

Binary Classification Analysis for Predicting Medication Adherence among US Adults Currently Taking Prescribed Medication for Depression

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Background

Medication adherence is essential for achieving symptom control and preventing relapse in depression, yet many patients take antidepressants inconsistently or discontinue early.¹

Improving adherence remains a persistent challenge in real-world care, highlighting the need to better understand adherence patterns in treated populations.²

Objective

This study used machine learning methods to identify patient and treatment characteristics associated with non-adherence to prescribed depression medications among US adults.

Methods

Data on 7,285 US adults diagnosed with depression and treated with prescription medication were identified and analyzed from the 2025 National Health and Wellness Survey, an online survey of the general US adult population (N = 75,005). Adherence was measured using self-reported ARMS³ scores (12=perfect; >12=non-adherent). XGBoost binary classification with 10-fold cross-validation predicted non-adherence and estimated feature importance. Variable selection and feature importance were based on SHAP values.

The final model included 24 variables spanning demographics, depression severity and symptoms, talk therapy, smoking and alcohol use, BMI, exercise, and prescription access (e.g., costs and financial barriers). Models were tuned using AUC and evaluated using AUC, accuracy, sensitivity, specificity, and Brier score.

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Results

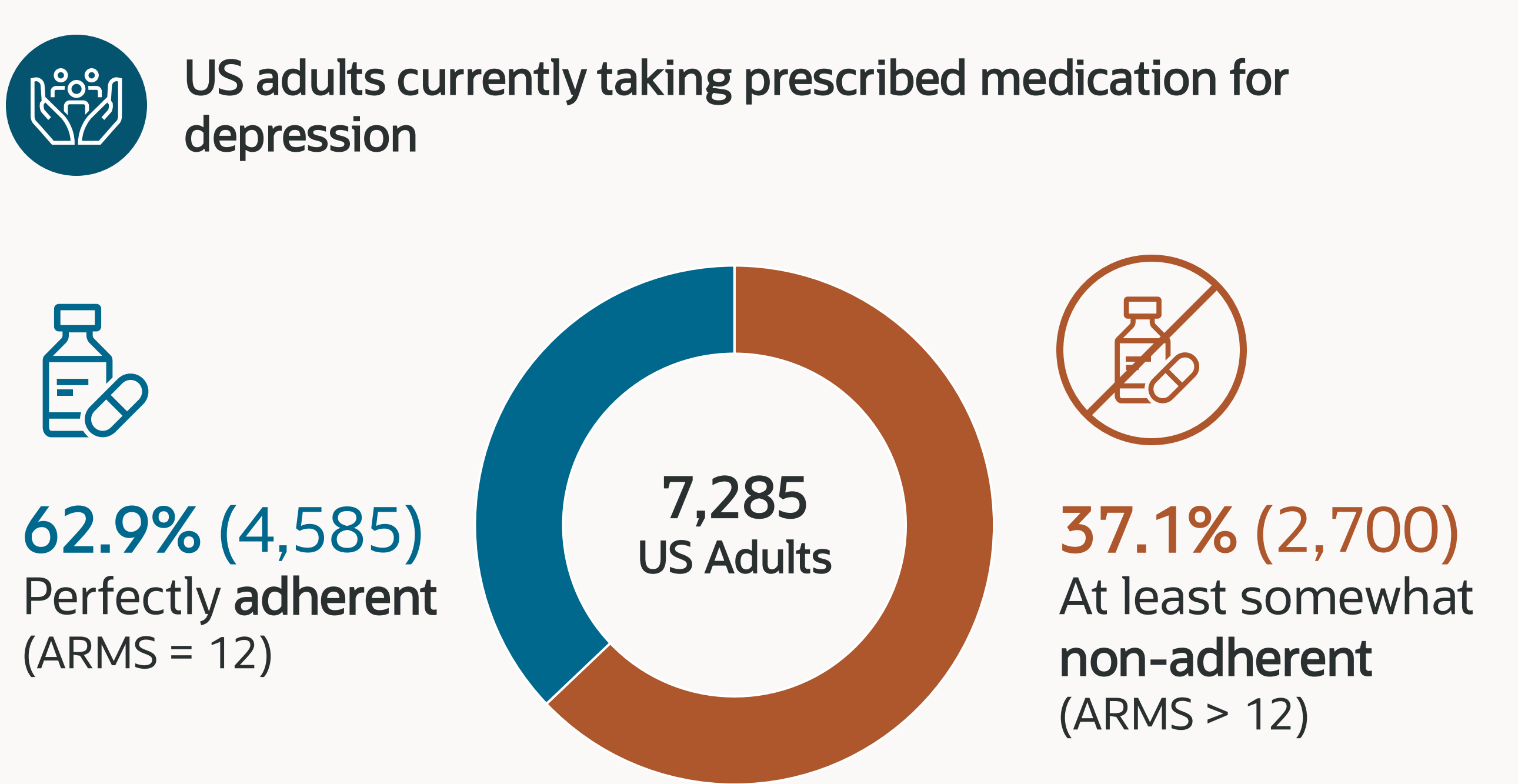


Table 1 Demographic characteristics

		Non-adherent (N = 4,585)		Perfectly adherent (N = 2,700)	
		N	%	N	%
Age	Mean ± SD	45.51 ± 15.35		54.41 ± 14.86	
	Median (Min - Max)	45.00 (18.00 - 85.00)		56.00 (18.00 - 85.00)	
Sex	Male	1,645	35.9%	686	25.4%
	Female	2,940	64.1%	2,014	74.6%
Race / ethnicity	African American	708	15.4%	342	12.7%
	American Indian	55	1.2%	24	0.9%
	Asian	69	1.5%	43	1.6%
	Hispanic	621	13.5%	248	9.2%
	White	2,925	63.8%	1,937	71.7%
	Mixed	177	3.9%	83	3.1%
Annual household income	\$75,000 or less	2,949	64.3%	1,890	70.0%
	\$75,000 to \$124,000	776	16.9%	420	15.6%
	\$125,000 or more	783	17.1%	344	12.7%
Employment status	Decline to answer	77	1.7%	46	1.7%
	Employed full time	1,895	41.3%	715	26.5%
	Self-employed	270	5.9%	187	6.9%
	Employed part time	412	9.0%	201	7.4%

- Non-adherent respondents** were more likely to report being current smokers (46.4% vs 34.0%)
- Perfectly adherent respondents** were more likely to report not drinking alcohol (47.4% vs 33.2%).
- Participation in talk therapy was reported more frequently among **non-adherent respondents**.
- Non-adherent respondents** were diagnosed more recently and had higher PHQ-9⁴ scores (more symptoms of depression).

Cost-related access measures differed between groups

41.0% of non-adherent respondents reported that prescription costs had prevented them from taking medication versus 27.7% of perfectly adherent respondents. Similarly, **non-adherent respondents** more often reported **higher average monthly prescription spending** (e.g., \$101–\$250: 7.7% vs 5.4%; \$251–\$500: 2.4% vs 1.8%; ≥\$501: 2.6% vs 1.2%) (Table 2).

Table 2 Health and Depression Characteristics

		Non-adherent (N = 4,585)		Perfectly adherent (N = 2,700)	
		N	%	N	%
Charlson Comorbidity Index (CCI) ⁵	Mean ± SD	1.13 ± 1.80		1.25 ± 1.56	
	Median (Min - Max)	1.00 (0.00 - 22.00)		1.00 (0.00 - 13.00)	
Yes, I smoke		1,308	46.4%	496	34.0%
	Currently smoke cigarettes, cigars, or pipes (Among those who have smoked)				
	Yes, but I am trying to quit	326	11.6%	131	9.0%
No, but I am in the process of quitting		107	3.8%	38	2.6%
	No, I quit smoking	1,080	38.3%	796	54.5%
	Daily	218	4.8%	109	4.0%
Frequency of alcohol consumption	4-6 times a week	320	7.0%	99	3.7%
	2-3 times a week	656	14.3%	244	9.0%
	Once a week	429	9.4%	168	6.2%
2-3 times a month		451	9.8%	212	7.9%
	Once a month or less often	987	21.5%	588	21.8%
	I do not drink alcohol	1,524	33.2%	1,280	47.4%
Participation in talk therapy for depression	Yes	2,563	55.9%	1,728	64.0%
	No	2,022	44.1%	872	36.0%
Years since depression diagnosis	Mean ± SD	15.06 ± 11.79		19.12 ± 12.80	
	Median (Min - Max)	12.00 (0.00 - 61.00)		18.00 (0.00 - 70.00)	
Has the cost of prescription medication ever prevented you from taking a prescription medication?	Yes	1,881	41.0%	748	27.7%
	No	2,186	47.7%	1,630	60.4%
Does not apply		518	11.3%	322	11.9%
PHQ-9 Score	Mean ± SD	11.54 ± 6.48		8.41 ± 6.39	
	Median (Min - Max)	11.00 (0.00 - 27.00)		7.00 (0.00 - 27.00)	
Average monthly cost of prescription medications	≤ \$100 in an average month	3,785	82.6%	2,353	87.2%
	\$101-\$250 in an average month	355	7.7%	147	5.4%
	\$251-\$500 in an average month	109	2.4%	48	1.8%
	\$501+ in an average month	118	2.6%	31	1.2%
	Don't know	218	4.8%	121	4.5%

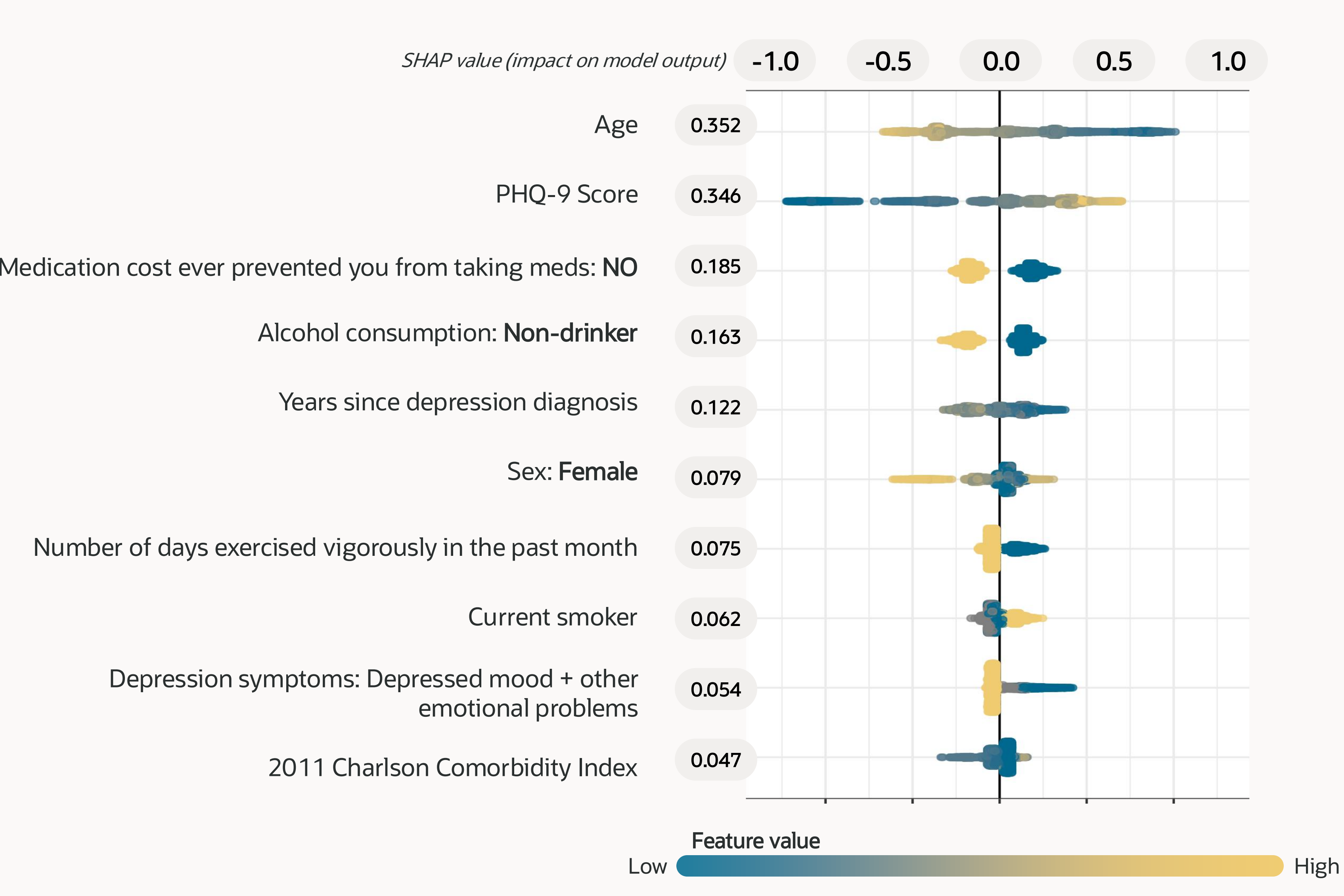
The XGBoost binary classification model showed moderate discrimination for predicting non-adherence, with an AUC of 0.73. Overall accuracy was 65.6%, with sensitivity of 58.6% and specificity of 76.7%. Calibration, assessed by Brier score, was 0.22.

SHAP-based feature importance indicated that non-adherence was most strongly associated with younger age, being male, greater depression severity, and prescription access challenges, particularly cost-related barriers.

Lifestyle factors such as alcohol use and smoking were also among the leading predictors of non-adherence.

Clinical and timing-related characteristics, including more recent depression diagnosis and a higher Charlson Comorbidity Index score, further contributed to elevated risk for non-adherence.

Figure 1 SHAP summary showing feature impact on predicted non-adherence



Conclusion

In this nationally representative survey of US adults treated for depression, a machine-learning model identified demographic, clinical, lifestyle, and cost-related factors associated with medication non-adherence, with moderate predictive performance (AUC=0.73). Findings highlight potential targets for adherence support, particularly among younger adults, men, and those reporting greater symptom severity or financial barriers to prescriptions.

Limitations include self-reported diagnosis, adherence, and symptoms not being validated, cross-sectional design (no causal inference), possible selection/recall bias from an online survey, and model performance that may not generalize beyond this dataset.

