The Effect of Depression on Paid Sick Leave due to Metabolic and Cardiovascular Disease in low-wage workers. (Depression and Sick Leave)*

El efecto de la depresión en la licencia por enfermedad remunerada producto de la enfermedad metabólica y cardiovascular en trabajadores con salarios bajos. (Depresión y licencia por enfermedad)

O efeito da depressão na licença-médica remunerada decorrente de doença metabólica e cardiovascular em trabalhadores com baixa renda. (Depressão e afastamento por doença)

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Abstract

Background: Colombia's health system allows workers to claim paid sick leave due to health conditions, some of this conditions are related to metabolic and cardiovascular disease. There has been an association between these diseases and depression. However, the effect of behavioral disorders such as depression on absence from work is unknown in the developing world. The objective of the research is to estimate whether low-wage workers suffering from depression, metabolic disease, and cardiovascular disease request more paid sick days than people with the same medical comorbidities, but without depression.

Data and Methods: We conducted a retrospective study using data from an insurer in the southwestern region of Colombia in 2016. Depression was identified using an international algorithm that detects chronic conditions from diagnosis and pharmacy data. Outcome variables were the number of days on sick leave allowed by the insurer in one year, and the amount paid by the insurer. We used multivariate regression to estimate whether depression increases sick leave due to metabolic and cardiovascular disease after pre-processing the data using coarsened exact matching.

Results: Individuals diagnosed with depressive disorders and absent from work due to metabolic and cardiovascular disease tend to have more paid sick days throughout the year than individuals with no depression suffering from these diseases. Additional absence days were statistically significant in nutritional and metabolic disease (10.6 days) and circulatory diseases (7.4 days).

Conclusions: Depression comorbid with a physical disease increases the number of days and consequently the associated costs to the insurer. The incremental cost due to depression is higher compared to what insurers receive annually from the government to cover health services; consequently, additional research is warranted to identify prevention activities that can treat depression, thus lowering the healthcare system's financial burden.

Keywords: Cardiovascular disease, sick leave, health insurance, depression, endocrine system diseases.

Resumen

Introducción: El sistema de salud colombiano permite que los trabajadores reclamen la licencia por enfermedad remunerada por condiciones de salud adversas, algunas de estas condiciones están relacionadas a la enfermedad metabólica y cardiovascular. Se ha encontrado una asociación entre la enfermedad metabólica y cardiovascular con la depresión. Sin embargo, el efecto de los trastornos del comportamiento, como la depresión, en el ausentismo laboral es desconocido en el mundo en desarrollo. El objetivo de esta investigación es estimar si los trabajadores de salarios bajos que sufren de depresión, enfermedad metabólica y enfermedad cardiovascular solicitan mayor cantidad de días de licencia remunerada, comparando este dato con personas con las mismas comorbilidades médicas pero sin depresión.

Palabras clave: enfermedad cardiovascular, licencia remunerada, seguro de salud, depresión, enfermedades del sistema endocrino.

Resumo

Introdução: O sistema de saúde colombiano permite que os trabalhadores solicitem licença-médica remunerada devido a condições de saúde adversas. Algumas dessas condições estão relacionadas à doença metabólica e cardiovascular. Constatou-se uma associação entre a doença metabólica e cardiovascular com a depressão. Contudo, o efeito dos transtornos do comportamento, como a depressão, no afastamento do trabalho é desconhecido no mundo em desenvolvimento. Nesse contexto, o objetivo desta pesquisa é estimar se os trabalhadores com baixa renda que sofrem de depressão, doença metabólica e doença cardiovascular solicitam maior quantidade de dias de licença-médica, comparando esse dado com pessoas com as mesmas comorbidades médicas, mas sem depressão.

Palavras-chave: doença cardiovascular, licença-médica, seguro de saúde, depressão, doenças do sistema endócrino.

Introduction

Metabolic syndrome (MTS) and cardiovascular disease (CVDs) are highly prevalent conditions that can lead to increase morbidity and mortality rates. This translates into a significant loss of productivity and economic cost to society (1). It is estimated that it can cause USD$ 152 billion in loss of productivity and USD$ 242 billion in direct medical expenditures in the United States of America (2). In addition, patients with MTS and CVDs miss, annually, 179 % more workdays and spend 147 % more days in bed than those without cardiometabolic diseases (2).

Mental disorders such as major depressive disorder (MDD) are significant issues with severe consequences for the person, the health system, and the economy. Depression has been considered a leading global cause of impairment and disability for working-age people with a tendency of having increased physical and cognitive impairments and reduced professional task performance (3). In 2030, it is expected that MDD will be one of the leading causes of adjusted life years in high-income countries (4), this results in important loss of productivity due to the effect of absenteeism (not being at work because of sickness) and presenteeism (being present at work while sick). A 2003 World Health Organization investigation about mental health suggests that the average annual health care cost for employees with depression is 4.2 times higher than those incurred by a typical beneficiary (5). In 2000, the economic burden of depression in the United States of America was estimated at USD$83.1 billion; depression includes major depressive disorder, bipolar depression, and dysthymia (6). In 2013, MDD accounted for 6.24 % of the total disability-adjusted life-years (DALYs) in the population aged 18 to 59 in Latin America and the Caribbean. DALYs are ranking as the third leading cause of burden of disease (7).

MDD is frequently encountered concurrent with CVD, and it is associated with poor clinical and physiological outcomes (4). It has been shown that when both conditions are present (MDD and CVD), the functional impairment and work absenteesim of the individual can be increased up to eight times (8). MDD is also related to MTS (9). MTS has been reported to occur 2-3 times more often when MDD is manifested (10). MTS has also been shown to increase a negative perception of health, paid sick days, significant loss of productivity, and economic impact to the health insurer (11). However, to our knowledge, there are no reports of the impact of the multimorbidity of MDD and MTS, as well as MDD and CVD on sick leave and productivity loss in low-wage workers in particular.

International studies about depression suggest that the impact in productivity is directly related to factors influencing sick leave. In some cases, depression has even been considered equivalent to clinical burnout or as a direct consequence of it (10). Main findings blame multimorbidity with medical diseases as a frequent and important factor, especially diseases affecting the endocrine, cardiovascular, and metabolic system.

MDD patients have higher risk of MTS and CVD (8). MTS and CVD that are present in depressive disorders can be originated due to multifactorial causes such as biological factors,

which include genetic predisposition and endocrinological vulnerability; emotional factors; unhealthy lifestyle including poor eating habits, nicotine dependence, and sleeping disorders (9). In addition, psychiatric medications like mood stabilizers are well documented to have side effects such as arrhythmia and metabolic syndrome, which directly give rise to atherosclerosis and acute coronary syndromes (12).

Colombian health system is divided in two schemes: Contributory regime (CR) and subsidized regime (SR). There are private and public insurers in both schemes, which are of similar character to Health Maintenance Organizations (HMOs) in the United States. CR affiliates formal and independent workers that can afford to pay the mandatory contribution established by law; this contribution includes coverage for family members. On the other hand, workers that cannot afford to pay the mandatory contribution are registered in the SR; here, the national government pays for their contribution to the system. Both schemes cover around 95 % of Colombian population. The system is set up in a managed competition style, whereby insurers compete for members and providers compete to be included in the insurer network. There is a government-defined benefits package that each HMO must provide; it includes sick leave. Insurers receive a risk-adjusted capitation defined by the government to cover the benefits package. Insurers in the CR also receive an extra premium from the government to cover sick leave. In 2016, 14 HMOs were registered in the CR; they covered 20 million lives.

Sick leave is regulated by law, employers pay for the first two days, and after that, insurers are in charge of reimbursing workers at a replacement rate of 66 % of their salary, but the coverage does not exceed 180 days. Every paid sick day must be certified by a physician, who defines how many days are necessary for the worker to recover and return to work. There is a separate insurance scheme for traffic road accidents and occupational diseases. Therefore, HMOs typically cover sick leave due to general disease.

In general, several diseases are directly associated with absence from work, such as work-related stress. To cover all such diseases is out of the scope of this paper. Instead, the objective is to focus on the relation amongst the three conditions. Our aim is to assess whether low-wage workers suffering from MDD and a physical disease have more paid sick days than people with the same medical condition, but without MDD in Colombia. This information is key to strengthening the case for cost-effective prevention programs in mental health care.

Data and Methods

This is a retrospective study on administrative data for 2016 using de-identified paid sick leave claims from an HMO in Colombia under an academic agreement with Universidad ICESI. The Internal Review Board considered the protocol of no risk for people in the dataset as long as the results were reported in aggregated figures.

The HMO is a midsize insurer with an average monthly enrollment for 2016 of 944.987 people. The national market share is 4 % in the CR, but it has the largest market share in Colombia's third largest economic region, the southwest. In addition, 80 % of workers enrolled in the HMO earn less than two minimum wages: thus, the population under analysis is statistically representative of low-wage workers in Colombia.

Data sources

For our analyzses, we linked four datasets: claims paid for by the insurer on all services included in the Colombian benefits package, sick-leave claims, member enrollment data, and economic indicators. The first three datasets are linked using an anonymized patient id. The fourth is linked using the municipality of residence. The first dataset includes all services paid by the insurer: age; gender; municipality of residence; date of service; primary diagnosis (ICD-10); service code, ATC in the case of pharmaceutical drugs and the Colombian classification systems of procedures for other services; and final payment made by the insurer to the provider.

The second dataset has the sick leave events. It includes all episodes of sick leave and the number of days that physicians authorize for all enrollees, regardless of payer e.g., employers, mandatory auto insurance companies, etc. In addition, the data includes primary diagnosis, description, length of leave, amount paid, and provider identifier for each leave. The third dataset is the enrollment file which includes: gender, age, municipality of residence, educational attainment, and whether the person is a worker or a dependent. Finally, the fourth dataset includes economic indicators such as population and unemployment rate by state.

Outcomes

There are four outcomes of interest: the number of paid sick days given by the HMO in one year due to MTS, the number of paid sick days given by the HMO in one year due to CVD, the amount paid in dollars by the HMO in one year due to MTS, and the amount paid in dollars by the HMO in one year due to CVD. Monetary values are initially recorded in the data in Colombian pesos and then, exchanged into dollars.

Exposure of interest

The variable of interest is whether, in 2016, patients have depression. Depression is identified using the Johns Hopkins ACG® System on the claims dataset. Using diagnosis and pharmacy data, the software classifies patients into morbidity categories. Specifically, depression condition marker uses the following criteria: 1. Inpatient or ER diagnosis, 2. outpatient diagnoses plus 2 prescription fills. This marker has been used in several publications (13, 14, 15).

The Adjusted Clinical Groups (ACG) is an actuarial cell, dozens of which form the building blocks of the Johns Hopkins ACG System methodology. ACG categories are a series of mutually

exclusive health status categories defined by morbidity, age, and sex. They are based on the premise that the level of resources needed for delivering appropriate health care to a population is correlated with the disease burden of that population.

ACG categories are methods for categorizing patient's diseases. ACG categories are person-focused. Based on the pattern of morbidities, the ACG approach assigns each individual to a single ACG category. This method also known as 'clustering of morbidity' is a better predictor of health services resource use than using specific diseases as predictors.

Covariates

As described previously, MDD is a complex disease associated with environmental and individual factors. We account for confounders that are observed in the data at the person-level. Those confounders are sex; age; type of enrollee (i.e., policyholder, dependent and spouse); and educational attainment (i.e, elementary education, secondary education, vocational education, or college).

To account for the individual level of morbidity risk, we use another variable computed by the ACG system: the local Johns Hopkins ACG® System concurrent risk score. The higher the score, the higher the morbidity of the individual.

To account for the likelihood of access to psychiatry services, the population size of the municipality in which the worker lives is used. It is assumed that the bigger the population, the likelihood of availability of such services increases. This variable does not change over time.

The monthly unemployment rate is used to account for fluctuations in economic activity that could affect people's willingness to seek paid sick leave. This variable changes over time.

Unemployment and population size are municipality-level variables. From a statistical point of view, it is necessary to adjust standard errors in linear regression models for clustering of data at the municipality level. Since these are variables used to control economic and likelihood of access to services, instead of variables of interest or exposure, the ecological inference fallacy is avoided.

Inclusion and exclusion criteria

In order to avoid bias and to restrict the analysis for the working population, several criteria are applied to the sick leave dataset. First, all sick leave claims that were paid by employers and by other insurers, but the HMO are excluded. Second, sick leaves episodes that were paid to people older than 62 or younger than 18 because of Colombia's legal working age were

excluded. Third, any sick leave greater than 180 days was also excluded because the HMO did not pay for it. Fourth, any paid sick leave that according to the data began in 2015 or ended in 2017 is excluded because our dataset corresponds to the 2016 claims. It is impossible to establish whether the patient had previous or subsequent claims. Lastly, in this study, the focus is on two major diagnosis groups because there is clinical and economic literature that clearly supported the mechanisms by which depression is linked to them. For that reason paid sick leaves associated with other dignoses were also excluded. These two major diagnosis groups are: "Diseases of the circulatory system" (CVD) defined as all claims with diagnoses coded between I00 and I99 in the data; and "Endocrine, nutritional and metabolic diseases" (MTS) defined as all claims with diagnoses coded between E00 and E89 (Table 1). Essentially the analysis focused on those sick leaves that had a clear start and end period in 2016.

The primary diagnosis for people with and without depression is tabulated among the paid sick days events remaining after those exclusions. Then, we excluded those sick leaves with a primary physical diagnosis for which there were no cases in both groups. Namely, for a given ICD10 code, there should be at least one patient with depression and one patient without depression. After these exclusions, the population under analysis is workers in the age group 18 to 62, who claimed paid sick days to the HMO in 2016 due to CVD or MTS.

Statistical Analysis

In the absence of experimental or quasi-experimental data, this descriptive analysis uses applied statistical techniques designed to improve the estimation of associations between a variable of interest and an outcome of interest. Matching techniques have been developed as methods to assess treatment effects from administrative data. The idea behind any matching approach is to reduce the imbalance in observed variables that could potentially confound or bias the treated (exposed) and the controls (unexposed). Several matching techniques are exact matching, propensity score matching (PSM), and coarsened exact matching (CEM). Among all matching tecniques, PSM is the most commonly used when there are many possible confounders, and the confounders need to be reduced.

CEM has advantages over PSM. Coarsened exact matching bounds the degree of model dependence and causal effect estimation error by ex-ante user choice; CEM is monotonic imbalance bounding, meaning that reducing the maximum imbalance on one variable has no effect on others. It does not require a separate procedure to restrict data to common supports. It meets the congruence principle. It is approximately invariant to measurement error, it balances all nonlinearities and interactions in a sample. While exact matching provides perfect balance, it typically produces few matches because of the curse-of-dimensionality issues. In addition, adding one continuous variable to a dataset effectively distorts exact matching given that two observations are unlikely to have identical values on a continuous measure. The idea of CEM is to temporarily coarsen each variable into substantively meaningful groups, exact match on these coarsened data, and then retain only the original (uncoarsened) values of the matched data for analysis.

The variables used to define CEM strata are the following: age (cut-off points: 18, 41, 51, 62), local risk score (cut-off points: 0.26, 0.60, 1.20, 2.00, 3.00); female; and type of enrollee. How CEM works is sorting all the observations into strata, each of which has identical values for all the coarsened pretreatment covariates. Then, it discards all observations within any stratum that does not have at least one observation for each unique value of the treatment variable. As a consequence, the CEM algorithm generates a measure of imbalance computed as the absolute difference over all the cell values. The procedure is repeated until global imbalance is achieved.

Since the data is balanced, including nonlinearities and interactions after CEM, we consider that no additional modeling of the outcome is necessary (e.g., using poisson models) to estimate our quantity of interest. This quantity refers to the adjusted conditional mean differences in the number of paid days of sick leave between people with and without depression. The ordinary least square estimator was used to achieve that goal.

In sum, our strategy uses CEM to control selection bias, inclusion and exclusion criteria for information bias, and multivariate regression for confusion bias. All of these are within the limits of the information available.

Lastly, all statistical analyses were performed in United States dollar (USD) for the international reader understanding, and for comparability with other studies. Therefore, the original data recorded in COP is expressed in USD using an exchange rate of COP$ 3,000 per USD$ 1.

Results

In 2016, the health insurer had around one million enrollees. Depression prevalence in the population was 3.4 %. Table 1 gives descriptive statistics on sick leaves (time and cost) by disease groups, MTS, CVD and depression. For 2016, there were a total of 77,423 sick leave claims corresponding to 57,041 unique enrollees.

After exclusion criteria, it is found that 44,782 people claimed and were paid at least one day of sick leave in 2016. Among these, depression disease prevalence was 7.8 %; these patients were paid 5,691 days, accounting for 9.6 % of the total. By type of disease-causing the sickness event, it is worth noting that people with depression always had a higher number of days than people without depression; in MTS 11 days; and in CVD 12 days of difference (Table 1). Similar results were found in the amount paid by the HMO.

Table 1. Paid sick leave claims (Time and Cost) by disease groups and depression

ICD-10[1] Groups	Group	Obs	Mean	Std. Err.	Std. Dev.	[95 % Conf.	Interval]	Pr(|T| > |t|)
Sick leaves (Days)								
Endocrine, nutritional and metabolic diseases	No Depression Ill	188	15.34	1.29	17.64	12.80	17.88	0.0047
	Depresion Ill	34	26.50	5.85	34.13	14.59	38.41	
Diseases of the circulatory system	No Depression Ill	1126	16.22	0.71	23.90	14.82	17.62	0.0000
	Depresion Ill	213	28.21	2.77	40.37	22.75	33.66	
Amount paid (USD[2])								
Endocrine, nutritional and metabolic diseases	No Depression Ill	188	158.09	13.79	189.03	130.89	185.28	0.0173
	Depresion Ill	34	268.92	78.17	455.80	109.88	427.95	
Diseases of the circulatory system	No Depression Ill	1126	174.91	10.47	351.43	154.36	195.46	0.0050
	Depresion Ill	213	250.91	28.09	409.99	195.53	306.28	

Source: Own elaboration

Table 2 shows differences between individuals with and without depression that claimed paid sick days, according to age, morbidity score, gender, and employment status. People with depression were more likely to be older, unemployed, and females. Also, on average and more important, people with depression had morbidity scores 2.5 times higher than those without it.

Table 2. Differences between individuals with and without depression that claimed paid sick days

ICD-10 Groups	Group	Obs	Mean	Std. Err.	Std. Dev.	[95 % Conf.	Interval]	Pr(|T| > |t|)
Age	No Depression Ill	41268	37	0.05	10.57	36.58	36.78	0.0000
	Depresion Ill	3514	42	0.18	10.83	41.63	42.35	
Morbidity Score	No Depression Ill	41268	1.85	0.01	2.66	1.82	1.87	0.0000
	Depresion Ill	3514	4.48	0.09	5.47	4.30	4.66	
Female	No Depression Ill	41268	45 %	0.00		0.44	0.45	0.0000[1]
	Depresion Ill	3514	61 %	0.01		0.60	0.63	
Regional Information								
State Unemployment (2016)	No Depression Ill	41268	10.74	0.01	1.08	10.72	10.75	0.0024
	Depresion Ill	3514	10.68	0.02	1.08	10.64	10.71	
City Pop in 2016	No Depression Ill	41268	1169604	5902	1199053	1158035	1181173	0.0001
	Depresion Ill	3514	1088815	19015	1127161	1051534	1126095	

Source: Own elaboration

Table 3 shows characteristics between individuals with and without depression that claimed paid sick days, according to enrollee type and education. For example, it shows that people with depression were more likely to have a high school degree and to be policyholders.

Table 3. Characteristics between individuals with and without depression that claimed paid sick days

	Depresion Ill		No Depression Ill	
	Number	Percentage	Number	Percentage
Type of enrollee				
Dependent	57	1.6 %	581	1.4 %
Policyholder	3212	91.4 %	38332	92.9 %
Spouse	245	7.0 %	2355	5.7 %
Education				
Elementary	510	14.5 %	5525	13.4 %
High School	1016	28.9 %	10448	25.3 %
Vocational	1109	31.6 %	14841	36.0 %
Bachelor o more	879	25.0 %	10454	25.3 %

Source: Own elaboration

Table 4 shows results of multivariate regression: adjusted paid sick days and payments made by health insurers for MTS and CVD. After pre-processing the data and adjusting for observed confounders, we found statistical evidence that people diagnosed at any moment in the year with depression were absent from work more days in a single year than people without such diagnosis. By diagnosis groups, the difference was 10.6 days for MTS compared to 7.4 days for CVD.

Table 4. Adjusted paid sick days and payments made by health insurer[1,2,3]

Major Diagnoses Groups	Paid sick days	Amount paid[3]	Number
Diseases of the circulatory system	7.402***	50.15*	1,339
	(2.836)	(29.13)	
Endocrine, nutritional and metabolic diseases	10.56*	117.9	222
	(6.032)	(83.44)	

Source: Own elaboration

Regarding the amount paid by the insurer, we found variation in the incremental cost. The HMO paid USD$ 52 more per year for patients with CVD and depression than for patients with CVD and no depression. Similarly, the HMO paid USD$ 118 more per year for patients with MTS and depression, than for with patients with MTS and no depression. The number of average extra days associated with depression is 7.4 days in the case of CVD and 10.6 days in the case of MTS. In perspective, USD$ 118 is equivalent to 91 % of the annual amount paid to the HMO from the government for males in the age group 19-44.

Discussion

Our results clearly shows evidence that for MTS and CVD, low-wage workers diagnosed at any time of the year with depression as comorbodity are absent from work more days in a single year than people without such diagnose. By law, a formal worker cannot earn less than the minimum wage. For those making more than the minimum wage, our results mean a decrease in their income. So, from the worker's perspective, those affected the most are workers earning more than the minimum wage.

Our study design means that these results must be taken as evidence that strictly refers to the HMO population, but it simultaneously points out an issue that could very well be of significance for other HMOs in Colombia. This is a question we leave for future research.

As suggested by others, these results strongly validate depression as a highly prevalent systemic illness affecting other body diseases (16, 17) that results in a significant negative impact on productivity (18). Therefore depression can be related to poorer work.

In our study, low-wage workers with depression had an average morbidity score 2.5 times higher than those without it. In the literature, including meta-analyses and other types of studies, depression has been found reciprocally linked to MTS and CVD, and different diagnostic group in the age between 29-31 years, with a range of poorer outcomes including increased morbidity; mortality; health care utilization; higher medical costs; reduced workforce participation and performance; increased functional disability; lower social functioning; more problems with activities of daily living; and higher disability days i.e., absenteeism (12, 14, 19-24). The relationship between these comorbidities and depression on work functioning suggests its adverse effects on functional outcomes.

Recent evidence describes several mechanisms on how depression as a systemic illness relates to other diseases, including metabolic and cardiovascular ones (25). Some interacting physiological and behavioral mechanisms have been described and highlighted (26-32): 1. Depression can start as a reaction to the stress produced by medical or surgical illness; 2. Depression can have deleterious effects on body function and allostatic load, mainly represented by inflammation and metabolic processes; 3. It can be due to direct effects on the brain of body malfunction and inflammation; 4. Depression can induce maladaptive and unhealthy behaviors that contribute to widespread disease by triggering or worsening it; 5. Depression can induce hypercortisolemia, which strongly correlates with abnormalities in glucose homeostasis and changes in serum lipids; 6. MTS and CVD can be caused as a side effect of psychiatric drugs that are often associated with weight gain and metabolic disarrangements.

In addition, low-wage workers with depression tend to have an unhealthy diet, sedentary lifestyle, and weight gain, especially during depressive episodes increasing the risk of MTS and CVD. Some studies have found that in depressive syndrome there is an increase in biochemical alterations such as decreased high-density lipoprotein (HDL) and increased cholesterol and

glucose levels (33). Knowing this information is essential to take preventive measures in this population at high risk of developing this type of complications. Eventually, work productivity would not be affected.

We found that people with CVD and MTS had a considerable high number of paid sick days in the year. Most circulatory disorders found were angina, and most metabolic disorders were related to obesity and diabetes. Those comorbid diseases are expected to have a more significant physiological impact with increased mean and range sick leave because of their chronicity. The percentage of increase in days above mean was between 40 to 60 % approximately, suggesting that the difference among disease groups is mostly due to the mean and range of paid sick days.

Our findings show that low-wage workers with depression, comorbid with CVD and MTS are at high risk of functional impairments. Implementing and evaluating targeted interventions in this population would facilitate work reintegration and productivity.

The problem in Colombia, as elsewhere in the world (34), seems to be growing, but data is limited. Government national data shows that care for depression has increased since 2009 (35). One recent study claimed that the average number of depression inpatient days of stay was 11.5, with a median of 9 and a range between 2 and 56 days (36). To tackle the impact of depression on productivity, activities are required at all levels (37). In this sense, Colombian government has issued laws and policies for health promotion and prevention of labor stress, depression, and other mental disorders at the workplace (38-40). However, continuous actions are needed to enforce rules among industry, workforce leaders, families, and the general public.

Several limitations were encountered in this research. First, we use the term multimorbidity to define more than one comorbidity. Nevertheless, we don't have the causality data to explain if the disease appeared first or after the mental illness. Also, stress related to work is associated with symptoms and diseases such as cardiovascular disease and metabolic syndrome. This, in workers with chronic depression, will add to the days paid by the insurance company.

We did not include factors that can increase the risk of depression, such as interpersonal relationships; the time frame in which they work, night or day shifts; the psychological and physical loads that are a product of tier activities; and the presence of burnout and bullying in the group of individuals who already have a diagnosis of metabolic syndrome and/or cardiovascular disease.

It is essential to mention that our research did not use data from other insurers, and for that reason, results are not generalizable to the country. Lastly, the study focuses on low-wage workers because the main source of work, in the southwest region, are low-skilled industries and employers on the agricultural sector. Therefore, our results do not generalize to a different workers population. This topic is left for future research.

Future studies should advance to the analytic stage (cohort, case control, etc.) in order to analyze the causal effects of anxiety, stress, depression on paid sick leave. Also, these studies should include preliminary information on diet, lifestyle, and anthropometric measurements, which will lead to closer inferences to estimate causal relationships.

Conclusions

To the best of our knowledge, this study is the first to evaluate the coexistence of MTS, CVD, depression and work productivity in low-wage workers who are entitled to sick leave. Based on the results and following Colombian provisions (38, 40, 41), the negative effects on productivity, due to the interacting effects of physical illness and comorbid depression found in this study, should be taken into account by the government and private parties. This is in order to develop science-based (20, 41-43) biological, psychological and social programs, which are able to tackle comorbid diseases at all levels of mental health promotion and prevention (44). The consequences include prevention of clinical burnout (43); decreasement of the country economic impact and improvement of workforce quality of life. Mental diseases should be prioritized given its prevalence in the population. Prompt evaluation and preventive measures such as screening tests should be performed to avoid comorbidities. This improves the individual's health, prevent complications, and improve work resumption and economic burden.

Future studies should advance to the analytic stage (cohort, case control, etc.) in order to analyze the causal effects of anxiety, stress, depression on paid sick leave. Also, these studies should include preliminary information on diet, lifestyle, and anthropometric measurements, which will lead to closer inferences to estimate causal relationships.

Compliance with Ethical Standards

This is a retrospective study on administrative data for 2016 using de-identified sick leave claims from an HMO in Colombia under an academic agreement with Universidad ICESI. The Internal Review Board considered the protocol of no risk for people in the dataset as long as the results were reported in aggregated figures, granting an exemption for further review.

Funding

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Conflict of Interest

Sergio I. Prada declares that he has no conflict of interest. Ana M. Pérez declares that she has no conflict of interest. Valentina Serna declares that she has no conflict of interest. Hernán G. Rincón-Hoyos declares that he has no direct conflict of interest, but he is a major holder of stock in Medicina Inteligente SAS.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Crisp R. Depression and occupational disability in five diagnostic groups: A review of recent research. Disabil Rehabil. 1 de enero de 2007;29(4):267-79. https://doi.org/10.1080/09638280600835267

2. Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, et al. The epidemiology of major depressive disorder: results from the National multimorbidity Survey Replication (NCS-R). JAMA. 18 de junio de 2003;289(23):3095-105. Doi: https://doi.org/10.1001/jama.289.23.3095

3. Pandalai SP, Schulte PA, Miller DB. Conceptual heuristic models of the interrelationships between obesity and the occupational environment. Scand J Work Environ Health. 1 de mayo de 2013;39(3):221-32. Doi: https://doi.org/10.5271/sjweh.3363

4. Nigatu YT, Reijneveld SA, Penninx BWJH, Schoevers RA, Bültmann U. The longitudinal joint effect of obesity and major depression on work performance impairment. Am J Public Health. mayo de 2015;105(5):e80-86. . Doi: https://doi.org/10.2105/AJPH.2015.302557.

5. World Health Organization, Noncommunicable Disease and Mental Health Cluster. Investing in mental health. [Internet]. 2003 [cited 2022 Jan 26]. Available from: http://www.myilibrary.com?id=9723

6. Koopmans PC, Roelen CAM, Groothoff JW. Sickness absence due to depressive symptoms. Int Arch Occup Environ Health. mayo de 2008;81(6):711-9. Doi: https://doi.org/10.1007/s00420-007-0243-7

7. Burton WN, Chen C-Y, Schultz AB, Edington DW. The prevalence of metabolic syndrome in an employed population and the Impact on health and productivity. J Occup Environ Med. octubre de 2008;50(10):1139-48. Doi: https://doi.org/10.1097/JOM.0b013e318188b8eb.

8. Sullivan PW, Ghushchyan V, Wyatt HR, Wu EQ, Hill JO. Productivity costs associated with cardiometabolic risk factor clusters in the United States. Value Health J Int Soc Pharmacoeconomics Outcomes Res. diciembre de 2007;10(6):443-50. . Doi: https://doi.org/10.1111/j.1524-4733.2007.00199.x

9. Singh VK, Karmani S, Malo PK, Virupaksha HG, Muralidhar D, Venkatasubramanian G, et al. Impact of lifestyle modification on some components of metabolic syndrome in persons with severe mental disorders: A meta-analysis. Schizophr Res. 2018;202:17-25. Doi: https://doi.org/10.1016/j.schres.2018.06.066

10. Ohaeri JU, Akanji AO. Metabolic syndrome in severe mental disorders. Metab Syndr Relat Disord. abril de 2011;9(2):91-8. Doi: https://doi.org/10.1089/met.2010.0053. Doi: https://doi.org/10.1177/0003319718780145.

11. Manolis TA, Manolis AA, Manolis AS. Cardiovascular Safety of Psychiatric Agents: A Cautionary Tale. Angiology. febrero de 2019;70(2):103-29. Doi: https://doi.org/10.1177/0003319718780145

12. Druss BG, Marcus SC, Olfson M, Tanielian T, Elinson L, Pincus HA. Comparing the national economic burden of five chronic conditions. Health Aff Proj Hope. diciembre de 2001;20(6):233-41. Doi:https://doi.org/10.1377/hlthaff.20.6.233

13. Murray CJL, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet Lond Engl. 15 de diciembre de 2012;380(9859):2197-223. Doi: https://doi.org/10.1016/S0140-6736(12)61690-0

14. Depression [Internet]. [citado 15 de agosto de 2019]. Disponible en: https://www.who.int/news-room/fact-sheets/detail/depression

15. Kessler RC. The costs of depression. Psychiatr Clin North Am. marzo de 2012;35(1):1-14. Doi: https://doi.org/10.1016/j.psc.2011.11.005

16. Bielecky A, Chen C, Ibrahim S, Beaton DE, Mustard CA, Smith PM. The Impact of comorbid mental and physical disorders on presenteeism. Scand J Work Environ Health. noviembre de 2015;41(6):554-64. Doi: https://doi.org/10.5271/sjweh.3524.

17. Evans-Lacko S, Knapp M. Global patterns of workplace productivity for people with depression: absenteeism and presenteeism costs across eight diverse countries. Soc Psychiatry Psychiatr Epidemiol. 2016;51(11):1525-37. Doi: https://doi.org/10.1007/s00127-016-1278-4.

18. Murray CJL, Lopez AD, Organization WH, Bank W, Health HS of P. The Global burden of disease : a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020 : summary [Internet]. World Health Organization; 1996 [citado 20 de agosto de 2019]. Disponible en:https://apps.who.int/iris/handle/10665/41864. Doi:

19. Uribe JM, Pinto DM, Vecino-Ortiz AI, Gómez-Restrepo C, Rondón M. Presenteeism, Absenteeism, and Lost Work Productivity among Depressive Patients from Five Cities of Colombia. Value Health Reg Issues. diciembre de 2017;14:15-9. https://doi.org/10.1016/j.vhri.2017.03.001

20. Angstman KB, Meunier MR, Rohrer JE, Oberhelman SS, Maxson JA, Rahman PAS. Future complexity of care tier affected by depression outcomes. J Prim Care Community Health. 1 de enero de 2014;5(1):30-5. Doi: https://doi.org/10.1177/2150131913511465

21. Rincon HG, Granados M, Unutzer J, Gomez M, Duran R, Badiel M, et al. Prevalence, detection and treatment of anxiety, depression, and delirium in the adult critical care unit. Psychosomatics. octubre de 2001;42(5):391-6. Doi: https://doi.org/10.1176/appi.psy.42.5.391

22. Rincon-Hoyos HG, Castillo A, Prada SI. Alcohol use disorders and psychiatric diseases in Colombia. Colomb Medica Cali Colomb. 30 de marzo de 2016;47(1):31-7. Doi: https://doi.org/10.25100/cm.v47i1.1991

23. O'Neil A, Williams ED, Stevenson CE, Oldenburg B, Sanderson K. Co-morbid depression is associated with poor work outcomes in persons with cardiovascular disease (CVD): a large, nationally representative survey in the Australian population. BMC Public Health. 18 de enero de 2012;12:47. . Doi: https://doi.org/10.1186/1471-2458-12-47

24. Waghorn G, Chant D, Lloyd C. Labor force activity among Australians with musculoskeletal disorders comorbid with depression and anxiety disorders. J Occup Rehabil. junio de 2006;16(2):241-52.

25. Depression as a Systemic Illness [Internet]. Oxford University Press; [citado 20 de agosto de 2019]. Disponible en: https://oxfordmedicine.com/view/10.1093/med/9780190603342.001.0001/med-9780190603342

26. Dantzer R, O'Connor JC, Freund GG, Johnson RW, Kelley KW. From inflammation to sickness and depression: when the immune system subjugates the brain. Nat Rev Neurosci. enero de 2008;9(1):46-56. Doi: https://doi.org/10.1038/nrn2297

27. Janssen DGA, Caniato RN, Verster JC, Baune BT. A psychoneuroimmunological review on cytokines involved in antidepressant treatment response. Hum Psychopharmacol. abril de 2010;25(3):201-15. Doi: https://doi.org/10.1371/journal.pone.0194029

28. Arango-Dávila CA, Rincón-Hoyos HG. Depressive Disorder, Anxiety Disorder and Chronic Pain: Multiple Manifestations of a Common Clinical and Pathophysiological Core. Rev Colomb Psiquiatr. marzo de 2018;47(1):46-55. . Doi: https://doi.org/10.1016/j.rcpeng.2017.12.003

29. Leonard B, Maes M. Mechanistic explanations how cell-mediated immune activation, inflammation and oxidative and nitrosative stress pathways and their sequels and concomitants play a role in the pathophysiology of unipolar depression. Neurosci Biobehav Rev. febrero de 2012;36(2):764-85. Doi: https://doi.org/10.1016/j.neubiorev.2011.12.005

30. Miller AH, Maletic V, Raison CL. Inflammation and its discontents: the role of cytokines in the pathophysiology of major depression. Biol Psychiatry. 1 de mayo de 2009;65(9):732-41. Doi: https://doi.org/10.1016/j.biopsych.2008.11.029

31. Slavich GM, Irwin MR. From stress to inflammation and major depressive disorder: a social signal transduction theory of depression. Psychol Bull. mayo de 2014;140(3):774-815. https://doi.org/10.1037/a0035302

32. Ervasti J, Vahtera J, Pentti J, Oksanen T, Ahola K, Kivekäs T, et al. Return to work after depression-related absence by employees with and without other health conditions: a cohort study. Psychosom Med. marzo de 2015;77(2):126-35. Doi: https://doi.org/10.1097/PSY.0000000000000138

33. Wysokiński A, Strzelecki D, Kłoszewska I. Levels of triglycerides, cholesterol, LDL, HDL and glucose in patients with schizophrenia, unipolar depression and bipolar disorder. Diabetes Metab Syndr. septiembre de 2015;9(3):168-76. Doi: https://doi.org/10.1016/j.dsx.2015.04.004

34. WHO | Depression and Other Common Mental Disorders [Internet]. WHO. [citado 20 de agosto de 2019]. Disponible en: http://www.who.int/mental_health/management/depression/prevalence_global_health_estimates/en/

35. Sistema Integral de Información SISPRO [Internet]. [citado 20 de agosto de 2019]. Disponible en: https://www.minsalud.gov.co/salud/Paginas/SistemaIntegraldeInformaci%C3%B3nSISPRO.aspx

36. Pinto Masís D, Gómez-Restrepo C, Uribe Restrepo M, Miranda C, Pérez A, de la Espriella M, et al. La carga económica de la depresión en Colombia: costos directos del manejo intrahospitalario. Rev Colomb Psiquiatr. septiembre de 2010;39(3):465-80. Doi: https://doi.org/10.1016/S0034-7450(14)60219-5

37. Rincón HG. COGNITIVE MEDICINE: AN ECOLOGICAL MODEL. Rev Colomb Psiquiatr. julio de 2003;32(3):260-6.

38. Derecho del Bienestar Familiar [RESOLUCION_MINPROTECCION_2646_2008] [Internet]. [citado 20 de agosto de 2019]. Disponible en: https://www.icbf.gov.co/cargues/avance/docs/resolucion_minproteccion_2646_2008.htm

39. Guía técnica general factor psicosocial.pdf [Internet]. Google Docs. [citado 20 de agosto de 2019]. Disponible en: https://drive.google.com/file/d/1pwrb6J4Rag-eo_dsL-YNlR06oCrkDxE9/view?usp=sharing&usp=embed_facebook

40. Duque CAO. Manual de procedimientos para la rehabilitación y reincorporación ocupacional. [citado 20 de agosto de 2019]; Disponible en: https://www.academia.edu/17308393/Manual_de_procedimientos_para_la_rehabilitaci%C3%B3n_y_reincorporaci%C3%B3n_ocupacional

41. Ortiz VHC, Prowesk KVS, Ortiz FA. Factores de riesgo psicosocial laboral: métodos e instrumentos de evaluación | Charria Ortiz | Facultad Nacional de Salud Pública. [citado 20 de agosto de 2019]; Disponible en: https://aprendeenlinea.udea.edu.co/revistas/index.php/fnsp/article/view/9715

42. World Health Organization. Prevention and Promotion in Mental Health.

43. Stenlund T, Ahlgren C, Lindahl B, Burell G, Steinholtz K, Edlund C, et al. Cognitively oriented behavioral rehabilitation in combination with Qigong for patients on long-term sick leave because of burnout: REST--a randomized clinical trial. Int J Behav Med. 2009;16(3):294-303. https://doi.org/10.1007/s12529-008-9011-7

44. World Health Organization. Prevention and Promotion in Mental Health.