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Impact of Depression on Work Productivity and Its Improvement after Outpatient Treatment with Antidepressants

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ABSTRACT

Objective: Depressive disorders influence socioeconomic burden at both the individual and organizational levels. This study estimates the lost productive time (LPT) and its resulting cost among workers with major depressive disorder (MDD) compared with a comparison group. It also estimates the change in productivity after 8 weeks of outpatient psychiatric treatment with antidepressants. **Methods:** Working patients diagnosed with MDD without other major physical or mental disorders were recruited (n = 102), along with age- and sex-matched healthy controls from the Seoul Metropolitan area (n = 91). The World Health Organization's Health and Work Performance Questionnaire and the Hamilton Rating Scale for Depression were utilized to measure productivity and severity of depression, respectively, at baseline and at 8 weeks of treatment. **Results:** The LPT from absenteeism and presenteeism (reduced performance while present at work) was significantly higher among the MDD group. Workers with MDD aver-

aged costs due to LPT at 33.4% of their average annual salary, whereas the comparison group averaged costs of 2.5% of annual salary. After 8 weeks of treatment, absenteeism and clinical symptoms of depression were significantly reduced and associated with significant improvement in self-rated job performance (31.8%) or cost savings of \$7508 per employee per year. **Conclusions:** We confirmed that significant productivity loss arises from MDD and that this loss can be reduced with psychiatric intervention after a time period as short as 8 weeks. Mental health professionals should work with employers to devise a cost-effective system to provide workers with accessible quality care.

Keywords: cost, depression, lost productive time, productivity, presenteeism.

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Introduction

Depression is one of the most prevalent health problems in the workplace. A recent report from the Office of Applied Studies of Substance Abuse and Mental Health Services Administration showed that 7.0% of adult full-time workers (10.1% for women vs. 4.7% for men) experienced a major depressive episode (MDE) during the past year [1]. Among workers in the United States, 6.4% have been reported to meet the criteria for major depressive disorder (MDD) [2], and 4.6% of working Canadians have been reported to meet criteria for an MDE during the past year [3].

Depressive disorders have been found to cause the largest disease burden (expressed as disability-adjusted life years, a standard burden of disease measure) in the working population of the United States [4]. Due to the early age of onset and the chronic course of illness, depressive disorders have a large influence on work productivity [5]. Three major cost categories are used to es-

timate the economic burden of depression: direct costs (e.g., medical expenses), indirect costs (e.g., costs associated with depression in the workplace like reduced productivity), and mortality costs arising from depression-related suicides [4]. Among these three categories, indirect costs are estimated to be as high as or even higher than direct costs in mental health problems, including depression [6,7]. The economic burden of depression in 2000 in the United States was estimated at \$83.1 billion, which consisted of \$51.5 billion (62%) in indirect workplace costs, \$26.1 billion (31%) in indirect medical costs, and \$5.4 billion (7%) in suicide-related mortality costs [4].

Regarding indirect costs, many studies use the concept of lost productive time (LPT), which consists of "absenteeism" and "presenteeism." Absenteeism refers to the LPT caused by hours or days missed from work (e.g., tardiness, leaving work early, sick leave) [7]. Presenteeism is defined as the estimated LPT caused by reduced work performance while at work [8], which can be brought on by decreased concentration, reduced motiva-

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tion, fatigue, or errors in decision making. Presenteeism is usually measured through surveys from employees, with measurements varying in complexity from single items assessing time spent at work while unwell, to multiple items incorporating employee perceptions of productivity as related to their own previous performance or to that of their colleagues [9,10]. For depressive disorders, LPT from presenteeism has been shown to exceed LPT from absenteeism. One study found that 81% of the LPT among workers with depression was due to presenteeism, whereas another study estimated the indirect costs of depression at \$32.5 billion—\$24 billion due to presenteeism and \$8.5 billion due to absenteeism [7,11].

Recently, an increasing number of clinical trials focusing on the treatment of MDD have shown favorable effects of intervention and have suggested preferable return-on-investment (ROI) results [12–15]. However, poor awareness and social stigma affect workers' access to quality care for MDD [16]. Thus, understanding the magnitude of lost productivity related to MDD, and the benefits of treatment in reducing LPT, will help to guide decisions about the allocation of additional resources or the provision of accessible care to this population.

In this research, we estimated the loss of work productivity among employees with MDD who visited psychiatrists in Seoul, Korea, using the World Health Organization's Health and Work Performance Questionnaire (HPQ) [10]. We compared their LPT with the LPT of a sample of healthy working controls, and we measured the amount of recovered productivity after 8 weeks of antidepressant treatment in an outpatient psychiatric setting.

Methods

Subjects

A total of 106 employees aged 20 to 60 years were screened from four outpatient psychiatric clinics located in highly industrialized districts in Seoul, Korea, using consecutive sampling technique. Those patients who met the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)*, diagnostic criteria for MDD using the Korean version of Structured Clinical Interview for DSM disorders [17], were eligible for inclusion. Patients with MDD who were already taking antidepressant medications were excluded. Patients with a history of MDD but not currently taking a psychiatric medication, and displaying symptoms of a current depressive episode were included. Four patients with medicosurgical disease or

other psychiatric disorders other than MDD were excluded. A total of 102 subjects with MDD were then enrolled in the study, with informed consent provided.

For the comparison group, age- and sex-matched healthy employees were recruited from the same region through advertising in local newspapers and on websites. Approximately 150 volunteers were initially screened using the Korean version of Structured Clinical Interview for DSM disorders and, among them, a group of 100 individuals with a similar age and sex distribution who did not have significant medical or psychiatric illnesses were recruited. Severe job stress and impending life events including job loss can confound the results of productivity measures, thus, nine healthy volunteers were excluded from the data analysis. Thus, 91 subjects completed the questionnaires and were enrolled as the comparison group. Each subject provided informed consent for his or her participation in this study after it had been fully explained. The institutional review board of Inje University Seoul Paik Hospital approved this study.

Treatment and assessment

The entire study population was assessed at baseline, and the MDD group was also assessed at study weeks 4 and 8. Out of the 102 subjects in the MDD group, 35 patients dropped out after baseline assessment and 15 patients dropped out between weeks 4 and 8. Fifty-two subjects completed assessments at baseline and week 8 as well as after 8 weeks of treatment for MDD with antidepressants and 20 to 30 minutes of supportive psychotherapy. They were included in a complete analysis to measure changes after 8 weeks of treatment. Among them, 10 patients missed the week 4 visit, and, thus, we performed a complete analysis for 42 subjects to compare changes among weeks 0, 4, and 8.

Measurement of health and productivity

We applied the Korean version of the HPQ for measurement of productivity. The Korean version of the HPQ was developed using conventional techniques of translation and back-translation by bilingual psychiatrists, maintaining equivalence with the permission of the original author. There are other available instruments for estimating absenteeism and presenteeism [18,19], but they are limited by their complexity and narrow scope [20,21].

The HPQ was developed to avoid these limitations and has been reported as valid and reliable [10]. It consists of three major parts (questions about health, productive time, and demographics), and most of the questions address the previous 4-week pe-

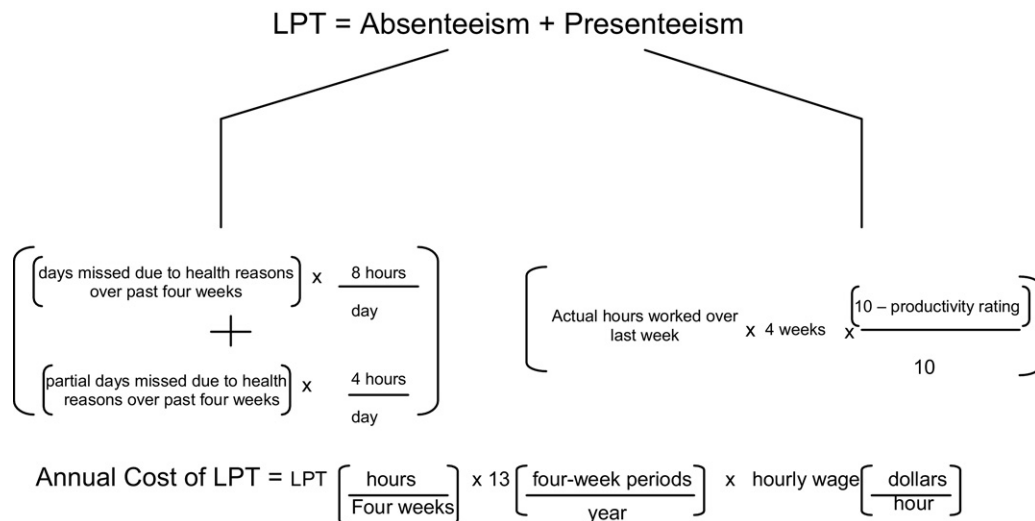


Fig. 1 – Calculation of the cost of lost productive time due to absenteeism and presenteeism.

riod. Absenteeism due to MDD is considered the sum of the number of absent work days due to health problems multiplied by 8 hours a day and the number of partial-day absences due to health problems multiplied by 4 hours a day (Fig. 1). Presenteeism is measured by the self-rated level of job performance, a visual analogue scale from 0 (worst) to 10 (best), during the past 4 weeks. To ensure the precise appraisal of presenteeism, the HPQ asks participants for an estimate of colleagues' average productivity and for their own average productivity in the past year or two. Excess LPT from MDD was calculated as the difference between the average LPT in the MDD group and the average LPT in the comparison group.

Measurement of depressive symptoms

We used the Hamilton Rating Scales for Depression (HAM-D) to measure the severity of depressive symptoms at baseline, week 4, and week 8 [22].

Calculation of the annual cost of LPT due to absenteeism and presenteeism

Absent work days because of health problems are assessed separately from those due to other reasons. LPT due to absenteeism is estimated by summing up absent work days multiplied by 8 hours per day and partial missing days multiplied by 4 hours per day. The annual cost of LPT due to absenteeism is calculated by projecting total hours missed from work due to health problems during a year, multiplied by the study subject's own hourly wage. Because the comparison group's LPT due to absenteeism is considered the standard in this study, the cost of LPT due to absenteeism from MDD is calculated as the differences of the costs of LPT due to absenteeism between the MDD group and the comparison group (Fig. 1).

LPT due to presenteeism is quantified as the actual work hours multiplied by the reduced performance level (productivity rating during the past 4 weeks) divided by 10. The annual cost of LPT due to presenteeism is estimated as the total hours lost from reduced performance for a year multiplied by the study subject's own hourly wage (Fig. 1). The cost of LPT due to presenteeism can be calculated by the same method used in absenteeism. Finally, the total cost of LPT from MDD is calculated as the sum of the cost of LPT due to absenteeism and the cost of LPT due to presenteeism.

Statistical analysis

We performed t tests, chi-square tests, and analysis of variance tests depending on whether the variables were continuous or categorical, comparing subjects' demographic data and the data from the HPQ. We compared the comparison group to the MDD group at baseline, and the MDD group before and after treatment. All significance levels reported were two-tailed and the criterion for statistical significance was $P \leq 0.05$. SPSS version 13.0 was used for the statistical analysis.

Results

Comparison between employees with MDD and healthy controls

There is no statistically significant difference between the MDD group and the comparison group in terms of demographic and work-related variables (Table 1). The severity of depressive symptoms as measured by the HAM-D is significantly higher in the MDD group than in the comparison group (24.05 vs. 6.27; $t = 23.6$, $df = 191$, $P < 0.001$) (Table 2). The expected work hours per week on average is 47.26 hours in the MDD group, which is significantly higher than the 42.43 hours in the comparison group ($t = 2.65$; $P = 0.009$). However, actual work hours per week are not statistically

Table 1 – Demographic data of workers with major depressive disorder (MDD) and control group.

	MDD group (n = 102)	Control group (n = 91)	P*
Age (y)	35.78	33.25	0.064
Sex			
Man	51	44	0.819
Woman	51	47	
Marital status			
Unmarried	41	45	$\chi^2 = 4.02$, $P = 0.134$
Married	51	43	
Divorced	10	3	
Education			
Junior high school	4	1	$\chi^2 = 19.90$, $P = 0.000$
High school	22	3	
University	61	60	
Graduate school	14	27	
Religion			
None	46	34	$\chi^2 = 3.79$, $P = 0.286$
Protestant	29	38	
Catholic	17	12	
Buddhism	10	7	
Shift work			
Regular daytime	89	77	$\chi^2 = 1.34$, $P = 0.512$
Fixed shift	4	2	
Variable work hours	9	12	
Employment status			
Regular	80	67	$\chi^2 = 0.61$, $P = 0.434$
Nonregular	22	24	
Company size			
Small*	59	46	$\chi^2 = 1.03$, $P = 0.310$
Larger	43	45	
Rank			
Staff	42	44	$\chi^2 = 2.25$, $P = 0.522$
Assistant manager	16	14	
Manager	16	16	
General manager	28	17	
Duration of employment	6.87 y	5.52 y	0.135
Annual salary (US\$)			
<15,000	24	22	$\chi^2 = 0.95$, $P = 0.918$
15,000–24,999	21	22	
25,000–34,999	22	21	
35,000–44,999	16	13	
≥45,000	19	13	

* The number of employees is less than 50.

significantly different between the MDD group and the comparison group (48.09 hours vs. 45.01 hours; $t = 1.29$; $P = 0.196$). Multivariate analysis using the demographic variables as predictors and the prevalent depression as the dependent variable indicated that only education showed a statistically significant contribution to prevalent MDD ($P = 0.004$).

Absent work days due to health problems during the past 4 weeks were significantly higher in the MDD group compared to the comparison group, both in the number of absent work days (0.94 vs. 0.10; $t = 2.46$, $P = 0.015$) and the number of partial missing work days (2.56 vs. 0.24; $t = 4.25$, $P < 0.001$). Absent work days for any other reason during the past 4 weeks also were significantly higher in the MDD group compared to the comparison group (full days 0.68 vs. 0.20; $t = 2.27$, $P = 0.011$; partial days 0.38 vs. 0.24; $t = 0.854$, $P = 0.535$). However, total actual work hours during the past 4 weeks are not statistically significantly different between the two groups (184.48 vs. 174.81 hours; $t = 1.11$, $P = 0.267$).

Regarding presenteeism, the MDD group rated their job performance during the past 4 weeks as significantly lower than did the comparison group (5.16 vs. 7.62; $t = 9.01$, $P < 0.001$). The MDD group

Table 2 – Control group vs. major depressive disorder (MDD) group at baseline.

	Control (n = 91)	MDD (n = 102)	t	P
17-item Hamilton Rating Scale for Depression	6.27 (4.99)	24.05 (5.40)	23.67	<0.001*
Actual work h/wk	45.01 (15.06)	48.07 (17.01)	1.30	0.196
Expected work h/wk	42.43 (11.77)	47.26 (12.46)	2.65	0.009
Absent work days due to health problems in the past 4 wk	0.10 (0.61)	0.94 (3.16)	2.60	0.015
Absent work days for any other reason in the past 4 wk	0.20 (0.58)	0.68 (1.67)	2.67	0.011
Partial missing work days due to health problems in the past 4 wk	0.24 (0.80)	2.56 (5.10)	4.47	<0.001*
Total actual work hours during the past 4 wk	174.81 (57.38)	184.48 (59.45)	1.11	0.267
Self-rated job performance during the past 4 wk	7.62 (1.35)	5.16 (2.23)	9.26	<0.001*
Lost productive time due to absenteeism over the past 4 wk	4.27 (12.11)	24.75 (37.33)	5.16	<0.001*
LPT due to presenteeism during the past 4 wk	43.07 (30.05)	86.35 (48.08)	7.36	<0.001*
Annual cost of absenteeism	72.51 (228.68)	440.55 (831.88)	-4.17	<0.001*
Annual cost of presenteeism	696.74 (540.22)	1339.58 (895.68)	-5.93	<0.001*
Annual cost of lost productive time [†]	7,812 (6,086)	17,989 (13,781)	6.51	<0.001*

* Significant at $P < 0.05$.
[†] Data are given as mean (SD).
[‡] Annual cost of absenteeism plus annual cost of presenteeism.

estimated their usual job performance during the past year or 2 years as 6.63, which indicates that depressed employees rate their own recent performance level as decreased by 22.18% when they seek psychiatric help compared to previous levels. The comparison group did not show a significant difference in their job performance between the past 4 weeks and the past year or 2 years (7.62 vs. 7.70; $t = 0.623$, $P = 0.535$).

We assessed the LPT and calculated costs from both absenteeism and presenteeism. The LPT due to absenteeism during the past 4 weeks was 24.75 hours in the MDD group, and 4.27 hours in the comparison group. The annual cost of absenteeism was calculated as \$4405 per person in the MDD group, and \$725 per person in the comparison group. The average annual per-employee cost of absenteeism due to MDD can be calculated as \$3680.

The LPT due to presenteeism during the past 4 weeks was 86.35 hours in the MDD group and 43.07 hours in the comparison group. The annual cost of presenteeism was estimated to be \$13,396 per employee in the MDD group, and \$6,967 per employee in the comparison group. Thus, the average annual per-employee cost of presenteeism due to MDD can be calculated as \$6429. The total average annual cost of LPT due to MDD (including absenteeism and presenteeism) was \$10,109 per employee, which corresponds to 33.4% of the mean annual wage in the MDD group (\$30,275).

Changes in depressive symptoms and LPT after 8 weeks of treatment with antidepressants

Among the 102 patients with MDD evaluated at baseline, 67 (66%) patients completed baseline and week 4 assessments, whereas 52 (51%) completed baseline and week 8 assessments. Forty-two (41%) subjects completed all three assessments (weeks 0, 4, and 8), as well as 8 weeks of treatment for MDD. Of the 50 subjects who did not complete treatment, reasons were as follows: 14 (28%) refused treatment or sought it elsewhere, 10 (20%) reported significant improvement and felt no need for further treatment, 10 (20%) were laid off or were on long-term medical leave and thus could not be assessed for presenteeism, 7 (14%) complained of time constraints preventing them from attending treatment sessions, 4 (8%) reported side effects, 1 (2%) became pregnant, and 4 (8%) were lost to follow-up. A subset of 10 patients completed 8 weeks of treatment, but only completed assessments at baseline and at week 8. When the 52 MDD subjects who completed the trial were compared at baseline with the 50 who did not, there was no statistically significant difference in any demographic or clinical variable.

The 52 MDD patients who completed the trial show almost the same severity of depression and work productivity measurements

Table 3 – Changes after 8 wk of psychiatric treatment in the major depressive disorder (MDD) group (n = 52)*.

	Before treatment	After treatment	t	P
17-item Hamilton Rating Scale for Depression	24.00 (6.16)	7.19 (3.99)	18.91	<0.001*
Actual work h/wk	47.42 (17.68)	45.58 (15.00)	0.98	0.333
Expected work h/wk	46.86 (11.81)	44.69 (10.08)	2.02	0.052
Absent days due to health problems during the past 4 wk	1.09 (3.45)	0.06 (0.31)	2.10	0.041*
Absent days for any other reason during the past 4 wk	0.82 (1.87)	0.12 (0.38)	2.75	0.008*
Partial missing days due to health problems during the past 4 wk	2.38 (4.94)	0.24 (1.42)	3.18	0.003*
Total actual work hours during the past 4 wk	175.53 (61.17)	175.27 (56.06)	0.04	0.969
Self-rated job performance during the past 4 wk	4.90 (2.27)	6.46 (1.74)	7.01	<0.001*
LPT due to absenteeism during past 4 wk	25.76 (40.35)	2.82 (7.93)	4.03	<0.001*
LPT due to presenteeism during past 4 wk	85.55 (46.19)	61.58 (39.69)	4.21	<0.001*
Annual cost of LPT due to MDD (US\$)	11,046	3,628	5.74	<0.001*

LPT, lost productive time.
* Data are given as mean (SD).

Table 4 – Changes after 4 and 8 wk of antidepressant treatment in the major depressive disorder group (n = 42)*.

	Before treatment	Week 4	Week 8	F	P
17-item Hamilton Rating Scale for Depression	23.48 (6.05)	12.05 (4.16)	6.60 (3.86)	165.58	<0.000*
Actual work h/wk	48.36 (18.81)	46.17 (16.80)	45.17 (15.04)	1.77	0.186
Expected h/wk	47.52 (12.08)	45.60 (10.23)	44.98 (10.21)	3.61	0.046
Absent days due to health problems during the past 4 wk	1.15 (4.39)	0.13 (0.46)	0.02 (0.15)	2.55	0.117
Absent days for any other reason during the past 4 wk	0.95 (2.02)	0.52 (2.00)	0.14 (0.42)	2.39	0.114
Partial missing days due to health problems during the past 4 wk	2.23 (4.54)	0.20 (0.83)	0.29 (1.57)	7.55	0.005
Total actual work hours during the past 4 wk	179.69 (62.04)	179.21 (65.53)	177.79 (55.17)	0.04	0.961
Self-rated job performance	4.86 (2.27)	5.88 (1.75)	6.45 (1.76)	25.55	<0.000*

* Data are given as mean (SD).

as those of the MDD group as a whole at baseline (Table 3). After 8 weeks of antidepressant treatment with supportive psychotherapy, HAM-D scores significantly improved (24.00 vs. 7.19; $t = 18.90$, $P < 0.001$). The average actual work hours per week did not change, although the average expected work hours per week decreased with a marginal statistical significance ($t = 2.02$, $P = 0.052$). The number of absent work days due to health problems and those due to any other reason significantly decreased after 8 weeks of treatment ($t = 2.10$, $P = 0.041$; $t = 2.75$, $P = 0.008$). The number of partial absent days due to health problems during the past 4 weeks also decreased ($t = 3.18$, $P = 0.003$). However, the actual work hours during the past 4 weeks did not change. The self-rated job performance significantly increased from 4.90 to 6.46 ($t = 7.01$, $P < 0.001$), which can be compared to the average performance estimate of 6.63 during the past year or 2 years in the MDD group.

We compared the treatment group at weeks 4 and 8 with baseline to assess the effects of psychiatric treatment. The severity of MDD assessed by the HAM-D and productivity measures, including partial absenteeism due to medical reasons and self-rated job

performance, were reduced in repeated measures analysis of variance with a statistical significance (Table 4).

Discussion

Our results show that the employees with MDD lost more productive time due to both absenteeism and presenteeism than the comparison group and that this loss was reduced by short-term antidepressant treatment with supportive psychotherapy (Fig. 2).

The employees with MDD missed approximately 25 hours during the past 4 weeks on average because of health problems, whereas the comparison group missed about 4 hours of work. The group with depression also had more absent days for reasons other than health. By definition, absenteeism caused by MDD does not include absences due to non-health reasons. Given the pervasive mental and physical effects of MDD, it may contribute to non-health-related absences. For example, an employee's concern about any disadvantages they could get from being noticed for

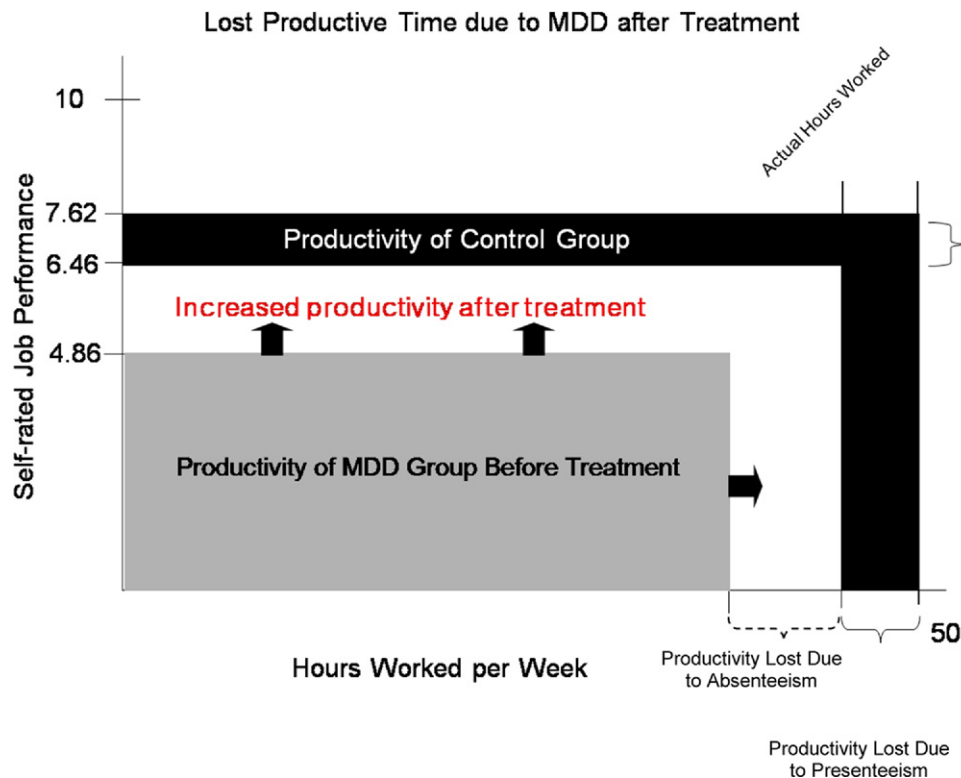


Fig. 2 – Graphic representation of a change of lost productive time between before and after treatment among people with major depressive disorder (MDD), compared to control group.

their depression could lead them to use personal leave rather than sick leave. In addition, employees may have already used up sick leave and must use other types of leave, such as personal leave. Thus, increased nonhealth-related absences can be considered as an alternate form of presenteeism. We have excluded absenteeism for non-health reasons from our calculation of LPT and related cost, but the loss would be more than our estimation had we included these. Our final annual cost of LPT due to absenteeism from MDD is estimated at \$3680, which is 12.2% of the workers' average annual salary.

Depressed workers rated their own work productivity as 32.3% lower than the comparison group on average. They also reported that their performance during the past 4 weeks as 22.2% lower than during the past year or 2 years. LPT from presenteeism due to MDD corresponds to 43.3 hours per 4 weeks. This result suggests that MDD significantly affects the employees' work performance and thus reduces productivity. Each worker with MDD cost the employer an average of \$6429 per year from presenteeism, with healthy controls' productivity used as baseline, which corresponds to 21.2% of his or her annual salary. The cost of LPT due to MDD is estimated at \$10,109 per year (33.4% of annual salary), with presenteeism costs of \$6429 per year, which exceeds the \$3680 cost of absenteeism. These results are consistent with previous studies reporting larger cost of lost productivity due to presenteeism than due to absenteeism in depression [23].

Because this study was performed in Korea, the US dollar estimates are not entirely representative of what costs might be in the United States. To add some perspective, the Gross Domestic Product (GDP) per capita for the Republic of Korea was \$20,015 in 2007, compared with GDP per capita of \$41,890 in the United States. If similar results were found in the US working population, one could expect costs and cost-savings of almost twice the magnitude, given the roughly 1:2 ratio of GDP per capita of Korea to the United States.

The fact that an employee present at work can cost the organization more than an absent employee supports the need for aggressive and active intervention. In severe cases, especially, patients cannot get restored by passive intervention, such as adjustments in working environment, less working time, or less responsibility. Employees with MDD are probably doing the best they can, but are limited in what they can accomplish due to their depressive symptoms. Ultimately, when absent from work, an employee can potentially rest or use health care services. Absenteeism may contribute to improvement of symptoms and restoration of job performance. However, presenteeism results in added stress and pressure upon employees, as they receive no treatment while at work, negatively affecting their overall health. A previous cohort study [24] investigating 5071 employees found that generally ill people with no absenteeism had two times the risk of heart attack than those with some absenteeism. This supports the idea that while absenteeism means one is away from the work place, and thus not productive, it may contribute to overall health by allowing for time to receive health care services and restore health. Considering that depression often causes a myriad of non-specific symptoms, rather than a specific physical malady, patients are less likely to seek care. Depression and other mental health disorders carry social stigma, and thus patients often end up suffering through it rather than asking for sick leave, causing reduced productivity and preventing improvement of symptoms. Both the costs to the employer and risks to the employee seem to be far greater in presenteeism than in absenteeism.

Eight weeks of treatment with antidepressants and supportive psychotherapy decreased depressive symptoms as well as increased productivity. Both absenteeism and presenteeism decreased significantly, resulting in a projected cost savings of \$7418 annually per employee. The HAM-D scores improved from an average of 24.0 at baseline, to 12.8 and 7.1 at 4 and 8 weeks, respec-

tively. Seven is the upper limit for remission, thus it appears that the treatment group had on average nearly achieved remission from their depressive episode. The group's job performance scores reflected a similar trend, increasing from 4.86 at baseline to 5.88 at 4 weeks to 6.46 at 8 weeks. The 8-week performance rating approached the 6.63 rating of self-reported performance during the past year or 2 years, indicating that after only 8 weeks of treatment, these employees with MDD had almost achieved their previous job performance levels. Symptom reduction generally precedes the improvement in social functioning, so productivity measures were likely to improve further with extended follow-up, as patients achieved remission. Indeed, selective serotonin reuptake inhibitors have been noted to take 6 to 12 weeks to have full effect, so it is likely that extending the treatment period past 8 weeks would have shown continued improvement in symptoms and productivity.

The MDD group rated their work performance during the past year or 2 years at 6.63, which was lower than the comparison group's rating of 7.62. It is very possible that the MDD group was experiencing depression, subclinical or clinical, at that time, as it is a chronic disorder. In addition, given that when they reported these numbers, they were all diagnosed with MDD, and they may have underestimated past performance due to current negative views of self. This difference, however, suggests that though employees may not have MDD, subclinical depression may cause reduced work performance, and, thus, it may be valuable to screen widely among the workplace and offer an array of interventions.

One concern with MDD treatment is that despite the proven benefits of antidepressant treatment, compliance rates remain low. Indeed, 20% of our treatment group dropped out due to work responsibilities and time constraints. This suggests that compliance would improve with more accessible and efficient psychiatric care, and thus points to the need for psychiatric services to be integrated into the workplace.

One interesting result is the actual number of hours worked by the MDD group. At baseline, the MDD group worked significantly more than the comparison group (184.5 vs. 174.8), while working at a less productive rate. It is possible that because of decreased performance, the MDD spent more time at work trying to accomplish similar tasks. Decreased concentration may play a large role in reducing efficiency, which leads to increased time spent at work. Additionally, because the MDD group had more absenteeism, they may have felt obligated to work more to make up for the missed work hours.

However, when looking at the MDD group who completed treatment, their pretreatment work hours were similar to the comparison group (175.5 vs. 174.8). Thus, the MDD group who did not complete treatment had a significantly higher number of work hours (roughly 195). This dropout group had several subjects who got laid off and/or had other environmental stressors preventing them from continuing treatment. It is possible that their job situations entailed increased work hours to avoid lay-offs or other consequences.

The MDD group members who completed treatment worked a similar number of hours as the comparison group before treatment, as well as after (175.5 vs. 175.3), while increasing their performance from 4.86 to 6.46. It is important that despite increasing productivity, they were working just as much as before, resulting in ultimate cost savings. If they were more productive, but worked fewer hours, they might have accomplished the same number of tasks as before treatment. However, our study indicates that in decreasing presenteeism, absenteeism was not increased, and is in fact decreased significantly (25.76 to 2.82). After just 8 weeks of treatment, absenteeism was reduced by 89.1% and presenteeism by 28.0%, showing significant gains toward increasing overall productivity and reducing costs of LPT due to MDD.

Our study has an advantage in that we quantified the monetary value of the increased productivity time from short-term antidepressant treatment with supportive psychotherapy. We also defined the MDD group as workers who met the DSM-IV diagnostic criteria for MDD, excluding workers with subclinical depressive symptoms. Many reports fail to clearly define psychiatric disorders, like MDD, creating unnecessary confusion when discussing or comparing different disorders. By clearly defining our study population as patients who met the DSM-IV criteria for MDD, we could more definitively compare the costs (whether due to LPT, direct medical, and so on) of MDD with costs of other health conditions.

As random sampling was very difficult to achieve in this kind of clinical study, we applied consecutive sampling to select every available subject in a given period of time to minimize possible selection bias from non-probability sampling. We also used frequency matching to ensure that the MDD group and the comparison group had the same distributions over strata defined by matching factors (i.e., age, sex). Other demographic and work-related variables were quite similar and thus made these two groups comparable.

The most significant limitation in the interpretation of our finding was that our study population only covered employees with a diagnosis of MDD who could visit psychiatrists while maintaining their jobs. Our sample may not represent all the employees with MDD at the workplace. Excess LPT due to MDD in our study was higher than the 5.6 hours per week of health-related LPT among workers with depression who participated in the American Productivity Audit [7]. It may be related to a higher severity of depression in our subjects, because they were from a patient population who voluntarily visited psychiatrists, instead of a community-based population. A selection bias exists in our study population, because employees with chronic MDD who had already lost their job, suicidal patients, and those who did not seek psychiatric care voluntarily were all excluded. Indeed, all of the participants were informed enough to recognize symptoms, willing to seek treatment, and able to access treatment from a financial and work standpoint.

A second limitation of our study was that we did not include an appropriate comparison group—workers with MDD who receive placebo or psychotherapy alone—to evaluate improvement after the outpatient treatment of MDD. However, it was impossible to recruit such a comparison group due to ethical issues. Most importantly, the primary focus of this study is to assess the effect of the treatment on work productivity among the MDD patients in a real-world clinical practice, not an experimental setting, and estimate the monetary value of it. Considering the current health care environment in Korea and the primary aim of our study, the best option that we could choose was the inclusion of age- and sex-matched healthy workers as a comparison group to compare the improvement of work productivity after treatment of MDD patients. In comparing the change in patients with a secular trend, it is not exactly showing what the effect of treatment is, but it is showing the maximum possible effect of treatment. And, it does also clearly reflect the change as a result of treatment for a clinically relevant population. It might be safe to say that the results of this study can hold for the specific population with MDD whose depression symptoms are severe enough to visit the psychiatric clinic for 8 weeks, but moderate enough to maintain their jobs and visit outpatient clinics.

A third limitation of the study was that our measures of lost productivity are subjective, not objective. It is possible that subjects' appraisals of their job performance were influenced by how they were feeling at the moment rather than by the "real" job performance, applying negative and harsh appraisal at baseline and overpositive job performance ratings as depressive symptoms improve. However, the HPQ is widely used, and during the past several years consistent findings were reported in many countries.

Furthermore, we had no alternative than to use the best available estimate of performance measurement, as either a comparison with others or rating by others could not guarantee any further objectiveness. The use of other information including quality of life to model performance measurement is not recommended, as the correlation between quality of life and productivity cost is not strong [25]. Thus, we do not have any evidence that hampers the validity of this subjective rating tool for job performance.

A fourth limitation of this study is that we did not take into account the fact that compensating mechanisms exist for absenteeism. We used participants' wages to estimate productivity losses for the period of absence. Some researchers argue that short-term absence can be often compensated for during the normal working hours and thus does not cause productivity losses [26]. We cannot deny the possibility of overestimating LPT for absenteeism in this study. And the nonsignificant difference between groups regarding education and rank might have influenced absenteeism, as compensating mechanisms are suggested to vary by occupational characteristics.

Another limitation is that the extrapolation of 8 weeks of measurement to 1 year might be biased, especially in cases where patients are absent from work on and off which might be the case in depression [27]. Furthermore, we assumed the preceding 4 weeks could be representative of the whole year. If we consider the natural course of depression, it may not hold true. However, we consecutively recruited the participants from 2005 to 2007, and the time point of recruitment was spread out through the year. Thus, seasonality of depressive episodes can be excluded. In addition, the possibility of spontaneous remission during 8 weeks is very low. If some of the participants naturally got better and vice versa, they seemed to drop out as shown in the reasons for the dropouts.

Our research findings suggest that there is a lot of room for improvement. We did not compare the costs from LPT with the costs of the intervention; however, we could estimate the direct medical costs incurred by the patients based on the data that we could get from the hospital. The result suggested that the total cost of the intervention among the patients who completed the 8-week treatment was estimated to be $\$334.25 \pm \159.28 per patient, and the cost for the dropouts was $\$119.22 \pm \91.96 per person. If we consider only out-of-pocket expenses, the completers were estimated to spend $\$133.70 \pm \63.71 , and the dropouts were estimated to spend $\$47.69 \pm \36.78 [28,29]. Recent studies suggest that the costs of depression treatment may be offset by an improved bottom line from increased worker productivity and reductions in other health care expenses [15,30]. Indeed, Lo Sasso et al. [31] also reported an ROI of \$3 for every \$1 invested in enhanced depression care. Depressive disorders are among the most common health problems, and employees have no clear way out of them. There are several obstacles to receiving optimal care, such as social stigma toward mental health conditions, time constraints, and fear of uncovering private difficulties. As depressive disorders cause more functional impairment and productivity loss than any other illness, attention and investments from multiple stakeholders would be needed to address and treat employees' mental health, thereby increasing the productivity of the organization.

Our sample showed quite a high dropout rate in comparison with other clinical trials. Thirty-five subjects dropped out between baseline and 4 weeks, and 52 patients followed up at 8 weeks (15 subjects dropped out between 4 weeks and 8 weeks). The low response rate (51%) in this study limits generalizability of the results from the study. Though the dropout rate was high, comparisons of the baseline group with the week 4 and week 8 intervals indicated that most of the results were similar, and thus, did not seem to introduce major bias in the study. Furthermore, this dropout rate was similar to the recently reported adherence rate of the patients

with MDD taking selective serotonin reuptake inhibitors, which amounts to only 17.9% throughout the first 3 months of treatment [32]. If we assume an even distribution of dropouts over 3 months, we would expect 45.3% of adherence rate among our study population and this is very similar to the 51.0% follow-up rate at 8 weeks (52 out of 102) from our data.

Preventing and managing mood disorders among workers is the principal issue. Organizational efforts can save money while creating a healthier, happier, and more productive workplace. If a worker in the service industry is not happy, then he or she cannot smile at the customers, cannot be kind enough, can ruin the relationship with them, and could lose the sale as a result. If a researcher in the information technology industry is not emotionally healthy or stable, he or she cannot generate creative and feasible ideas and thus cannot be productive.

Further studies are needed to estimate employer ROI and the cost-benefit of managing depressive disorders in the workplace, and to foster awareness of positive implications for employees, employers, their families, and society at large.

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