > 0 vs = 0" as the dependent variable. The Spearman correlations between HAQ, pain, disease severity, and lost hours were then measured only among respondents whose lost hours due to presenteeism were > 0.

RESULTS

A total of 212 participants (OA, n = 111 and RA, n = 101) provided information about their actual working hours for the past 2 weeks and thus were included in our analysis. The mean age was 50.5 years, 83% were women, 54.2% had had arthritis for more than 5 years, and 83% rated their health status as good or better (Table 1). In general, the participants had a low function disability level (HAQ = 0.8), moderate arthritis (severity = 3.1), and mild pain (35.2).

Most respondents (70.8%) were working full-time and the average number of hours worked was 69.9 (9.2 days). The percentage of respondents who reported that they were hindered by arthritis at work was 43.8%, and 5.2% were absent from work in the past 2 weeks.

Table 2 presents the lost hours and costs due to presenteeism according to the 4 instruments. The missing data rate for the HLQ was the highest (17%) and most of the responses to the HLQ were 0 (60.9%). There were no missing data for the WPAI. The distribution of the lost hours was positively skewed for all the instruments, with most lost-hour estimates being small. The average number of lost hours per 2-week period due to presenteeism was 1.6 for the HLQ, 4.0 for the WLQ, 13.5 for the HPQ, and 14.2 for the WPAI ($p < 0.001$). The total corresponding costs for the 2-week period

Table 1. Demographic, disease, and job characteristics (n = 212).

Variables	N	%
Age, yrs, mean (SD)	50.5 (9.3)	
Women	176	83.0
Diagnosis		
Osteoarthritis	111	52.4
Rheumatoid arthritis	101	47.6
Disease duration		
< 1 yr	21	9.9
1–5 yrs	72	34.0
> 5 yrs	115	54.2
Education		
High school or less	38	17.9
Some university or college	83	39.2
University graduate	90	42.5
Marital status		
Single	39	18.4
Married, living as married, committed relationship	125	59.0
Divorced, separated, widowed	47	22.2
Current work status		
Full-time	150	70.8
Part-time	60	28.3
Unemployed (i.e., looking for work)	1	0.5
Occupation		
Business, finance, administration	88	41.5
Health, science, arts, sports	69	32.5
Sales and services	38	17.9
Trades, transport, equipment operators	15	7.1
Income (CAN$)		
Prefers not to answer	24	11.3
< 20,000	22	10.4
20–34,999	23	10.8
35–49,999	34	16.0
50–74,999	50	23.6
> 75,000	47	22.2
Health status		
Excellent or very good	88	41.5
Good	88	41.5
Fair or poor	36	17.0
Other medical problems		
0	83	39.2
1	64	30.2
2	45	21.2
> 2	20	9.4
Hindered by arthritis at work in the past 2 weeks		
No, not at all	117	55.2
Yes, to a degree	77	36.3
Yes, very much	16	7.5
Absent from work due to arthritis in the past 2 weeks	11	5.2
	Mean (SD)	Median (Q1-Q3)
Health Assessment Questionnaire index (0–3)	0.8 (0.6)	0.9 (0.3–1.3)
Arthritis severity (1–7)	3.1 (1.7)	3.0 (1.0–4.0)
Pain score (0–100)	35.2 (26.5)	30.0 (10.0–60.0)
No. of working hours in the past 2 weeks	69.9 (27.7)	72.0 (51.9–80.0)
No. of working days in the past 2 weeks	9.2 (2.5)	10.0 (8.0–10.0)

Table 2. Lost hours and costs due to presenteeism in the past 2 weeks. Numbers are mean (SD) unless otherwise indicated. Costs are Canadian dollars.

	Mean (SD)	Median (Q1–Q3)
HLQ		
Response, n (%)		
Missing	36 (17.0)	
0	129 (60.9)	
> 0	47 (22.2)	
Lost hours for all	1.6 (3.9)	0.0 (0.0–1.0)
Lost hours for response > 0	5.8 (5.7)	4.0 (2.0–7.0)
Costs for all	$30.03 (73.05)	$0.00 (0.00–22.74)
WLQ		
Response, n (%)		
Missing	16 (7.6)	
0	10 (4.7)	
> 0	186 (87.7)	
Lost hours for all	4.0 (3.9)	3.1 (1.2–5.1)
Lost hours for response > 0	4.2 (3.9)	3.2 (1.4–5.5)
Costs for all	$83.05 (82.62)	$57.32 (25.06–114.36)
HPQ		
Response, n (%)		
Missing	2 (0.9)	
0	34 (16.0)	
> 0	176 (83.0)	
Lost hours for all	13.5 (12.5)	10.0 (5.1–17.6)
Lost hours for response > 0	16.1 (12.0)	13.6 (7.5–20.6)
Costs for all	$284.07 (307.76)	$197.22 (82.15–380.36)
WPAI		
Response, n (%)		
Missing	0 (0.0)	
0	58 (27.4)	
> 0	154 (72.6)	
Lost hours for all	14.2 (16.7)	8.7 (0.0–19.8)
Lost hours for response > 0	19.6 (16.7)	14.5 (8.0–24.0)
Costs for all	$285.10 (355.66)	$182.93 (0.00–393.91)

HLQ: Health and Labour Questionnaire; WLQ: Work Limitations Questionnaire; HPQ: WHO Health and Work Performance Questionnaire; WPAI: Work Productivity and Activity Impairment Questionnaire. $p < 0.001$ for comparison of means using repeated measures analysis of variance. $p < 0.05$ for all 6 pairwise comparisons except for HLQ vs WLQ and HPQ vs WPAI (Bonferroni correction).

were CAN$30.03, $83.05, $284.07, and $285.10. Pairwise comparisons using Bonferroni's correction showed that there were not significant differences between the HLQ and the WLQ or between the HPQ and the WPAI, although without Bonferroni's correction the difference between the HLQ and the WLQ was significant ($p = 0.034$).

Analysis of agreement. The ICC across all the 4 lost-hour estimates of presenteeism was 0.35 (95% CI 0.28–0.43). The ICC between pairs of instruments were $\rho_{HLQ\ vs\ WLQ}$ = 0.22 (0.08–0.34), $\rho_{HLQ\ vs\ HPQ}$ = 0.16 (0.02–0.29), $\rho_{HLQ\ vs\ WPAI}$ = 0.37 (0.25–0.48), $\rho_{WLQ\ vs\ HPQ}$ = 0.26 (0.13–0.38), $\rho_{WLQ\ vs\ WPAI}$ = 0.30 (0.17–0.41), and $\rho_{HPQ\ vs\ WPAI}$ = 0.61 (0.51–0.68). The low ICC indicated low agreement between instruments. For all Bland-Altman plots (Figure 1a-f), the deviations greater than the generally acceptable twice the SD tended to happen at the higher end of lost-time estimates rather than randomly across the scale. The Bland-Altman plots for the HPQ and the WPAI and for the HLQ and WLQ had a fan-like shape, which indicates that the difference between the 2 estimates increases as the average lost-hour estimates increase (Figures 1a and 1f). All other plots showed that at the higher levels of lost-hour estimates the relationship between the difference and the average of 2 methods tended to be positively linear, indicating that 1 measure is mostly greater than the other as the average of the 2 measures is high. The poor agreement was also well illustrated by scatter plots of lost hours due to presenteeism according to instruments for all respondents, in which the respondents were ordered according to their lost-hour estimates using WPAI (Figure 2).

Associations between lost-hour estimates due to presenteeism and participant characteristics. According to the 4 instruments, the lost hours due to presenteeism were significantly associated with whether respondents felt hindered by arthritis at work and with their health status (Table 3). But no significant association was found between lost-hour estimates and sex, arthritis type, and occupations. The respondents with disease duration > 5 years lost significantly more hours due to presenteeism than those with duration ≤ 5 years only when the HLQ was applied. The respondents with other medical conditions were more likely to lose hours due to presenteeism, but the trend was significant only when the HLQ was used.

Functional disability, pain, and arthritis severity were all significantly associated with the risk of losing hours due to presenteeism according to all 4 instruments (Table 4). But for those with lost hours > 0, the low Spearman correlations indicated weak associations between lost-hour estimates and functional disability, pain, and arthritis severity.

DISCUSSION

We compared productivity loss due to arthritis while working according to 4 different instruments and showed that the lost-hour estimates varied widely during a 2-week period from a mean of 1.6 hours to 14.2 hours. The HLQ gave a minimum mean estimate and the WPAI gave a maximum, while the distribution of lost-hour estimates for all 4 instruments was skewed to the right with relatively more 0 or low lost-hour estimates. Among respondents to the HLQ, 69% had a higher lost-hour estimate for the WPAI than the HLQ and 28% had a 0 lost-hour estimate on both instruments. Agreement between instruments was very low (ICC < 0.40) except for that between HPQ and WPAI (ICC = 0.61). Bland-Altman plots suggested that although the agreement between HPQ and WPAI is higher than the agreement between other pairs, their agreement gets lower as the productivity loss estimates increase. The associations between lost-hour estimates due to presenteeism and participant characteristics were also different depending on which

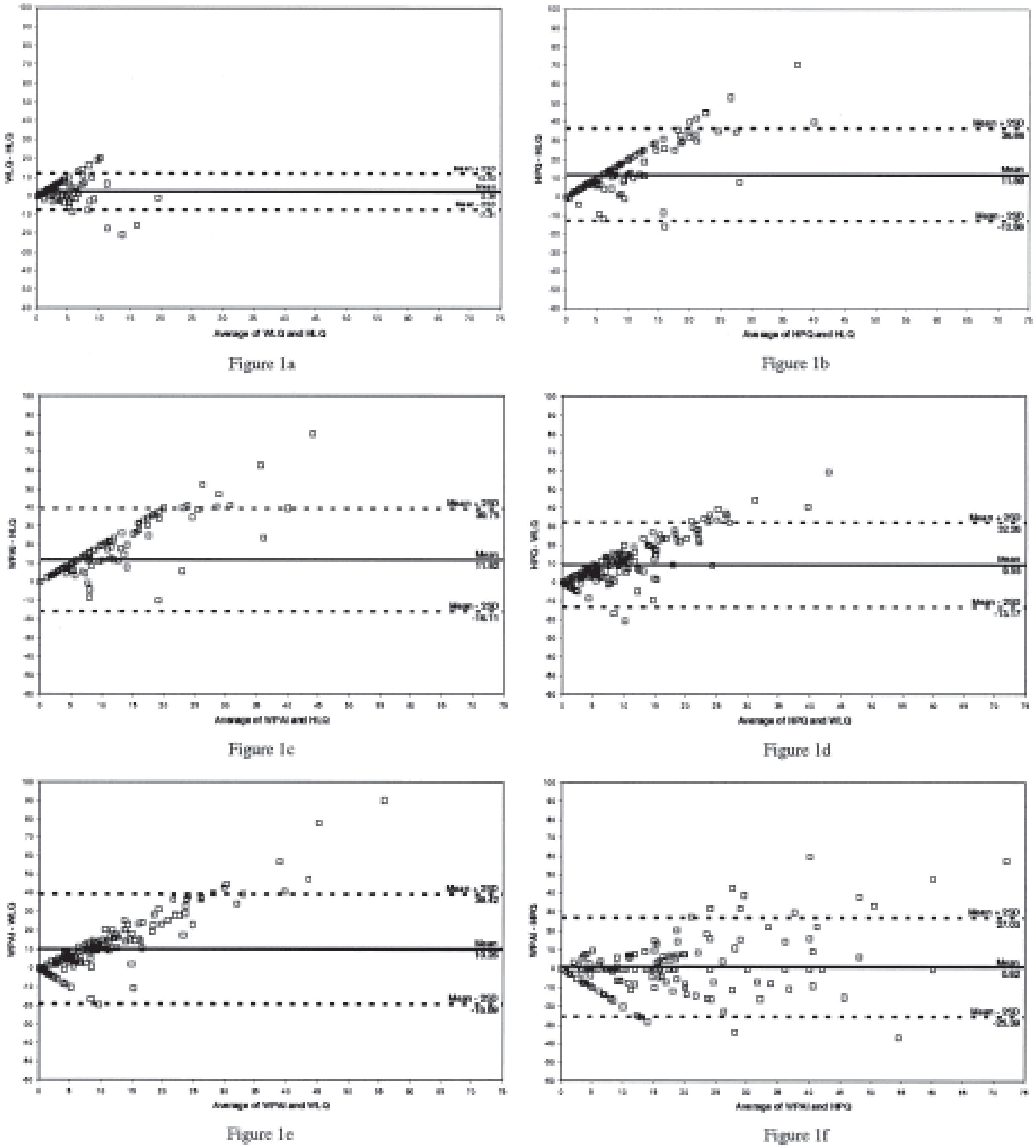

Figure 1. Bland-Altman plots. HLQ: Health and Labor Questionnaire; WLQ: Work Limitations Questionnaire; HPQ: WHO Health and Work Performance Questionnaire; WPAI: Work Productivity and Activity Impairment Questionnaire.

instrument was used. This lack of agreement between instruments suggests that current measurement methods may have important underlying conceptual differences in the way presenteeism is defined, and that users of these measures need to carefully consider whether specific conceptualization of presenteeism by these tools is appropriate for their intended purpose and/or population.

The HLQ was an instrument that directly asked individuals to estimate lost hours due to presenteeism. It measured reduced productivity by asking people to estimate the number of hours required to compensate for reduced work productivity rather than to estimate reduced productivity directly[6,12]. This method implies that if an employee caught up on lost work during normal working hours or if that employee did not have to or was not able to catch up on lost work, no productivity loss would occur[6]. This might explain why the

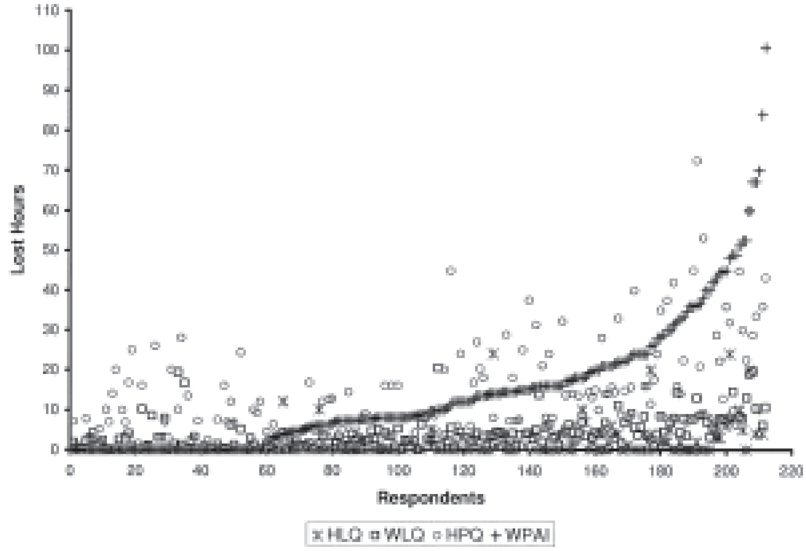

Figure 2. Scatter plot of lost hours due to presenteeism according to instruments. Y-axis represents the lost-hour estimates according to instruments; x-axis represents the respondents; respondents were ordered by their lost-hour estimates using WPAI. HLQ: Health and Labor Questionnaire; WLQ: Work Limitations Questionnaire; HPQ: WHO Health and Work Performance Questionnaire; and WPAI: Work Productivity and Activity Impairment Questionnaire.

Table 3. Univariate correlation of lost-hour estimates with demographic, disease, and job characteristics. Value indicated by mean (SD).

Characteristic	HLQ	WLQ	HPQ	WPAI
Hindered by arthritis at work				
No, not at all	0.4 (1.3)*	3.2 (3.9)*	9.5 (8.4)*	7.8 (10.0)*
Yes, to a degree	2.8 (5.1)	4.8 (3.4)	18.4 (15.2)	20.6 (18.4)
Yes, very much	5.5 (6.8)	7.0 (4.9)	21.0 (13.6)	31.7 (24.1)
Health status				
Excellent or very good	0.6 (1.6)*	3.3 (3.7)*	11.5 (12.1)*	9.5 (15.5)*
Good	1.4 (4.0)	4.0 (3.5)	12.3 (9.5)	14.9 (14.9)
Fair or poor	4.5 (6.1)	5.9 (4.7)	21.6 (16.8)	24.2 (19.4)
Diagnosis				
OA	1.6 (3.7)	3.8 (3.7)	12.8 (12.6)	12.4 (15.2)
RA	1.5 (4.0)	4.3 (4.1)	14.3 (12.4)	16.3 (18.0)
Sex				
Male	1.5 (4.4)	4.0 (4.4)	14.3 (12.8)	13.8 (18.2)
Female	1.6 (3.8)	4.0 (3.8)	13.2 (12.3)	14.3 (16.5)
Duration				
≤ 5 yrs	1.1 (3.8)*	4.1 (4.2)	13.4 (13.9)	12.3 (14.5)
> 5 yrs	1.9 (4.0)	4.0 (3.7)	13.2 (10.9)	15.8 (18.4)
Occupation				
Business, finance, administration	1.5 (3.7)	4.2 (4.1)	14.4 (14.8)	13.0 (15.1)
Health, science, arts, sports	1.2 (2.7)	3.4 (2.8)	13.5 (11.8)	13.5 (17.1)
Sales and services	1.1 (2.5)	3.7 (4.3)	11.0 (7.8)	15.2 (17.1)
Trades, transport, equipment operators	2.8 (6.6)	6.5 (5.8)	15.1 (11.6)	22.7 (22.6)
Other medical problems				
0	1.1 (3.3)*	3.6 (3.9)	12.7 (12.4)	12.6 (17.0)
1	1.1 (2.5)	4.2 (3.6)	12.5 (12.6)	13.0 (15.3)
2	2.1 (4.9)	3.9 (3.5)	14.2 (11.3)	14.4 (11.7)
> 2	3.7 (6.4)	5.4 (5.7)	18.4 (14.6)	24.6 (25.2)

* $p < 0.05$ for Wilcoxon test (2 groups) or Kruskal-Wallis test (3 groups). HLQ: Health and Labour Questionnaire; WLQ: Work Limitations Questionnaire; HPQ: WHO Health and Work Performance Questionnaire; WPAI: Work Productivity and Activity Impairment Questionnaire; OA: osteoarthritis; RA: rheumatoid arthritis.

Table 4. Univariate correlation of lost-hour estimates with function, pain, and arthritis severity. Values in parentheses are SE.

	Intercept	HAQ Coefficient	Intercept	Pain Coefficient	Intercept	Arthritis Severity Coefficient
Simple logistic regression*						
HLQ	–2.06 (0.34)	1.13 (0.29)**	–2.11 (0.34)	0.03 (0.01)**	–2.55 (0.44)	0.45 (0.11)**
WLQ	1.26 (0.40)	4.88 (1.80)**	1.16 (0.48)	0.10 (0.04)**	0.86 (0.65)	0.99 (0.39)**
HPQ	1.04 (0.28)	0.83 (0.34)**	0.53 (0.29)	0.04 (0.01)**	–0.05 (0.37)	0.67 (0.15)**
WPAI	–0.05 (0.25)	1.43 (0.31)**	–0.54 (0.27)	0.06 (0.01)**	–0.81 (0.33)	0.66 (0.12)**
Spearman correlations†						
HLQ		0.41		0.25		0.23
WLQ		0.15		0.20		0.20
HPQ		0.41		0.25		0.23
WPAI		0.15		0.20		0.20

* Lost hours due to presenteeism > 0 vs 0. ** P < 0.05 for simple logistic regression coefficient. † Correlation was measured only among the patients whose lost hours due to presenteeism were > 0. HLQ: Health and Labour Questionnaire; WLQ: Work Limitations Questionnaire; HPQ: WHO Health and Work Performance Questionnaire; WPAI: Work Productivity and Activity Impairment Questionnaire; HAQ: Health Assessment Questionnaire.

lost-hour estimates using the HLQ were mostly zeros (61%) and the mean estimates were much lower than those using other instruments. In addition, many missing values from the HLQ (17%) might indicate that respondents did not understand the question or they had difficulty in understanding how to provide the estimates.

Lerner, *et al* attempted to measure the relationship between self-reported work limitations measured by the WLQ and objectively measured work productivity among 2612 customer service department representatives and return department employees in a large firm[22]. The objective measures of work productivity were indicated by the number of telephone calls answered per payroll-hour and the number of merchandise units processed per hour. According to the relationship found in the study, weights were generated for the 4 WLQ domains and the weighted summary was then converted into the percentage of productivity loss while working relative to the healthy worker norm. The WLQ was validated by an objective measure of productivity loss while working, which is normally considered the gold standard. However, the estimation of productivity loss while working depends on the weights for the 4 WLQ domains, which were generated only from the single study. The weights might differ for populations with different occupations working in different locations. Moreover, the weights were not derived by taking into account chronic diseases such as arthritis[12]. In addition, the maximum percentage of productivity loss while working according to the WLQ is 25%[23], which may not be true and needs further verification. This may explain why the lost-hour estimates using the WLQ were lower than the estimates using the HPQ and the WPAI.

In the HPQ, respondents are asked to rate the work performance of people in a similar job and their own usual performance before rating their own current work performance[24,25]. In this way, the respondents' current performance can be compared with the performance of average workers and with their own usual performance. In our study, we found that the respondents' ratings on their current performance were similar to their ratings on average workers' performance and their own usual performance. Mattke, *et al* suggest that measuring comparative performance sets up a benchmark for one's perceived performance and provides a reference against which productivity loss can be measured[14]. When measuring the effect of health problems on a person's work performance, the ideal reference would be his or her work performance when he or she did not have any health problems. The average worker's performance also acts as a point of reference, but the reliability of one's evaluation of other workers' performance remains questionable. For example, the social comparison may elicit more socially desirable responses, with respondents being less likely to state that they are performing below average. In addition, according to the scoring manual[26], the algorithm for HPQ "relative presenteeism," a ratio of current performance to the performance of most workers at the same job, does not provide a score between 0 and 1. Thus, we were not able to generate a lost-hour estimate based on HPQ relative presenteeism. Instead, in our study, the lost-hour estimates were generated based on 1 item, respondents' self-rated current work performance.

Using a scale of 0–10, the WPAI measures the effects of health problems on work while working[27,28]. It is worth noting that assessments using a 0–10 scale, with 1 as the minimum unit, may contribute to a higher estimate of the lost hours due to presenteeism. Each 1 unit represents an additional 10% of the actual working hours that are lost. For example, if 1 person worked for 80 hours in the past 2 weeks, the lost hours due to presenteeism would be 8 hours for WPAI scale = 1 and 24 hours for WPAI scale = 3. It is impossible to obtain a lost-hour estimate between 0 and 8 or between 16 and 24, and so on. A similar scale of 0–10 is also applied in the HPQ. Based on a similar scale, the lost-hour estimates using the WPAI agreed more highly with those using the HPQ than with those using the other 2 instruments and their estimates were not significantly different. However, the estimates they provide do not appear to be sensitive to small changes in performance at the individual level.

Similar results were also found in other studies that have directly compared time-loss estimates from multiple instruments. Based on 53 weekly diaries from employees of a Dutch trade firm, Brouwer, *et al* found that the HLQ yielded the highest 0 answers (85%) and the lowest average lost-hour estimates: 0.23 hours compared with 1.54 hours using the Quantity and Quality instrument (QQ) and 1.72 using the Osterhaus method (OST)[6]. Similarly, according to Meerding, *et al*, only 30% of construction workers and 25% of industrial workers with work limitations due to health problems provided non-zero answers in the HLQ and 27% had values missing[7]. Poor agreement between the HLQ and the QQ was also reported in their study. In a study by van Roijen, *et al*, 8.9 days per migraine patient per year were lost due to reduced efficiency according to the OST, while the HLQ estimated 2.7 days per patient per year[16]; the Pearson correlation was 0.41. In the study by Ozminkowski, *et al*, the percentage of work time lost due to presenteeism based on the Work Productivity Short Inventory was 6.91%, which was significantly higher than that based on the WLQ (4.91%)[17]. Even though our study and these studies were conducted among different populations, they all suggested a lack of comparability among instruments, which creates difficulty in comparing the productivity loss estimates due to presenteeism across studies using different instruments.

It should be noted that our study cohort came from 3 urban centers in Canada. A total of 83% of participants were women. Our study subjects had relatively higher education and their jobs were mostly physically undemanding. Therefore, the results may not be generalizable for the entire employed arthritis population in Canada. In addition, to have a decent sample size, we decided to conduct the analyses by pooling patients with OA and RA. However, we have found that the lost-hour estimate according to each instrument was not significantly different between patients with OA and patients with RA, and the difference among instruments in each patient population continues to be large (Table 3).

There are several limitations to our study that highlight the need for ongoing research in this area. One such limitation is that the 4 instruments had different recall periods, which may contribute to the differences among their estimates. The recall period for the HLQ and WLQ was 2 weeks and that for the HPQ and WPAI was 1 week. We assumed that the respondents had constant presenteeism over the past 2 weeks, and thus the 1-week measurement from the HPQ and WPAI could be extrapolated to a 2-week measurement. In our study, only 5.2% of respondents were absent from work because of arthritis in the past 2 weeks (Table 1) and therefore it may be reasonable to assume that the health status of our study subjects did not significantly change over the past 2 weeks, nor did the effect of their health on their work performance. However, the nature of arthritis is quite variable. Because this is a cross-sectional analysis, we were not able to examine whether the disease is associated with relatively stable productivity loss or variable/unpredictable loss. Thus, more work is needed to examine week-to-week variations in lost productivity attributed to arthritis.

Another limitation is that we used only the HC method to value productivity loss. Another valuation method, the friction cost (FC) method, has also been suggested[38,39]. According to the FC method, within a friction period, productivity costs should be calculated as being 80% of the production value[38]. Further, Jacob-Tacken, *et al* suggested that productivity loss attributable to presenteeism should be corrected for compensating mechanisms related to productivity loss[39]. If the employee or the employee's colleagues compensate for the lost work during normal working time, or the lost work is not made up at all, there would be no productivity costs. If the lost work requires extra hours by the employee or colleagues, or requires hiring additional employees, there would be productivity costs. As mentioned, the HLQ somewhat corrects for the compensation mechanisms, but the other 3 instruments do not. Therefore, if applying the FC method and correcting for compensating mechanisms, the loss estimates from the other 3 instruments would be much lower than the presented estimates using the HC method, and the differences among instruments would be much lower. In our study, we did not collect enough information to examine the agreement between instruments by correcting for compensating mechanisms.

Finally, we administered the 4 instruments in the same order (WLQ, WPAI, HPQ, and HLQ) to all study individuals, which could cause measurement errors. Different question orders might affect the way that participants respond, as well as overall response rates. For example, the high missing rate (17%) of the HLQ might be partially attributed to the fact that the instrument was placed at the last position. However, similar studies also found low agreement between instruments and the high missing rate of the HLQ[6,7,16,17]. This may suggest that the effects of question order are not problematic in our study.

Given the importance of indirect costs in determining the true cost-effectiveness of expensive therapies to treat arthritis, our findings on the variability of indirect costs estimates and the low agreement among the instruments chosen are particularly worrisome. One can only argue for the inclusion of indirect costs in economic evaluations once we have improved on their estimation methodology and accuracy. Otherwise, instruments may be opportunistically chosen according to their ability to generate favorable cost-effectiveness ratios to positively influence funding decisions for arthritis interventions. Therefore, more systematic research is needed regarding measures to assess actual productivity losses due to presenteeism. Future research in this topic should also focus on developing instruments specifically targeted at measuring and valuing productivity loss due to presenteeism instead of simply adapting existing measures.

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