Impact of Medication Adherence on Work Productivity in Hypertension

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ABSTRACT

Objectives: To evaluate the impact of antihypertensive medication adherence on work productivity.

Study Design: Cross-sectional study.

Methods: Antihypertensive medication–treated respondents from the 2007 National Health and Wellness Survey (NHWS; n = 16,474) were included. Blood pressure measurements, medication adherence, and work productivity measures were obtained using subject self-reported data collected by the NHWS. Productivity and adherence were evaluated using the Work Productivity and Activity Impairment questionnaire and Morisky Medication Adherence Scale. Subjects were classified as normotensive (systolic blood pressure [SBP] <120 mm Hg and diastolic blood pressure [DBP] <80 mm Hg), prehypertensive (SBP 120-139 mm Hg or DBP 80-89 mm Hg), stage 1 hypertensive (SBP 140-159 mm Hg or DBP 90-99 mm Hg), or stage 2 hypertensive (SBP ≥160 mm Hg or DBP ≥100 mm Hg). Multivariate linear regression was used to determine the relationship between antihypertensive medication adherence and work productivity loss, while controlling for important covariates.

Results: Among treated hypertensive subjects (n = 16,474), the mean age was 59.6 years, and 49% were female. Respondents employed full time (n = 3041) were younger (mean age = 51 years); 14%, 54%, 24%, and 8% were normotensive, prehypertensive, and stage 1 and 2 hypertensive, respectively. High adherence was reported by 55% of employed respondents. Low adherence was associated with more work productivity impairment ($\beta = 2.12; P <.05$). Stage 2 hypertension was associated with a greater productivity impairment compared with other stages ($\beta = -6.79$ vs prehypertensives; $\beta = -5.18$ vs stage 1; all $P <.05$).

Conclusions: Low adherence to prescribed antihypertensive medication regimens was associated with a reduction in work productivity. Programs to support antihypertensive medication adherence may present economic opportunities for employers by reducing work productivity impairment.

(Received for publication, April 13, 2012; accepted, June 15, 2012.)

METHODS

This cross-sectional study evaluated data from the 2007 National Health and Wellness Survey (NHWS). The NHWS
is a self-administered, Internet-based annual survey of 63,012 US adults 18 years and older which has been conducted in the United States since 1998 by Consumer Health Sciences. Survey participants provide informed consent and are sampled to mirror generalized demographic characteristics (gender, age, and race/ethnicity) of the US population. The survey sample is drawn from an Internet panel maintained by Lightspeed Research (Warren, New Jersey) and includes self-reported information on participant demographic characteristics, medical history, healthcare utilization, and healthcare attitudes, behaviors, and outcomes. The protocol and informed consent were reviewed and approved by Essex Institutional Review Board, Inc, in Lebanon, New Jersey. NHWS respondents were eligible if they had a self-reported diagnosis of hypertension and reported use of antihypertensive prescription medication. While descriptive statistics are reported for the entire eligible hypertensive population with antihypertensive medication use (n = 16,474), NHWS respondents were included in the final sample used for productivity analyses if they also reported full-time employment (n = 3041).

Medication adherence was estimated using the Morisky Medication Adherence Scale (MMAS) as a proxy for medication consumption. The MMAS has been shown to be a reliable instrument (reliability \( \alpha = 0.61 \)), and demonstrated both concurrent and predictive validity with regard to BP control at both 2 and 5 years, respectively. The MMAS consists of the following 4 questions which are scored using a 0/1 response scale corresponding to no/yes answers, respectively: “With regard to your high blood pressure medications: 1) Do you ever forget to take your medicine? 2) Are you careless at times about taking your medicine? 3) When you feel better do you sometimes stop taking your medicine? and 4) Sometimes if you feel worse when you take your medicine, do you stop taking it?” Respondent scores to the MMAS are calculated as the sum of the 4 question responses; the sum is used to categorize respondents as having high adherence (MMAS = 0 “yes” responses) or low adherence (MMAS = 1–4, or at least 1 “yes” response). Due to a small percentage (<6%) of respondents reporting an MMAS score \( \geq 3 \), MMAS scores of 1 to 4 were collapsed into 1 group. This categorization has been reported in previous research.

Work productivity and activity impairment were measured using the general health version of the Work Productivity and Activity Impairment Questionnaire: General Health (WPAI:GH). The WPAI:GH is a 6-item, quantitative, self-reported evaluation of the level of absenteeism, presenteeism, and daily activity impairment attributable to general health during the prior 7 days. Activity impairment was evaluated for all NHWS respondents, while work productivity measures were assessed for respondents who reported full-time employment. Among full-time employed subjects, the following were evaluated: absenteeism (the percent of work time missed due to health reasons, or the number of hours missed during the last 7 days as a percentage of the number of hours actually worked), presenteeism (the percent of impairment while working due to health reasons, or the degree that health affected productivity while working as a percentage of the maximum possible productivity), and overall work productivity loss (percent of overall work impairment due to health, or presenteeism plus presenteeism).  

Self-reported BP levels were also obtained as part of the NHWS. Respondents were asked, “What was your last blood pressure reading?” to obtain estimates of systolic BP (SBP) and diastolic BP (DBP) measurements which were used to classify participants according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7)–defined stages of hypertension, based on highest reported SBP or DBP levels: normotensive (SBP <120 mm Hg and DBP <80 mm Hg), prehypertensive (SBP 120-139 mm Hg or DBP 80-89 mm Hg), stage 1 hypertensive (SBP 140-159 mm Hg or DBP 90-99 mm Hg), or stage 2 hypertensive (SBP \( \geq 160 \) mm Hg or DBP \( \geq 100 \) mm Hg). The presence of more than 140 other comorbid conditions, including diabetes, dyslipidemia, arthritis, insomnia, and anxiety, was ascertained by respondent self-report, and total number of comorbid conditions per

PRACTICAL IMPLICATIONS
This study included self-reported data on antihypertensive medication–treated respondents from the 2007 National Health and Wellness Survey (NHWS; n = 16,474) and a subset of subjects who were employed full time (n = 3041).

- A reduction in work productivity was reported by nonadherent subjects, primarily associated with productivity while at work.
- Stage 2 hypertensive respondents reported more work productivity impairment than other hypertensive subjects, and the number of comorbidities was associated with work productivity impairment.
- Since an association was found between nonadherence and poorer outcomes, programs to support antihypertensive medication adherence present economic opportunities for employers by improving work productivity.
The subject was calculated. Demographic information, including age, gender, smoking history, race/ethnicity, income, and marital status, was also obtained.

### Statistical Analysis

Univariate analyses were conducted for all study variables; mean, median, and standard deviations were computed for all continuous variables, and frequency tables were computed for all categorical variables. Bivariate analyses of patient demographics, JNC 7 hypertensive stages, antihypertensive treatment, work productivity loss, and presenteeism were evaluated using \( \chi^2 \) tests for categorical variables and analysis of variance for continuous variables. Multivariate linear regression analyses were performed to determine the relationship between antihypertensive medication adherence and work productivity loss, while controlling for important covariates including age, gender, ethnicity, income, smoking, and subject comorbidities. Variables included in the final model were selected based on results of bivariate analyses, as well as clinical significance. SAS version 9.1 was used for all study analyses.

### RESULTS

Overall, 19,874 of the 63,012 respondents to the 2007 NHWS reported a prior physician diagnosis of hypertension (31.5%). About 83% (n = 16,474) of persons with hypertension reported use of an antihypertensive medication. The mean standard deviation age overall was 59.56 (11.99), and only 26% of our study population reported being employed full time (Table 1). Subjects who were classified as highly adherent to their antihypertensive medication regimen were more likely to be female, Caucasian, married, and non-smokers compared with those reporting low adherence (\( P < .001 \), all comparisons). Highly adherent subjects were older than low-adherence subjects (mean age = 61.5 vs 55.8 years, \( P < .001 \)); consequently, subjects who were low adherence were also more likely to report full-time employment (36% vs 22%, \( P < .001 \)). Antihypertensive medication adherence was related to BP, as high adherence individuals were also more likely to be normotensive or prehypertensive, and less likely to have stage 1 or 2 hypertension, compared with their low-adherence counterparts.

Demographic and clinical characteristics of treated, full-time employed respondents are summarized in the Figure (n = 3041). Mean age of treated, full-time employed hypertensive respondents was considerably younger than the entire antihypertensive cohort using medication at 50.9 (9.91) years. More than half (55%) of these subjects reported high adherence (eg, MMAS = 0) with their antihypertensive medication regimen. More than half (56%) self-reported having dyslipidemia as a comorbid condition, and nearly 1 in 4 (24%) also reported having diabetes.

The relationship between antihypertensive medication adherence, work productivity, and hypertensive stages is

### Table 1. Demographic and Clinical Characteristics of Hypertensive Subjects Reporting Antihypertensive Medication Use (n = 16,474)

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 16,474)</th>
<th>Low Adherence (MMAS = 1-4) (n = 5580; 33.9%)</th>
<th>High Adherence (MMAS = 0) (n = 10,894; 66.1%)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, %</td>
<td>49.0%</td>
<td>46.5%</td>
<td>50.3%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age, mean (SD), years</td>
<td>59.6 (12.0)</td>
<td>55.8 (12.3)</td>
<td>61.5 (11.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Caucasian, %</td>
<td>82.3%</td>
<td>75.5%</td>
<td>85.8%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Married, %</td>
<td>59.8%</td>
<td>57.4%</td>
<td>61.1%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Smokers, %</td>
<td>19.2%</td>
<td>21.3%</td>
<td>18.1%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Total # of comorbidities, mean (SD)</td>
<td>8.1 (5.3)</td>
<td>8.2 (5.4)</td>
<td>8.0 (5.2)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Hypertension stages, %</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Normotensive BP &lt;120 mm Hg and DBP &lt;80 mm Hg</td>
<td>14.8%</td>
<td>11.3%</td>
<td>16.4%</td>
<td></td>
</tr>
<tr>
<td>Prehypertensive SBP 120-139 mm Hg or DBP 80-89 mm Hg</td>
<td>56.6%</td>
<td>54.1%</td>
<td>57.8%</td>
<td></td>
</tr>
<tr>
<td>Stage 1 hypertensive SBP 140-159 mm Hg or DBP 90-99 mm Hg</td>
<td>22.1%</td>
<td>25.4%</td>
<td>20.5%</td>
<td></td>
</tr>
<tr>
<td>Stage 2 hypertensive SBP ≥160 mm Hg or DBP ≥100 mm Hg</td>
<td>6.6%</td>
<td>9.2%</td>
<td>5.3%</td>
<td></td>
</tr>
<tr>
<td>Full-time employed, %</td>
<td>26.3%</td>
<td>35.8%</td>
<td>21.5%</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

DBP indicates diastolic blood pressure; MMAS, Morisky Medication Adherence Scale; SBP, systolic blood pressure; SD, standard deviation.
summarized in **Table 2**. Compared with those with low adherence (MMAS >0) to antihypertensive medications, respondents who reported high adherence (MMAS = 0) had significantly overall less work productivity loss \((P <.001)\) and were more likely to have no overall work impairment. Among the full-time employed respondents with high blood pressure treated with antihypertensive medications, 41% of low-adherence respondents experienced no work impairment compared with 49% of high-adherence respondents. Almost one-third (29%) of individuals with low adherence experienced high levels (>30%) of work impairment. Presenteeism was significantly worse for subjects with low adherence versus high adherence \((P <.001)\). The stage of hypertension disease was also significantly associated with self-reported adherence \((P <.001)\). Participants with more severe stages of hypertension were less likely to be classified as highly adherent.

Multivariate regression results are included in **Table 3**. After adjusting for demographics and comorbidities,
low adherence was associated with more work productivity impairment ($\beta = 2.12; P < .05$), primarily related to presenteeism. Stage 2 hypertension was associated with greater productivity impairment compared with other hypertensive stages ($\beta = –6.30$ vs normotensives; $\beta = –6.79$ vs pre-hypertensives; $\beta = –5.18$ vs stage 1; all $P < .05$). A positive association between the number of comorbidities and more productivity impairment was also noted ($\beta = 1.86; P < .05$). Other comorbidities that significantly predicted work productivity loss included depression, pain, high cholesterol, and nasal allergies. Non-smokers were less likely to experience work productivity loss compared with current smokers ($\beta = –2.82; P < .05$). While patient antihypertensive treatment was included as a covariate in the regression, it was not a significant predictor of work productivity.

**DISCUSSION**

This cross-sectional study found a relationship between low self-reported antihypertensive medication adherence and increased work productivity impairment, following covariate adjustment, in a large, medication-treated, employed hypertensive population. In our study, 31.5% of subjects self-reported a hypertension diagnosis; this figure is very close to national hypertension prevalence estimates of 29.3%. We found that an advanced stage of hypertension was an independent predictor of increased work impairment while controlling for other clinical and demographic factors. Stage 2 hypertensive participants had a higher likelihood of work impairment compared with subjects who were normotensive, prehypertensive, or stage 1 hypertensive. Subjects who were highly adherent to their antihypertensive medication regimen had better BP control than those who were classified as low adherence.

Among all of the hypertensive patients treated, those reporting high adherence to their antihypertensive medication regimen were significantly less likely to be employed full time. In addition, consistent with previous research, we found that better antihypertensive medication adherence was associated with increased age. In our study, the mean age of highly adherent subjects was 62 years (compared with 56 years for low-adherence subjects) and consequently, a larger proportion of these subjects would be expected to have retired. This is consistent with US Census data, which indicate that 63% of those aged 55 to 64 years, 24% aged 65 to 74 years, and 6% 75 years and older were in the labor force overall during years 2006 to 2008.
Our findings are particularly important when considered in the context of the employer burden of hypertension. Goetzel and colleagues studied the total cost of health, absence, short-term disability, and productivity losses for 10 chronic diseases using the MedStat MarketScan Health and Productivity Management database, which contains information on 374,799 employees over a 3-year time period. Hypertension ranked among the 10 chronic diseases with the highest total employer cost burden in this study. The economic burden of illness for hypertension, including inpatient and outpatient services, prescription drugs, absenteeism, short-term disability expenditures, and productivity losses, was estimated at $392 per employee yearly. Annual productivity losses due to hypertension were estimated at $247 per employee. Lamb and colleagues conducted a study of 8267 US employees from 47 employer locations to compare productivity losses for allergic rhinitis with other conditions, including hypertension. The authors found that absenteeism plus presenteeism accounted for $105 yearly per employee for hypertension. It is reasonable to infer that association between antihypertensive medication adherence and decreased work productivity found in the current study may have cost implications from an employer's perspective.

Rizzo and colleagues, using data from the nationally representative 1987 National Medical Care Expenditure Survey, estimated the effects of prescription medication on worker productivity for hypertension, along with diabetes, heart disease, and depression. The authors estimated that the net benefit to employers during 1987 amounted to $286 per hypertensive employee, $633 per employee with heart disease, $822 per employee with depression, and $1475 per diabetic employee. Average compliance (63%) with antihypertensive medications saved, on average, 3.5 days of work annually, compared with 5.5 days lost for untreated patients. The authors concluded that the observed benefits were due to reduced absenteeism associated with prescription medication use among employees with chronic illness.

Suboptimal adherence and persistence to prescribed antihypertensive regimens has been documented by several studies in “usual-care” settings, and long-term persistence with antihypertensive therapies is poor. Antihypertensive medication adherence has been identified as an important contributor to BP goal attainment. Poor antihypertensive medication adherence is associated with higher healthcare resource use and higher hospitalization rates. Previous research has documented that medication adherence differs by therapeutic class, with agents from the angiotensin-receptor blocker (ARB) class generally associated with slightly higher adherence and persistence. Although a few studies have found a link between adverse effects from antihypertensive medication and medication persistence, it is possible that adverse effects from antihypertensive medications could potentially impact employees to some degree at the workplace. However, in the current study, antihypertensive treatment was not associated with work productivity loss in the multivariate analysis. Among hypertensive study subjects who had high adherence to their prescribed antihypertensive medication regimen, 21% had stage 1 hypertension and 7% had stage 2 hypertension. Patients with hypertension usually require 2 or more different antihypertensive medications to attain goal BP. Addition of another class of antihypertensive medication to the existing regimen or a dosage increase of the current regimen would be warranted in these patients. The failure of healthcare providers to intensify medication regimens despite patients not achieving treatment goals is often referred to as “clinical inertia,” which has been well documented in usual care settings for hypertensive patients. In addition to clinical inertia, other factors in medication-compliant patients (such as dietary habits and obesity) may play a role in failure to attain goal BP; despite this, however, our findings suggest that a proportion of our study population may require intensification of their existing antihypertensive regimen, which is consistent with the findings from these studies.

Sullivan and colleagues found that hypertension, in conjunction with being overweight/obese and having hyperlipidemia and/or diabetes, significantly impacted a patient’s productivity. Controlling for other covariates, overweight/obese patients with 2 of the 3 possible cardiometabolic comorbidities (diabetes, dyslipidemia, and/or hypertension) missed 179% more workdays and additionally spent 147% more days in bed compared with those without any cardiometabolic comorbidities. Furthermore, the authors estimate that lost workdays and bed days combined account for $17.3 billion annually in the United States attributable to cardiometabolic risk factor clusters and associated lost work productivity. Burton and colleagues studied 5512 employees, and similarly found that as the number of metabolic risk factors increased, the incidence of short-term disability increased, as well as the increase in days missed due to illness. While to our knowledge, this is the first study to evaluate the relationship between antihypertensive medication adherence and work productivity limitations since that of Rizzo and colleagues in 1996, this link has since been
demonstrated for other chronic diseases, including asthma and depression. However, due to the recognized symptomatic nature of these diseases, findings observed for these chronic illnesses may not be generalizable to hypertension, which is recognized as an asymptomatic disease for most patients.

While our study provides a valuable contribution to the antihypertensive medication adherence literature, several limitations are important to consider when interpreting our study’s findings. Our study was performed on a sample of subjects with hypertension who reported full-time employment, and thus is representative of only those employed full time; there may be subject characteristics that are associated with the likelihood of employment, medication adherence, and/or low productivity that resulted in population selection bias and/or confounding. However, the multivariate regression used for the productivity analysis should have reduced the effects of other factors for those covariates that were available for analysis. As our study sample was identified via an Internet-based survey, our population may not be representative of the general US population; due to the method of survey administration and the full-time employment status of our sample it is plausible that our study sample represented persons with higher income, education, and socioeconomic status than the US population as a whole. However, our study’s estimate of the prevalence of hypertension is consistent with published estimates for a similar time period. Nevertheless, for these reasons, our study’s findings may not be generalizable to all hypertensive persons across the United States. Some important information was not available for inclusion as covariates, including duration of hypertension, duration of medication use, medication acquisition cost, insurance status, subject body mass index, and number and specific classes of antihypertensive medications prescribed. In addition, while antihypertensive therapy adherence was assessed, the reasons for antihypertensive medication nonadherence are unknown. Our study utilized self-reported data for all measures, including BP measurements, productivity, and self-reported antihypertensive agent use. No objective measurements of BP and/or data to validate patient self-reported medication acquisition and consumption (such as prescription claims information) were available. While prescription claims data are usually considered the most accurate data source to enable assessment of medication adherence, the validated Morisky scale has been used across therapeutic areas as a proxy to estimate medication adherence, although admittedly, the MMAS may be somewhat less sensitive and is subject to patient self-report bias. Previous research has generally supported the validity of subject self-report of blood pressure and/or hypertensive status in various settings, with self-report correctly identifying the majority of actual hypertensive persons, with higher specificity than sensitivity generally reported. Previous research has also supported the use of subject self-report of absenteeism based on validation using administrative data. However, the WPAI is not condition-specific, and productivity estimates may also reflect the impact of other comorbid conditions (although these were included as covariates in multivariate analyses) as well as other external unmeasured factors. Finally, it is possible that our study’s findings as related to antihypertensive medication adherence may also reflect adherence to other classes of medications, as patients might be expected to have similar adherence results for medications for other comorbid conditions; this may, in part, contribute to the relationship between productivity and antihypertensive medication compliance.

CONCLUSIONS

A significant reduction in work productivity was reported by participants who were classified as low adherence with regard to their antihypertensive treatment, primarily associated with productivity while at work (eg, presenteeism). Stage 2 hypertensive respondents reported significantly more work productivity impairment than respondents with less severe stages of hypertension, and the number of comorbidities was also significantly associated with work productivity impairment. Our findings suggest an association between low adherence to antihypertensive treatment and poorer outcomes. Initiatives targeting improved adherence to medications and improved BP control among patients with hypertension may present economic opportunities for employers by impacting work productivity.

Acknowledgment

Jennifer Wogen, MS, MedMentis Consulting, LLC, provided medical writing and editorial services in support of this manuscript, and received financial compensation from Novartis Pharmaceuticals Corporation.

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Funding Source: Novartis Pharmaceuticals Corporation.

Author Disclosures: Dr Frech-Tamas and Ms Lau report employment with Novartis Pharmaceuticals Corporation, the funder of the study, and stock ownership in the company. The other authors (SW, SG) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (SW, HL, FF-T, SG); acquisition of data (SW); analysis and interpretation of data (SW, HL, FF-T, SG); drafting of the manuscript (HL, FF-T); critical revision of the manuscript for important intellectual content (SW, HL, FF-T, SG).
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