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Preliminary communication

A clinical predictive score for mood disorder risk in low-income primary care settings

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ABSTRACT

Background: Despite availability of validated screening tests for mood disorders, busy general practitioners (GPs) often lack the time to use them routinely. This study aimed to develop a simplified clinical predictive score to help screen for presence of current mood disorder in low-income primary care settings.

Methods: In a cross-sectional study, 197 patients seen at 10 primary care centers in Santiago, Chile completed self-administered screening tools for mood disorders: the Patient Health questionnaire (PHQ-9) and the Mood Disorder Questionnaire (MDQ). To determine participants' current-point mood disorder status, trained clinicians applied a gold-standard diagnostic interview (SCID-I). A simplified clinical predictive model (CM) was developed based on clinical features and selected questions from the screening tools. Using CM, a clinical predictive score (PS) was developed. Full PHQ-9 and GP assessment were compared with PS.

Results: Using multivariate logistic regression, clinical and demographic variables predictive of current mood disorder were identified for a simplified 8-point predictive score (PS). PS had better discrimination than GP assessment (auROC-statistic=0.80 [95% CI 0.72, 0.85] vs. 0.58 [95% CI 0.52, 0.62] p-value <0.0001), but not as good as the full PHQ-9 (0.89 [95% CI 0.85, 0.93], p-value=0.03). Compared with GP assessment, PS increased sensitivity by 50% at a fixed specificity of 90%. Administered in a typical primary care clinical population, it correctly predicted almost 80% of cases.

Limitations: Further research must verify external validity of the PS.

Conclusion: An easily administered clinical predictive score determined, with reasonable accuracy, the current risk of mood disorders in low-income primary care settings.

1. Introduction

In Chile, diagnosis and treatment of mood disorders in primary care settings (PCS) is based on non-standardized clinical assessment by general practitioners (GP), despite the fact that Santiago, its capital, has the largest proportion of depressed people abroad (Simon et al., 1999). GPs are frequently overburdened, with numerous patients to treat daily, creating an environment in which a complete mental health evaluation is unlikely to be administered. Most GP spend only 5–10 min with each patient, making mood disorder assessment even more difficult.

While screening tests for mood disorders in primary care settings have proven useful, applying and interpreting the results

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typically takes several minutes (Spitzer et al., 1999). With clinicians' responsibility to screen for numerous other conditions, universal use of such tests is therefore prohibitively time-consuming. Even when screening tools are attached to electronic records, a considerable proportion of GPs still do not use them extensively (Gill et al., 2012). When applied, GPs mostly use screening tools to confirm mood disorder diagnoses or to follow their course, not for routine screening (Rost et al., 2000). These problems are worsened in low-income countries, where electronic records are not available and early prediction could be especially useful in conserving scarce economic resources. Thus, simpler screening methods for mood disorder risk are badly needed in low-income primary care settings. In this study, we explored whether a substantially simplified screening instrument – one that combines easily obtainable clinical and demographic information with selected key questions from the screening questionnaire – might be clinically useful for mood disorders detection in resource-limited primary care settings.

2. Methods

Using a cross-sectional design, we aimed to develop a logistic regression model, then a simplified tool based on this model, to predict presence versus absence of current mood disorder as determine by a full diagnostic interview. Items from current well-validated screening tools, as well as clinical and demographic features readily available to GPs, were examined as independent variables. We aimed to select a substantially reduced subset of these screening tool questions, plus clinical and demographic information, to create our predictive score. The sample includes 197 patients enrolled between 2009 and 2011 in a study undertaken to improve the detection of mood disorders in primary care settings.

2.1. Participants

To minimize sample bias, subjects were recruited consecutively from clinic sessions in the general medical clinics ("Programas de medicina general") of 10 low-income primary care centers in Santiago, Chile. Patients 18 to 75 years old seeking primary care medical evaluation for common illnesses were included. Patients were asked to voluntarily participate in a study for mood disorder screening. In order to participate, these patients were required to have a cognitive status compatible with the assessment and to offer informed consent. Positive mood disorder diagnosis in the previous 6 months was the only exclusion criterion. No patient declined to participle in the study.

2.2. Procedure

After regular GP assessment, prospective participants received a protocol including an informed consent and two self-administered screening instruments for mood disorders: the Patient Health Questionnaire 9 (PHQ-9) (Kroenke et al., 2001) for depression and the Mood Disorder Questionnaire (MDQ) for bipolar disorder (Hirschfeld et al., 2000). Next, blinded to PHQ-9/MDQ screening results, a trained psychiatric clinician applied the DSM-IV Structural Clinical Diagnostic Interview (SCID-I) (Spitzer et al., 1990) to obtain current mood diagnostic status for each participant (point prevalence, not lifetime prevalence). Finally, medical records were reviewed to examine drug prescription (antidepressants, anxyolitics, antibiotics, NSAIDS, others), comorbidities (including hypertension, diabetes, COPD, epilepsy, drug/alcohol abuse, and obesity), and diagnosis of mood disorder by GP. The study obtained ethical approval from the IRB of the University of Chile's main hospital (Hospital Clínico de Universidad de Chile).

2.3. Instruments

2.3.1. Demographics

A form was used to identify gender, marital status, and education level.

2.3.2. Determination of GP assessment

Diagnosis of mood disorders by GPs was based on any of the following findings in patients' medical records within the past month:

1. Any explicit mood disorder diagnosis. Words used to define an accurate diagnosis of each disorder are as follows: "Depression, major depression, major depressive episode, major depressive disorder, depressive syndrome, depressive-anxious syndrome, bipolar, bipolar disorder, manic episode, hypomanic episode, mania, hypomania or bipolar affective disorder."
2. Any clinical description of mood symptoms in the medical history along with changes in treatment or management of the patient (i.e. antidepressant, mood stabilizers or neuroleptics prescriptions and/or mental health professional referral). Applicable words included: "low mood, anxiety and low mood, sleep disturbances, insomnia, suicidal thoughts, worry, stress."

2.3.3. Patient Health Questionnaire (PHQ-9)

The PHQ-9 was used to screen for depressive disorders. It is a 9-item self-administered measure of depression, with documented reliability and validity in the sample population (Kroenke et al., 2010). It screens for elevated depressive symptoms in the previous two weeks and can be used to measure presence and/or severity of depression. A score of 10 points (pts) or higher is indicative of major depressive syndrome (Kroenke et al., 2010). Severity is categorized as follows: healthy (1–5 pts), subclinical depressive symptoms (6–10 pts), mild depression (11–15 pts), moderate depression (16–20 pts), and severe depression (21–27 pts).

2.3.4. Mood Disorder Questionnaire (MDQ)

The MDQ was used to screen for bipolar disorder (Hirschfeld et al., 2000). It is a 15-item self-administered scale with a score from 1 to 13, with demonstrated reliability and validity in primary care settings (Hirschfeld et al., 2003). A score of 7 of higher indicates a positive screen for bipolar disorder.

2.3.5. Structured Clinical Interview for DSM IV Axis I disorders (SCID-I)

(Spitzer et al., 1990) The SCID-I was used as the gold-standard to determine the diagnosis of current (in the previous month) major depressive episode or manic/hypomanic episode. It was administered to patients face-to-face after the GP consult. Raters were psychiatric clinicians, trained by accredited instructors (two MD psychiatrist-researchers with expertise in mood disorders, and completed an accredited training on the SCID-I).

2.4. Data description

2.4.1. Primary outcome variable

The primary outcome was defined as presence or absence of current (previous month) mood disorder, i.e. a major depressive episode (MDE) or a manic/hypomanic episode. Presence of mood disorder was assessed by trained, experienced clinicians using the structured clinical diagnostic interview from the diagnostic

manual of the American Psychiatric Association in its fourth version (SCID-I of DSM-IV).

2.4.2. Predictor variables of mood disorders

The main predictor variables were obtained from self-report of mood disorders symptoms from the PHQ-9 and MDQ. In addition to these items, we included well-established risk factors for mood disorders in the literature, including: female gender (Weich et al., 1998), low socio-economic status (Weich and Lewis, 1998a), employment status (Weich and Lewis, 1998b), loneliness (Prince et al., 1997), poor physical and mental health (Bruce and Hoff, 1994), chronic illness (Weich, 2001), marital status and depressive symptomatology (Salokangas and Poutanen, 1998). As part of our study, we collected the following variables that were included as candidate predictor variables: gender, age, educational status, marital status, employment status: (working at home, paid work, unemployed), living alone or with others, current medications, and chronic comorbidity: (hypertension, diabetes, chronic smoking, alcohol abuse or use of illicit drugs).

2.5. Statistical analysis

2.5.1. Procedures

For continuous variables, independent sample *t*-tests were applied assuming unequal variance. Continuous clinical data were reported in a stratified descriptive analysis as means with standard deviations (SD). For binary or categorical variables, chi-square or Fisher exact tests were applied. Categorical variables were reported as percentages with 95% confidence intervals (Table 1). All statistically significant (p-value <0.05) clinical and demographics variables and items from the PHQ-9 and MDQ were analyzed in a univariate fashion, with mood disorder status as the primary outcome. All screening test items with p-values <0.1 were included in logistic regression modeling using a backward selection procedure (with AIC criterion) to obtain the best-fit model (Steyerberg, 2009). Robustness of model and logistic model assumptions were tested, as were the presence of collinearity and interaction effects. Diagnostic evaluations of the model were conducted by removing influential points. It is well known that prediction models from multivariable regression analysis usually *overestimate* their regression coefficients, possibly resulting in extreme predictions when applied to new patients (Harrell et al., 1996; Spiegelhalter, 1986). Therefore, to improve internal validity of the classifier, a penalized log likelihood shrinkage factor was applied to the regression coefficients and the area under the receiver operating curve (auROC)-statistic values (Statacorp, 2009).

2.6. General modeling approach

A logistic regression model was built using the variables given by the backward selection procedure, in addition to clinically-based knowledge. This model included mood disorder status as the primary outcome (binary) and the clinical and demographical predictors and screening tool items. This classifier was denominated as the "Clinical predictive Model" (CM), (see Table 2). Model calibration was assessed using a Hosmer–Lemershow test, which determines whether observed and predicted outcome rates across deciles are statistically different.

2.7. Internal validity assessment of clinical predictive model

A ten-fold cross-validation procedure was applied in order to obtain an internal validation assessment of the CM (Statacorp, 2009). The total sample was randomly partitioned into 10 subsamples. Of these, a single subsample was retained as the *testing* subsample, and the remaining data were used as *training* subsample. This procedure was repeated 200 times, with each iteration producing a measure of the variability explained by the model in every subsample (Nagelkerke pseudo-R-square) (Steyerberg, 2009). Afterwards, a final average pseudo-R-square for each subsample was calculated. The predictive error of the model along with its 95% confidence interval was obtained by calculating the difference between the training and testing subsamples. Finally, the original measure of variability from the whole sample was adjusted using the value of the predictive error already calculated.

2.8. Clinical predictive score development

After the final clinical predictive model (CM) was built and tested, shrunken regression coefficients of the predictors were transformed into rounded score points (Table 2) and an easy-to-use clinical predictive score (PS) was constructed (Table 3). Total scores were linked to levels of risk of mood disorder. Risk of mood disorders strata were computed for each score stratum (Table 4) (Zuithoff et al., 2009). The PS was compared with CM using a chi-square test.

2.9. Assessment of clinical predictive score performance

Model discrimination was assessed by the auROC statistic, along with its 95% confidence interval, to ascertain possible increases in predictive information given by the clinical predictive score (PS) and its comparators (see Fig. 1). Hypothesis testing between the comparators was conducted using a chi-square test. To detect possible differences gained in sensitivity, PS was compared to GP assessment. In this analysis, specificity was fixed to detect possible differences in sensitivity. To report how PS would perform in usual epidemiologic primary care conditions, a predictive performance analysis was conducted with a predictive threshold set at 0.4 (similar to prevalence of mood disorders in the sample). Analyses were completed with Stata 11 (Statacorp, 2009) and R Statistical Software (R Statistical Package, 2011).

3. Results

Characteristics of the study sample ($n=197$; 75% women; mean age of 48.5 years and SD of 16.8 years) are presented with effect estimates along 95% confidence intervals by mood disorder status in Table 1. After GP assessment, all consecutively invited patients consented to participate. Clinical predictors that reached statistical significance at the univariate level were included in the multivariate analysis: Female gender, age, being married, working at home, long term relationship without being married, use of psychotropic drug, untreated chronic conditions. Four PHQ-9/MDQ items that reached the 0.10 significance level were also included in the multivariate analysis. These included: PHQ-9 item #1 "presence of anhedonia in the last two weeks"; PHQ-9 item #2 "presence of low mood in the last two weeks"; MDQ, item #2 "presence of irritability in the last two weeks"; and MDQ, item #16 "family background of mood disorders."

3.1. Multivariate model

The following final variables were selected from a backward variable selection procedure in addition to clinical evidence:

1. PHQ-9 question #1: Presence of anhedonia, more than half the days for the last two weeks.
2. Presence of long-term relationship without being married.
3. Presence of untreated chronic conditions.

Table 1
Stratified descriptive analysis of demographic and clinical characteristics of the sample. ($n=197$).

Variable		Overall sample	Mood disorders (+) ($n=72$) %	Mood disorders (−) ($n=125$) %	RR or mean difference (95% CI)
Age	[Mean (SD)]	48.5(16.8)	47.17 (16.48)	53.20 (16.45)	−6.03 (−10.76, −1.29)
Gender	*n* (%)				
	Women	147(75)	88	68	2.31 (1.24, 4.30)
	Men	49(25)	12	31	0.43 (0.23, 0.80)
Marital status	*n* (%)				
	Married	83(43)	32	48	0.64 (0.42, 0.96)
	Single	61(31)	33	29	1.11 (0.75, 1.63)
	Divorced/separated	22(11)	10	12	0.85 (0.45, 1.62)
	Widow	15(7)	7	8	0.90 (0.43, 1.89)
	LTR with a significant other without being married	16(8)	18	2	1.42 (1.01, 2.48)
Education	*n* (%)				
	No graduate	180(91)	90	92	0.87 (0.48, 1.59)
	Graduate	17(9)	10	8	1.14 (0.62, 2.07)
Occupation	*n* (%)				
	At home	69(35)	44	29	1.51 (1.05, 2.17)
	Working	67(34)	32	37	0.88 (0.59, 1.31)
	Retired	30(15)	13	18	0.76 (0.42, 1.36)
	Unemployed	13(7)	7	6	1.14 (0.57, 2.24)
	Occasional work	18(9)	5	9	0.52 (0.18, 1.46)
Lives with*	*n* (%)				
	Significant other	99(50)	47	52	0.90 (0.62, 1.30)
	Children	95(48)	53	46	1.20 (0.82, 1.73)
	Other family	67(34)	26	37	0.71 (0.46, 1.09)
	Alone	14(7)	8	6	1.18 (0.62, 2.24)
	Friends	6(3)	3	7	0.55 (−3.64, −1.40)
Children	*n* (%)				
	Yes	160(81)	82	85	0.94 (0.58, 1.51)
	No	37(19)	18	15	1.05 (0.65, 1.69)
Chronic conditions*					
	n (%)				
	Absent	69(35)	36	42	0.62 (0.68, 1.48)
	Hypertension	91(46)	42	49	0.83 (0.57, 1.21)
	Obesity	45(23)	25	22	1.12 (0.74, 1.70)
	Chronic smoking	28(14)	17	13	1.20 (0.75, 1.93)
	Diabetes	26(13)	13	12	1.03 (0.56, 1.71)
	Epilepsy-COPD	10(5)	4	5	0.90 (0.35, 2.33)
Medication*	*n* (%)				
	No drug	80(41)	32	44	0.62 (0.92, 1.91)
	Hypoglycemic agents	12(6)	4	7	0.90 (0.28, 2.86)
	Antihypertensives	47(24)	18	28	0.67 (0.42, 1.02)
	NSAIDs	32(16)	13	19	0.73 (0.40, 1.32)
	Antibiotics	12(6)	8	5	1.40 (0.77, 2.54)
	Anxyolitics	18(9)	15	6	1.79 (1.17, 2.73)
	Antidepressants	20(10)	17	6	1.87 (1.25, 2.79)
Untreated chronic conditions §	*n* (%)	128(65)	74	52	1.42 (1.34, 1.91)
PHQ-9	[Mean SD)]	9.97(6)	15.30(5.27)	6.53(4.27)	8.83 (8.79, 8.86)
MDQ	[Mean SD)]	4.74(2.7)	5.43(2.51)	3.92(2.72)	1.51 (0.97, 1.04)
SCID-I	*n* (%)				
	Depression	49(25)	86	0	13.5 (7.43, 24.5)
	Bipolar disorder	10(5)	32	0	3.55 (2.80, 4.50)
	Both	13(7)	18	0	3.11 (2.52, 3.84)
	Mood disorders (Either)	72(37)	100	0	
Screening tools	*n* (%)				
	Depression	39(20)	63	4	4.9 (3.44, 6.97)
	Bipolar disorder	14(7)	24	7	2.12 (1.50, 3.00)
	Both	11(6)	13	1	2.72 (2.06, 3.59)
	Mood disorders (either)	64(32)	72	9	5.53 (3.63, 8.41)
General practitioner Diagnosis of mood disorder (either)	*n* (%)	26(13)	24	7	2.02 (1.41, 2.88)
Endorsed any mood disorder	*n* (%)				
	General practitioner	26(13)			
	Screening tools	64(32)			
	SCID-I	72(37)			

SCID-I: Structured Clinical Interview for DSM-IV Axis I disorders; LTR: Long-term relationship; PHQ-9: Patient Health Questionnaire 9; MDQ: Mood Disorders Questionnaire; NSAIDs: Non-steroidal anti-inflammatory drugs; COPD: Chronic obstructive pulmonary disease; "*": More than one category could apply. Total sum more than 100%; * RR: Relative risk for categorical variables, mean differences for continuous variables; CI: Confidence interval; §: Diabetes, hypertension, chronic smoking and obesity.

Table 2
Final CM after shrinkage procedure and related PS.

Predictor	Coefficient (β)	OR	SE	p value	95% CI	PS (Total 0–8)
PHQ-9 question #1: anhedonia	2.15	8.58	5.63	0.000	3.43, 32.72	2
LTR without being married	2.14	8.49	7.64	0.003	2.43, 49.52	2
Untreated chronic conditions	0.63	1.87	0.54	0.037	1.18, 4.47	1
Psychotropic drug treatment	2.52	12.42	13.29	0.004	2.92, 53.4	2
Female	0.84	2.31	0.92	0.055	−0.98, 6.52	1
Constant	−3.69	0.03	0.4	0.000	−6.13, −2.76	

CM: Clinical predictive model; PHQ-9: Patient Health Questionnaire 9; LTR: Long term relationship; OR: Odds ratio; SE: Standard error; CI: Confidence interval; PS: Clinical predictive score.

Table 3
Final clinical prediction score for mood disorders risk.

Score 0: if absent; 2 if present	**Score**
1. Current LTR without being married 2. Presence of anhedonia in the last two weeks 3. Current treatment with psychotropic drugs	
Score 0: if absent; 1 if present 4. Current untreated chronic conditions (HT, DM, obesity, chronic smoking) 5. Female gender	
Total score=	Range (0–8 points)

LTR: Long term relationship; HT: Hypertension; DM: Diabetes type II.

Table 4
Clinical predictive score and mood disorder risk strata (n=197).

If Total PS score is:	Likelihood of mood disorder	Mood disorder risk % (cases/total patients)
0–1	**Low**	5% risk (3/55)
2–3	**Moderate**	32% risk (21/66)
4–5	**High**	60% risk (39/66)
6–8	**Very high**	90% risk (9/10)

PS: Clinical predictive score.

4. Presence of psychotropic drug treatment.
5. Female gender: This predictor was forced into the model despite the fact it had not been selected with the stepwise procedure, because of strong evidence in the scientific literature (Weich et al., 1998).

The final output of the clinical predictive model (CM) after the shrinkage procedure is shown in Table 2. Goodness-of-fit indicates that the CM model is well-calibrated (Hosmer–Lemeshow test=2.69; numbers of groups=10; p-value=0.74>0.05). Internal validity results of CM reveal its predictive error of 0.046 [95% CI −0.02, 0.11].

3.2. Clinical predictive score results

Clinical predictive score (PS) values and mood disorder risk strata are shown in Table 2, along with the clinical predictive model (CM) regression coefficients. Final PS and mood disorder risk strata are given in Tables 3 and 4.

Fig. 1 compares areas under the receiver operating curve (auROC) for PS and its comparators. The PS simplified screening tool had considerably better discrimination that general practitioner assessment (0.78 [95% CI 0.72, 0.85]; versus 0.58 [95% CI 0.50, 0.64] p-value<0.0001) but was not quite as accurate as the full PHQ-9 (0.89 [95% CI 0.85, 0.93], p-value=0.03). There was no statistical difference between PS and the CM (auROC: 0.79 [95% CI 0.72, 0.84] versus 0.78 [95% CI 0.72, 0.85] X^2=0.02, p-value=0.9). Of note, GP assessment did not show statistically significant difference compared with a prediction produced totally at random (auROC=0.50) (X^2=2.95, p-value=0.09). Full MDQ score was not included in the comparison because it presented high collinearity with full PHQ-9 results, and the latter obtained higher predictive value. Given a fixed specificity of 90%, the PS yielded greater sensitivity than GP assessment (74% versus 23%). When the PS model was applied using usual epidemiologic features in primary care settings (predictive threshold of 0.4, similar to mood disorder prevalence in the sample), it correctly classified mood disorder in almost 80% of the cases.

4. Discussion

We developed and internally validated a clinical predictive score (PS) for mood disorder risk in the primary care setting that predicts current mood disorders risk with reasonable accuracy. The score was based on a clinical predictive model (CM) built using the following easily obtainable current clinical features: long term relationship without being married, current psychotropic drug treatment, untreated chronic conditions, female gender and anhedonia.

Our results show statistically significant differences in discriminative capacity (auROC statistic) between the full PHQ-9 and the PS and between the PS and GP prediction. Statistical difference was not found either between the CM and the PS, nor between GPs prediction and a prediction produced at random (equivalent to tossing a coin).

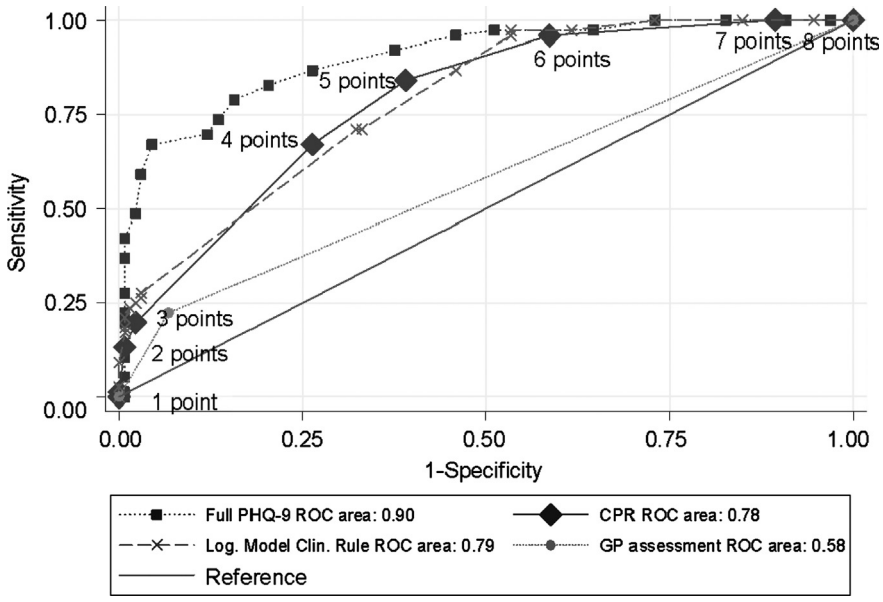

Fig. 1. Discriminative capacity of PS compared with full PHQ-9, general practitioner assessment and CM. PHQ-9: Patient Health Questionnaire 9; PS: clinical predictive score; CM: clinical predictive model; GP: general practitioner; ROC area: area under the receiver operating curve; "Points": score levels given by the PS.

Of the items in the Patient Health Questionnaire-9 (PHQ-9), we found that the most predictive item was "presence of anhedonia in the last two weeks"; this single item from the screening instruments was included in our predictive model.

This PS may enhance detection of mood disorders in low-income countries like Chile, even under primary care constraints such as limited appointment time and limited diagnostic training. This score is similar to depression symptom scales like the PHQ-9 but may be substantially easier to use. It includes only one item from the PHQ-9 and four likely-evident clinical features of the patients. One study found that screening tests like PHQ-9 accurately detect depression, but require several extra minutes to score and interpret even after they are self-administered. This extra time commitment might not be feasible for GPs, especially in low-income primary care settings (Spitzer et al., 1999). Moreover, about one half of GPs show resistance to using any kind of mood symptoms scale (Gill et al., 2012; Zimmerman and McGlinchey, 2008; Zimmerman and Galione, 2010) despite national guidelines to the contrary for mental illnesses (Depression Guideline Panel, 1993).

The clinical predictive score is the first to be developed for mood disorder risk in low-income countries. Research in mood disorder screening has been predominantly produced in advanced countries; one study published a risk prediction algorithm for episodes of major depression in primary care in developed countries (Europe) and later validated it in the Chilean population (King et al., 2008). This tool was built using ten factors requiring specific assessment by GPs outside of their usual routine. In contrast, our clinical predictive score has five factors, only one of which, anhedonia, requires specific questioning outside GPs' usual routine. Since scarce resources are a fundamental problem in low-income countries, a simple clinical predictive score like ours may be especially useful.

Limitations of this study include potential bias from overly high compliance in a sample in which no patient refused consent. However, such high compliance with research is not uncommon in underdeveloped countries like Chile where medical resources are scarce. Another limitation might be sample size, which, though not small, was not very large, thus potentially impairing the accuracy of the results. Furthermore, generalizability could be uncertain if the score is eventually applied to populations with different mood disorder prevalence rates. In that case, adjustment of cut-off values might be needed. Another independent dataset is required to assess predictive external validity of this clinical score. We have begun developing that replication dataset in Chilean primary care centers. Our point-prevalence assessment of mood disorders also may not generalize to making lifetime diagnoses.

5. Conclusions

A clinical predictive score for risk of current mood disorder presence has been developed for low-income primary care settings based on a predictive model built with five easily obtainable clinical features. Its predictive capacity is lower than screening test results, but it appears to be more feasible for use by general practitioners. External validation is required. If proven generalizable, this clinical predictive score may be useful in detection of mood disorders in primary care settings.

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Conflict of interest

In the past 12 months, Dr. Nassir Ghaemi has received research grants from Pfizer and Takeda. Neither he nor his family hold equity positions in pharmaceutical corporations. All other authors declare that they have no conflicts of interest.

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References

Bruce, M.L., Hoff, R.A., 1994. Social and physical health risk factors for first-onset major depressive disorder in a community sample. Social Psychiatry and Psychiatric Epidemiology 29 (4), 165–171.

Depression Guideline Panel., 1993. Depression in Primary Care: Treatment of Major Depression, in AHCPR Publication no. 93-0551. US Dept of Health and Human Services: Rockville, MD.

Gill, J.M., Chen, Y.X., Grimes, A., Diamond, J.J., Lieberman, M.I., Klinkman, M.S., 2012. Electronic clinical decision support for management of depression in primary care: a prospective cohort study. The Primary Care Companion for CNS Disorders 14, 1.

Harrell Jr., FE, Lee, K.L., Mark, D.B., 1996. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. Statistics in Medicine 15 (4), 361–387.
Hirschfeld, R, et al., 2000. Development and validation of a screening instrument for bipolar spectrum disorder: The Mood Disorder Questionnaire. American Journal of Psychiatry 157 (11), 1873–1875.
Hirschfeld, R.M., et al., 2003. Screening for bipolar disorder in the community. Journal of Clinical Psychiatry 64 (1), 53–59.
King, M, et al., 2008. Development and validation of an international risk prediction algorithm for episodes of major depression in general practice attendees: the PredictD study. Archives of General Psychiatry 65 (12), 1368–1376.
Kroenke, K., Spitzer, R.L., Williams, J.B., 2001. The PHQ-9: validity of a brief depression severity measure. Journal of General Internal Medicine 16 (9), 606–613.
Kroenke, K., Spitzer, R.L., Williams, J.B., Löwe, B., 2010. The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. General Hospital Psychiatry Journal 32 (4), 345–359.
Prince, M.J., et al., 1997. Social support deficits, loneliness and life events as risk factors for depression in old age. The Gospel Oak Project VI. Psychological Medicine 27 (2), 323–332.
Rost, K., et al., 2000. The role of competing demands in the treatment provided primary care patients with major depression. Archives of Family Medicine 9 (2), 150–154.
R Statistical Package. (2011).
Salokangas, R.K., Poutanen, O., 1998. Risk factors for depression in primary care. Findings of the TADEP project. Journal of Affective Disorders 48 (2–3), 171–180.
Simon, G.E., VonKorff, M., Piccinelli, M., Fullerton, C., Ormel, J., 1999. An international study of the relation between somatic symptoms and depression. New England Journal of Medicine 341 (18), 1329–1335.
Spiegelhalter, D.J., 1986. Probabilistic prediction in patient management and clinical trials. Statistics in Medicine 5 (5), 421–433.
Spitzer, R.L., Kroenke, K., Williams, J.B., 1999. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary care evaluation of mental disorders. Patient health questionnaire. Journal of the American Medical Association 282 (18), 1737–1744.
Spitzer, R, et al., 1990. Structured Clinical Interview for DSM-III-R—Patient Edition (SCID-P, Version 1.0). American Psychiatric Press, Washington, D.C..
Statacorp LP., 2009. Stata 11: College Station, Texas.
Steyerberg, E., 2009. Clinical Prediction Models: A Practical Approach to Development, Validation, and Updating. Springer, New York p. 50.
Weich, S., Sloggett, A., Lewis, G., 1998. Social roles and gender difference in the prevalence of common mental disorders. British Journal of Psychiatry 173, 489–493.
Weich, S., Lewis, G., 1998a. Material standard of living, social class, and the prevalence of the common mental disorders in Great Britain. Journal of Epidemiology and Community Health 52 (1), 8–14.
Weich, S., Lewis, G., 1998b. Poverty, unemployment, and common mental disorders: population based cohort study. British Medical Journal 317 (7151), 115–119.
Weich, S., 2001. Risk Factors for the Common Mental Disorders in Primary Care. University of Cambridge, Cambridge, England.
Zimmerman, M., Galione, J., 2010. Psychiatrists' and nonpsychiatrist physicians' reported use of the DSM-IV criteria for major depressive disorder. Journal of Clinical Psychiatry 73 (3), 235–238.
Zimmerman, M.M., McGlinchey, J.B., 2008. Why don't psychiatrists use scales to measure outcome when treating depressed patients? Journal of Clinical Psychiatry 69 (12), 1916–1919.
Zuithoff, N.P., et al., 2009. A clinical prediction rule for detecting major depressive disorder in primary care: the PREDICT-NL study. Family Practice 26 (4), 241–250.