Supplemental Material for:

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SUPPLEMENT

Contents

Section S1 . Screening Survey 3

Section S2 . Daily Survey 5

Section S3 . Predictor Susceptibility to Measurement Error 15

Section S4 . Discrete Hazard of Migraine Events 16

Section S5 . Timing of Data Collection 19

Section S6 . Distribution of Predictors. 20

Section S7 . Estimated Odds Ratios from Best Category Models 23

Section S8 . Estimated Odds Ratios from Primary Model. 25

Section S9 . Estimated Odds Ratios from Penalized Model. 27

Supplementary Figures

Figure S1: Discrete Hazard of Migraine Attack, 1-day Recovery Period. 17

Figure S2: Discrete Hazard of Migraine Attack, 0-day Recovery Period. 18

Figure S3: Timing of Data Collection and Intended Risk Estimation. 19

Figure S4: Estimated Odds Ratios from the Best Category-Specific Models. 24

Supplementary Tables

Table S1: Distribution of Predictors (Overall). 20

Table S2: Distribution of Predictors (Within-Person Means). 21

Table S3: Distribution of Predictors (Within-Person Standard Deviations) 22

Table S4: Estimated Odds Ratios from Primary Model. 26

Table S5: Estimated Odds Ratios from Penalized Model. 28

Section S1. Screening Survey

This section displays the questions administered in the RedCap Screening Survey.

Basic Questions	
Timestamp of survey start	_____
What is your date of birth?	_____ (YYYY-MM-DD)
Age	_____ (This is automatically calculated based on birth date.)
Over the past year, have you suffered from severe headaches?	◯ Yes ◯ No
Do you use an iPhone as your primary mobile phone?	◯ Yes ◯ No
Are you currently living in the United States?	◯ Yes ◯ No
Where did you first hear about this study?	◯ ResearchMatch ◯ Stanford - Email ◯ Stanford - Flyer ◯ Facebook group ◯ Twitter ◯ Nextdoor ◯ Other
Basic Criteria Eligible?	_____ (Calculates whether basic eligibility criteria are met.)

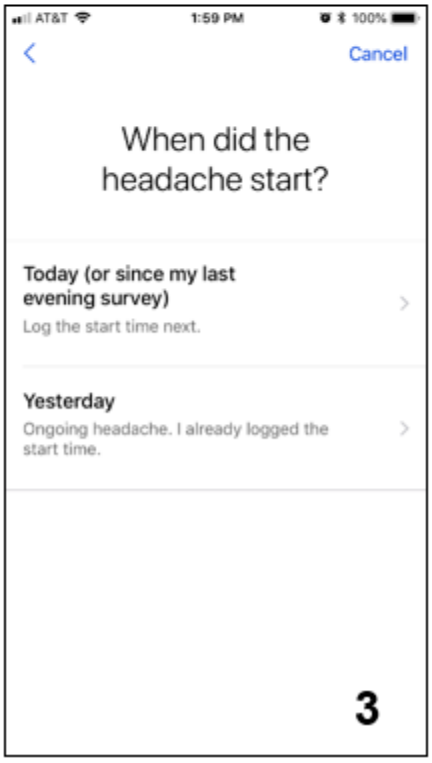
Headache Symptoms	
During the last 3 months, did you have the following with your headaches:	
You felt nauseated or sick to your stomach?	◯ Yes ◯ No
Light bothered you (a lot more than when you didn't have headaches)?	◯ Yes ◯ No
Your headaches limited your ability to work, study, or do what you needed to do for at least 1 day?	◯ Yes ◯ No
Headache Symptoms Eligible?	_____ (Calculates whether headache symptoms criteria are met.)

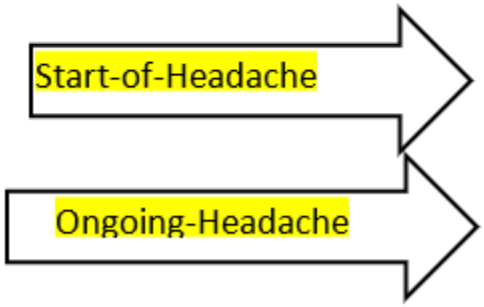
Headache Frequency	
For how long have you experienced severe headaches?	◯ Less than one year ◯ One year or more
During the last 3 months, did your headaches change noticeably (in frequency or severity)?	◯ Yes, my headaches changed noticeably during the last 3 months. ◯ No, my headaches were consistent for the last 3 months.
During the last 3 months, did you have 1 or more headaches per month?	◯ Yes, I had 1 or more headaches per month ◯ No, I had less than 1 headache per month
During the last 3 months, about how many headaches did you have per month?	_____ (headaches per month)
Sometimes a headache may last longer than one day. During the last 3 months, how many days per month did you have a headache?	_____ (days per month)
Headache Frequency Eligible?	_____ (Calculates whether headache frequency criteria are met.)

iPhone Questions	
Are you willing to complete a 2-4 minute survey every evening for 90 days (3 months), within an app downloaded onto your iPhone?	◯ Yes ◯ No
Which model number is your iPhone?	◯ iPhone 3G, 3GS, 4, or 4S ◯ iPhone 5, 5C, 5S, or SE ◯ iPhone 6, 6 Plus, 6S, or 6S Plus ◯ iPhone 7 or 7 Plus ◯ iPhone 8 or 8 Plus ◯ iPhone X
Are you willing to update your iPhone to the latest version of iOS?	◯ Yes ◯ No
Are you comfortable reading and writing on your iPhone in English?	◯ Yes ◯ No
iPhone Eligible?	_____ (Calculates whether iPhone-related eligibility criteria are met.)
Finally Eligible?	_____ (Calculates final decision on eligibility.)

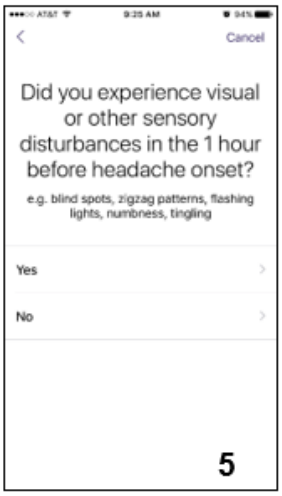
Section S2. Daily Survey

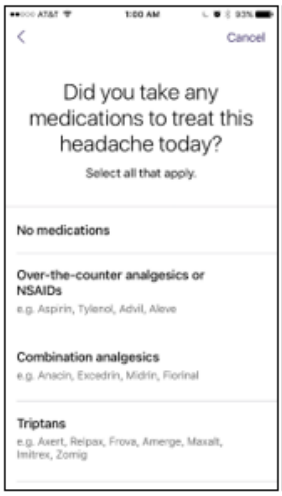
The purpose of this section is to display the questions administered in the daily in-app survey.





Start-of-Headache



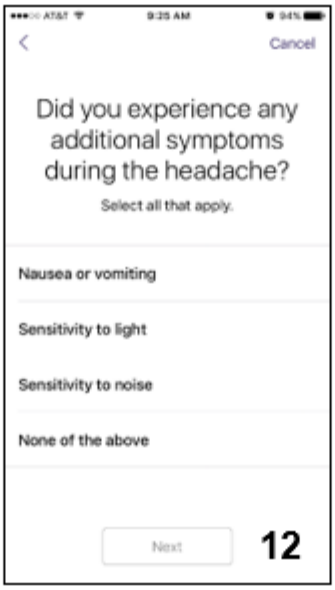


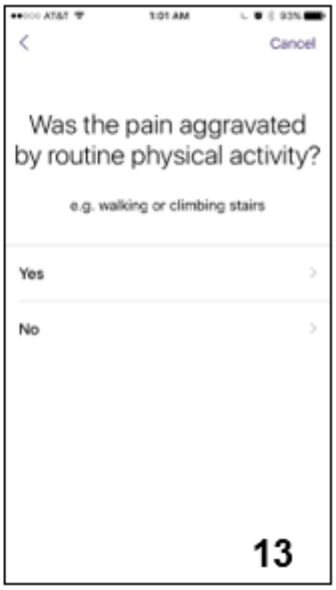
Ongoing Headache questions

End-of-Headache

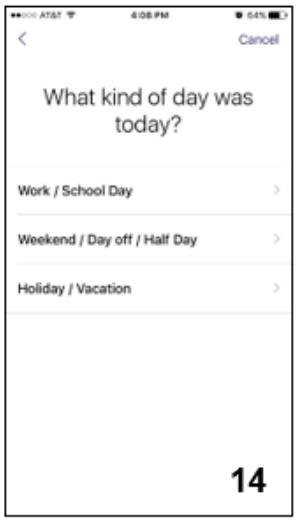
Trigger Factors

End-of Headache questions

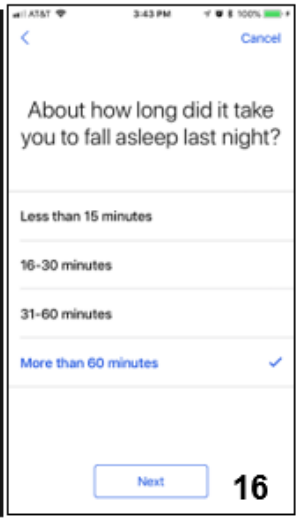


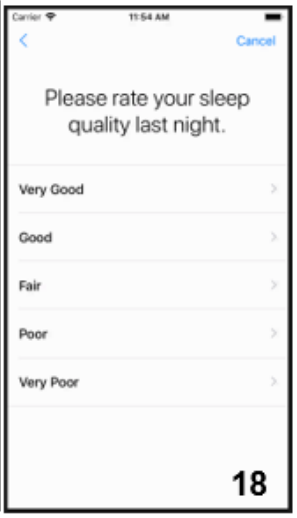


Trigger Factors



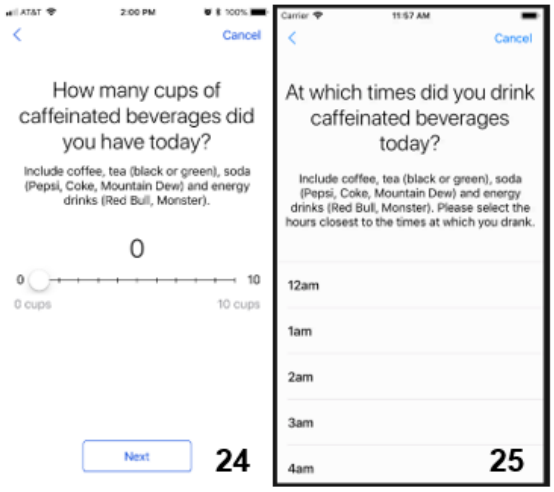
Sleep Questions

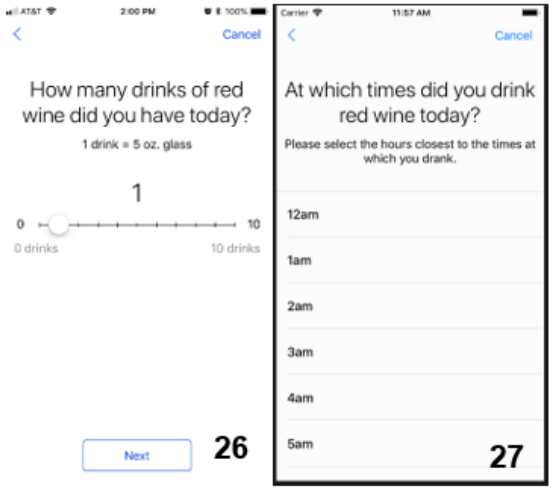


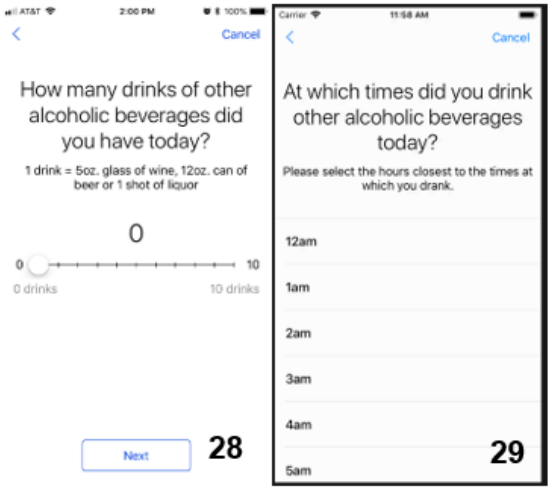


Stress Questions

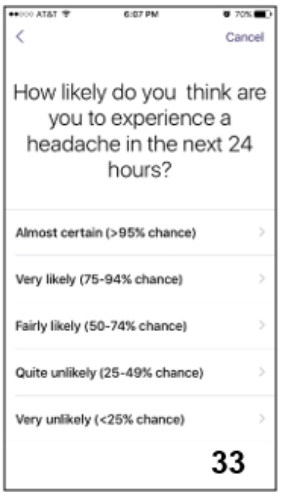
Dietary Triggers





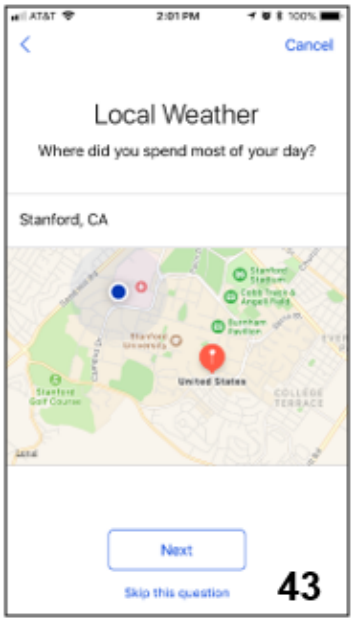


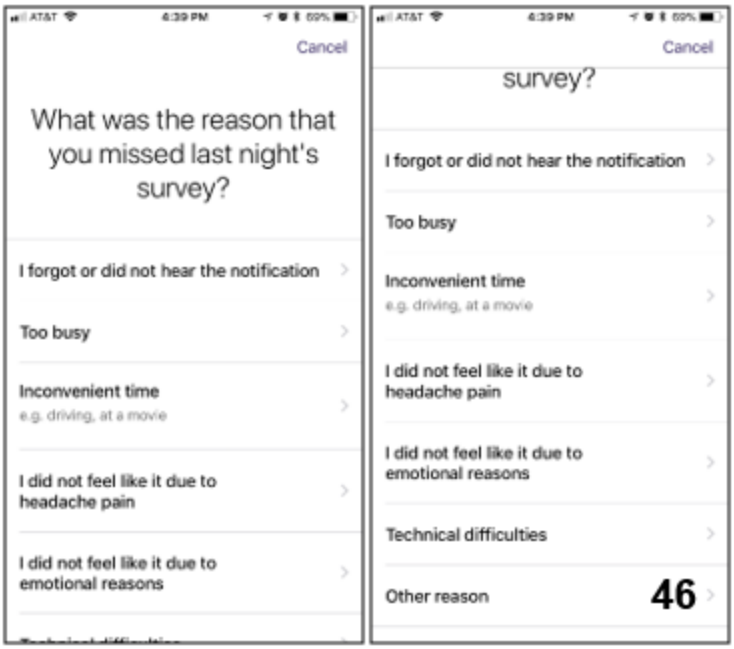
Other questions



Premonitory Symptoms

Local weather (if not sharing location with app ALWAYS)





(If last night's survey missed)

Section S3. Predictor Susceptibility to Measurement Error

The purpose of this supplemental section is to acknowledge the degree of measurement error that may have been present in the predictors that were almost exclusively collected through a very basic iPhone survey, and that these errors may have reduced the prediction model accuracy.

Sleep: High susceptibility to measurement error. Participants were asked to report last evening's bedtime, wake time, sleep latency, and nighttime awake duration on the next evening's survey. These might be difficult to remember with accuracy, even immediately upon waking.

Stress: Moderate to high susceptibility to measurement error. Participants provided a subjective one-dimensional summary every evening which may have been subject to recall bias over the day and/or systematic bias due to recording at the same time every day. Participants may not have accurately perceived their own level of stress.

Consumption: Medium susceptibility to measurement error. Participants reported caffeine and alcohol consumption in units of cups or drinks. Participants may have biased recall about the number of cups or drinks they consumed, and different beverages have different amounts of caffeine and alcohol which may contribute additional error.

Weather: Low susceptibility to measurement error. We expect a low risk of error for weather data which was passively collected from a separate API. The source of error here is participant travel, at which time they would not have actually been exposed to their home weather conditions.

Menstruation: Low susceptibility to measurement error. We expect a low likelihood of error in reporting of menstruation, but some participants appeared to have irregular or unpredictable cycles which may cloud the interpretation of the derived indicator variable for days -2 to 2.

Workday vs. Non-Workday: Low susceptibility to measurement error.

In future work, measuring sleep, stress, and consumption in ways that are less susceptible to measurement error may improve predictions.

Section S4. Discrete Hazard of Migraine Events

The purpose of this supplementary section is to further describe the observed discrete hazard of migraine and explain why we elected not to include predictors based on lagged migraines or time since the last migraine.

Episodic migraine may be a cyclical disorder, in which the threshold for trigger sensitivity gradually declines over an interictal period.[57,58] Under this model, the risk of new migraine onset varies depending on the time since the last migraine. When a patient is exposed to one or more trigger factors during a susceptible period, that can bring him/her over the "migraine threshold" and initiate an attack.[4,15,59,60] The baseline hazard of migraine may depend upon the time since the last migraine. If so, then it would be essential to incorporate a time-varying baseline hazard into the prediction model.[61]

Using our empirical data, we examined how the discrete hazard of migraine changed over the time since recovery from previous migraine. We first grouped participants by decile of migraine risk (number of new migraines divided by number of at-risk days). Within each decile we calculated the discrete hazard of new migraine (the number of new migraines occurring at a given time since last migraine, divided by the total number of at-risk days with that same time since last migraine). We did this for the migraines identified using a one-day recovery period (the primary method in this paper) as well as no recovery period. The results are plotted in Error! Reference source not found. and Error! Reference source not found.. The results showed a roughly constant hazard (not counting the last couple of days in each stratum, which have very few exposures). This suggests that the time since recovery from the last migraine does not give much information about the risk of the next migraine. For this reason, we elected not to include predictors based on lagged migraines or time since the last migraine.

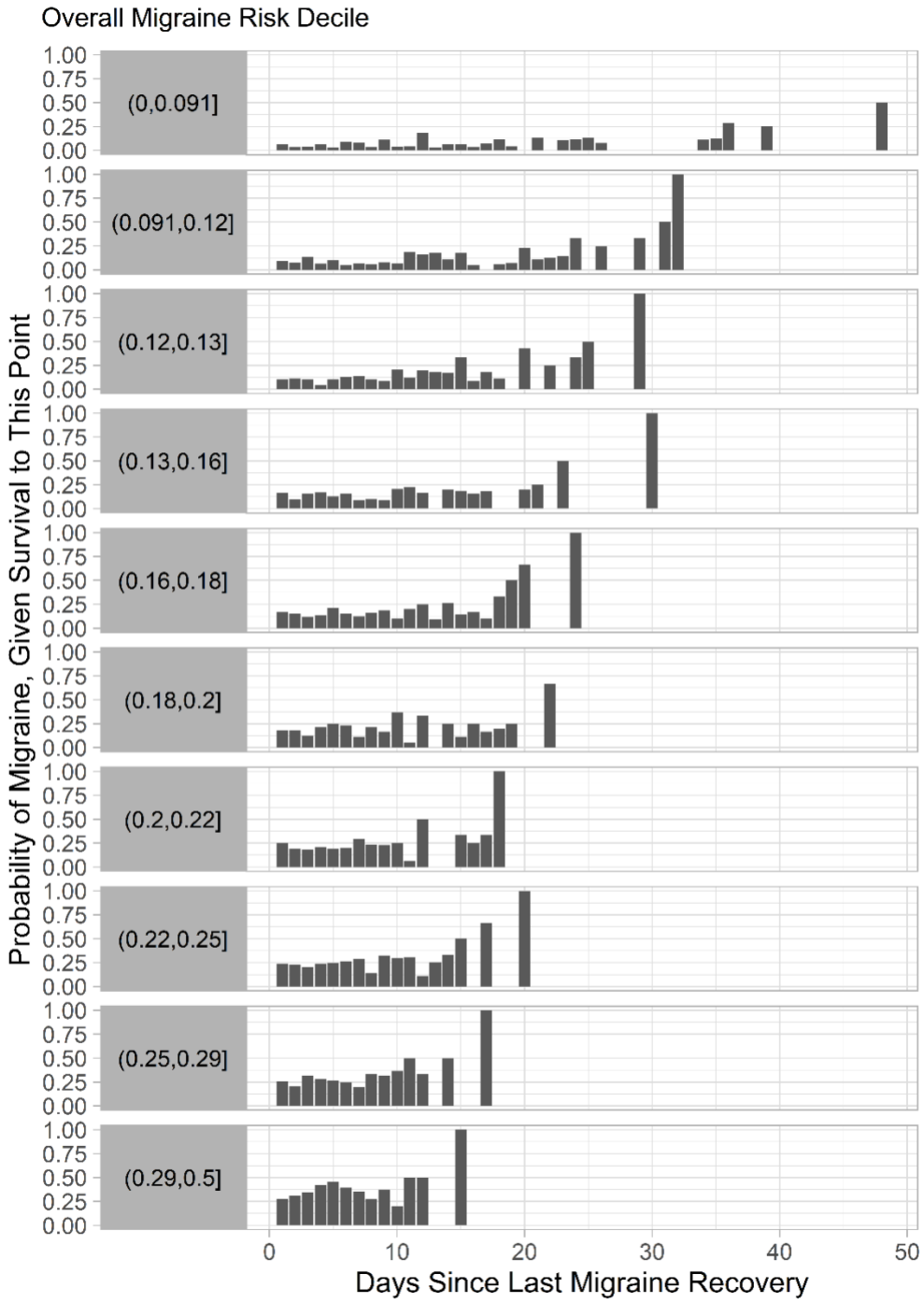


Figure S1: Discrete Hazard of Migraine Attack, 1-day Recovery Period.

Discrete hazards were calculated based on the number of days since recovery from the last migraine, where recovery was defined as the completion of a migraine-free day. The plot is stratified by decile of participant-specific migraine risk observed in the study (lowest at the top).

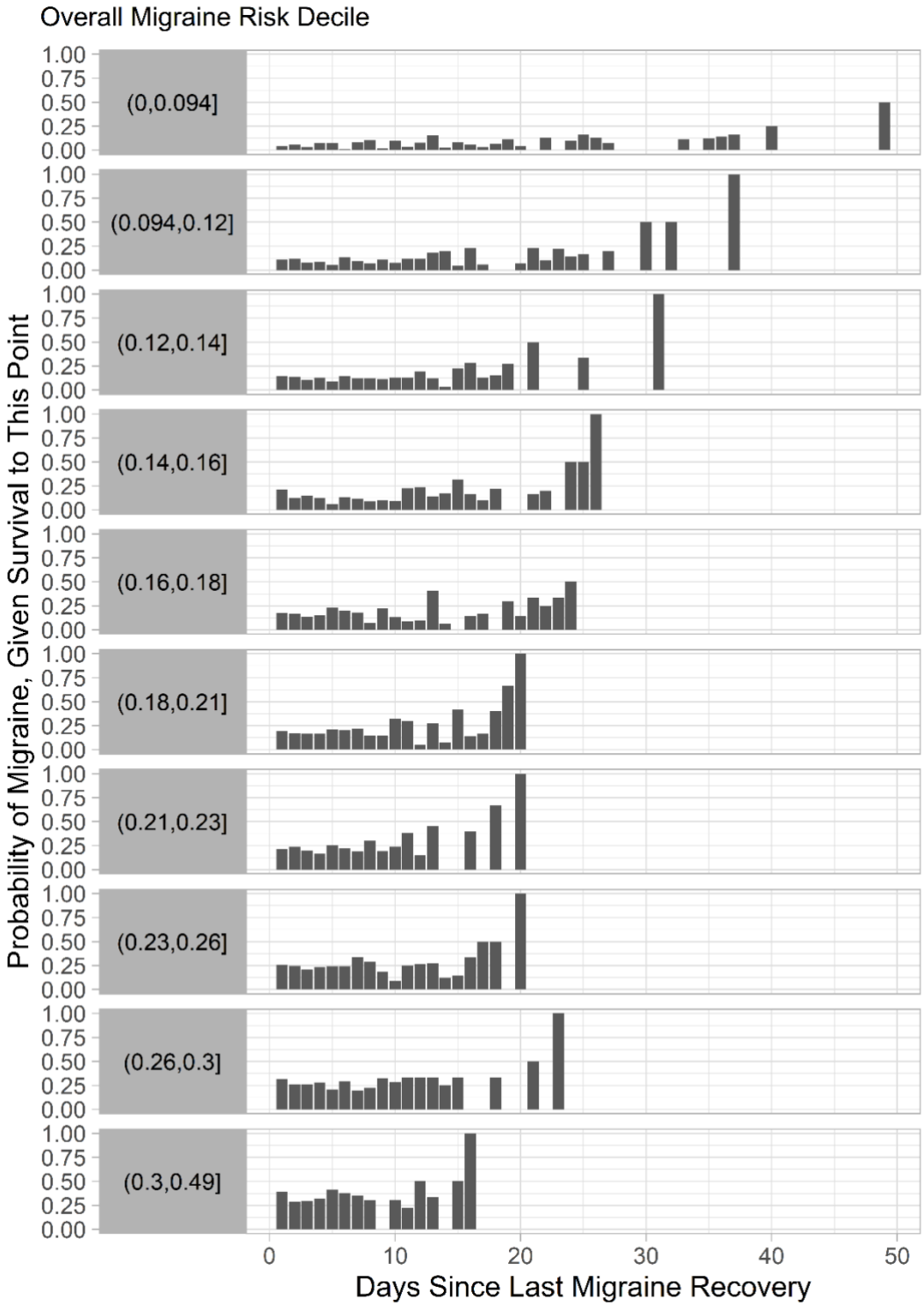


Figure S2: Discrete Hazard of Migraine Attack, 0-day Recovery Period.

Discrete hazards were calculated based on the number of days since recovery from the last migraine, where recovery was defined as the completion of the day on which a migraine ended (with no extra migraine-free day). The plot is stratified by decile of participant-specific migraine risk observed in the study (lowest at the top).

Section S5. Timing of Data Collection

This section summarizes the timing of data collection used in the current predictive model, with respect to the intended timing of risk estimation (**Figure S3)**. Participants were expected to complete their evening surveys before 3 am, at which point a new 24-hour risk period for the migraine event would begin. In practice, a daily migraine prediction app would take into account the data available up until 3am, apply the predictive model, and output a probability for the coming day. Such predictions would not have access to any data collected after 3am on the target day. All day-level factors except for menstruation and workday status are collected before 3am on the target day. Menstruation, workday status, and within-person means of all factors rely on same-day and/or future data to construct the predictors.

Intended Time of Estimation of Risk on Day 0

Day	-4	-3	-2	-1	0 (Target for Prediction)	+1 & future
Time	3am	3am	3am	3am	3am	3am
Data	*	*	*	(*): [- Stress level - Sleep timing/ duration/quality last night - Consumption of Caffeine/Alcohol - Menstrual cycle today] - Headache Self-Prediction - Workday or Off day	- Migraine today (outcome) - Workday or Off day - Menstrual cycle today	- Menstrual cycle look-ahead (2 days) - Within-person means of predictors (all days)

Figure S3: Timing of Data Collection and Intended Risk Estimation.

Section S6. Distribution of Predictors.

This section gives the distribution of predictors over all person-days (**Table S1**), for within-person means (**Table S2**), and within-person standard deviations (**Table S3**). These descriptive statistics help to interpret the current findings and to estimate the expected predictor variation for future studies.

Table S1: Distribution of Predictors (Overall).

Predictor	Units	Percentile of Overall Distribution							
		5th	10th	25th	50th	75th	90th	95th	SD
Bedtime, Diff from 12am	hours	-3.0	-2.5	-2.0	-1.0	0.0	1.0	2.0	1.6
Sleep Duration	hours	4.7	5.5	6.6	7.5	8.4	9.4	10.0	1.6
Sleep Quality (PC1)	unitless	-1.6	-0.9	-0.8	-0.2	0.5	1.6	2.5	1.3
Change in Sleep Hours	hours	-3.0	-2.2	-1.0	0.0	0.9	2.1	3.0	1.9
Change in Bed Time	hours	-2.0	-1.3	-0.5	0.0	0.5	1.3	2.0	1.3
Change in Sleep Quality (PC1)	unitless	-2.1	-1.3	-0.6	0.0	0.7	1.5	2.3	1.5
Stress Rating	0-10 scale	0.0	1.0	2.0	4.0	5.0	7.0	8.0	2.3
Change in Stress Rating	-10 to 10	-3.0	-2.0	-1.0	0.0	1.0	3.0	4.0	2.1
Temp. Max	degrees F	27.8	32.7	42.6	55.5	67.2	77.4	82.0	17.0
Pressure Min	millibars	1000.4	1003.6	1008.8	1014.2	1019.2	1023.7	1026.2	7.9
Wind Gust Speed	miles per hr	5.7	6.8	9.2	13.5	19.2	24.9	28.7	7.2
Precipitation/Humidity (PC1)	unitless	-1.5	-1.3	-0.9	-0.6	0.7	2.0	3.0	1.6
Change in Temp. Max	degrees F	-14.0	-9.9	-4.3	0.4	4.7	9.7	12.9	8.0
Change in Pressure Min	millibars	-12.2	-8.5	-4.1	-0.1	3.8	9.0	12.7	7.4
Change in Wind Gust Speed	miles per hr	-12.4	-9.0	-4.2	0.0	4.1	9.4	13.1	7.6
Caffeinated Bev	cups	0.0	0.0	0.0	1.0	2.0	3.0	4.0	1.4
Change in Caffeinated Bev	cups	-1.3	-1.0	0.0	0.0	0.0	1.0	1.0	0.9
Alcohol	drinks	0.0	0.0	0.0	0.0	0.0	2.0	2.0	1.0
Change in Alcohol	drinks	-2.0	-1.0	0.0	0.0	0.0	1.0	2.0	1.0
Headache Self-Prediction	0-4 scale	0.0	0.0	0.0	1.0	2.0	2.0	2.0	0.8

Table S2: Distribution of Predictors (Within-Person Means).

Predictor	Units	Percentile of Within-Person Means							
		5th	10th	25th	50th	75th	90th	95th	SD
Bedtime, Diff from 12am	hours	-2.4	-2.2	-1.6	-1.1	-0.5	0.4	0.8	1.1
Sleep Duration	hours	6.1	6.5	6.9	7.5	8.1	8.4	8.9	0.9
Sleep Quality (PC1)	unitless	-0.8	-0.6	-0.4	-0.1	0.4	0.9	1.5	0.7
Change in Sleep Hours	hours	-0.2	-0.2	-0.1	0.0	0.0	0.1	0.2	0.1
Change in Bed Time	hours	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1
Change in Sleep Quality (PC1)	unitless	-0.1	-0.1	0.0	0.0	0.1	0.1	0.2	0.1
Stress Rating	0-10 scale	1.3	1.8	2.7	4.2	5.1	5.7	6.2	1.5
Change in Stress Rating	-10 to 10	-0.2	-0.1	0.0	0.1	0.2	0.3	0.4	0.2
Temp. Max	degrees F	32.3	37.7	44.5	56.4	64.6	70.6	77.7	13.4
Pressure Min	millibars	1010.2	1011.1	1012.1	1014.2	1015.5	1016.5	1016.9	2.4
Wind Gust Speed	miles per hr	10.1	10.9	12.3	14.3	17.0	19.9	22.1	3.7
Precipitation/Humidity (PC1)	unitless	-0.8	-0.6	-0.3	0.0	0.3	0.6	0.7	0.5
Change in Temp. Max	degrees F	-0.8	-0.6	-0.3	0.1	0.5	0.8	1.0	0.6
Change in Pressure Min	millibars	-0.8	-0.6	-0.3	0.0	0.3	0.7	1.0	0.6
Change in Wind Gust Speed	miles per hr	-0.7	-0.4	-0.2	0.1	0.3	0.6	0.8	0.5
Caffeinated Bev	cups	0.0	0.2	0.6	1.5	2.1	3.1	4.0	1.3
Change in Caffeinated Bev	cups	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1
Alcohol	drinks	0.0	0.0	0.0	0.1	0.5	1.1	1.5	0.6
Change in Alcohol	drinks	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1
Headache Self-Prediction	0-4 scale	0.2	0.3	0.6	1.1	1.4	1.8	2.0	0.6

Table S3: Distribution of Predictors (Within-Person Standard Deviations).

Predictor	Units	Percentile of Within-Person Standard Deviations							
		5th	10th	25th	50th	75th	90th	95th	SD
Bedtime, Diff from 12am	hours	0.5	0.6	0.7	0.9	1.2	1.4	1.5	0.5
Sleep Duration	hours	0.8	0.9	1.0	1.3	1.6	2.0	2.3	0.5
Sleep Quality (PC1)	unitless	0.5	0.6	0.7	1.0	1.2	1.6	1.9	0.4
Change in Sleep Hours	hours	1.0	1.1	1.3	1.7	2.1	2.6	3.1	0.6
Change in Bed Time	hours	0.6	0.7	0.9	1.1	1.5	1.8	2.0	0.5
Change in Sleep Quality (PC1)	unitless	0.7	0.8	1.0	1.3	1.6	2.0	2.5	0.6
Stress Rating	0-10 scale	0.7	1.0	1.3	1.7	2.1	2.6	2.9	0.7
Change in Stress Rating	-10 to 10	0.9	1.1	1.5	2.0	2.4	3.0	3.2	0.7
Temp. Max	degrees F	5.2	7.0	8.4	10.3	12.0	13.3	14.1	2.7
Pressure Min	millibars	4.0	4.7	6.3	7.5	8.9	9.7	9.8	1.9
Wind Gust Speed	miles per hr	3.9	4.5	5.4	6.3	7.0	7.7	8.4	1.4
Precipitation/Humidity (PC1)	unitless	0.6	0.8	1.0	1.3	1.7	2.0	2.3	0.5
Change in Temp. Max	degrees F	3.5	4.2	6.5	8.4	9.4	10.1	10.3	2.1
Change in Pressure Min	millibars	3.2	4.0	5.6	7.6	8.5	9.9	10.3	2.2
Change in Wind Gust Speed	miles per hr	4.6	5.1	6.2	7.3	8.7	9.6	10.4	1.8
Caffeinated Bev	cups	0.1	0.3	0.5	0.6	0.8	1.1	1.2	0.3
Change in Caffeinated Bev	cups	0.2	0.5	0.7	0.8	1.0	1.4	1.5	0.4
Alcohol	drinks	0.0	0.0	0.1	0.5	0.9	1.3	1.6	0.5
Change in Alcohol	drinks	0.0	0.0	0.2	0.7	1.2	1.6	2.0	0.6
Headache Self-Prediction	0-4 scale	0.3	0.3	0.5	0.6	0.7	0.9	0.9	0.2

Section S7. Estimated Odds Ratios from Best Category Models

This section shows the estimated odds ratios of the best category-specific models that were selected based on the AIC (**Figure S4**). Each model was also adjusted for the three baseline features: self-reported headaches per month, headache days per month, and presence of a change in headache frequency or severity within the past 3 months. The predictors from these best category models were included in the primary predictive model.

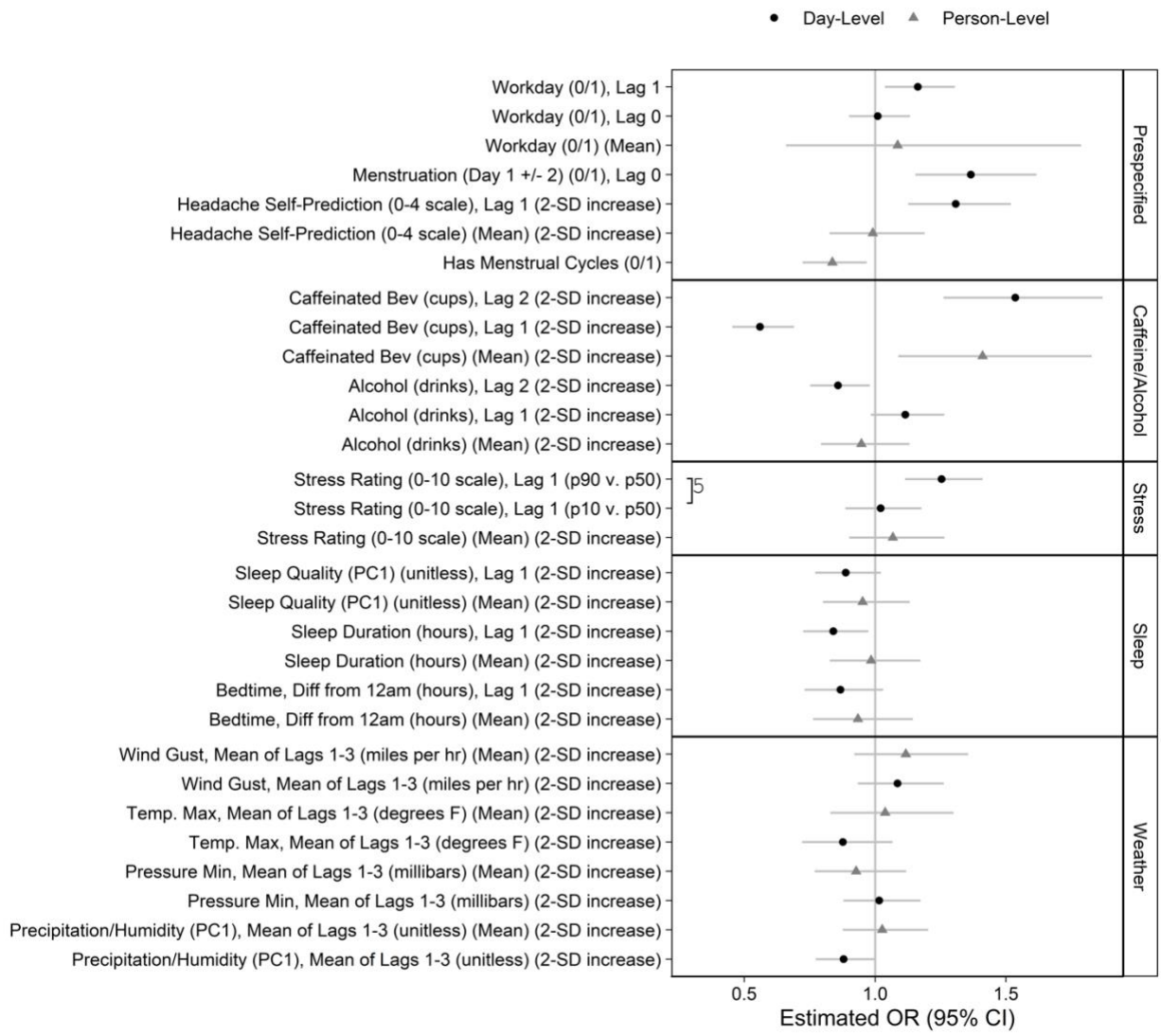


Figure S4: Estimated Odds Ratios from the Best Category-Specific Models.

Separate multivariable logistic regression models were estimated for each category of predictors (indicated by separate boxes on the plot). Each model was also adjusted for the three baseline features: self-reported headaches per month, headache days per month, and presence of a change in headache frequency or severity within the past 3 months. Lag 0 denotes the day for which migraine risk is predicted; lag 1 denotes the day before, and lag 2 denotes two days prior. Predictors modeled by 3-knot natural cubic splines were represented in the model by two separate linear terms and are shown in this plot by two separate estimates to summarize the nonlinear relationship: odds ratio for the 90th vs. 50th, and 10th vs. 50th percentiles of the overall distribution of the predictor. On this plot, these pairs of terms are always connected by a "]" with an integer denoting the number of imputations (of 5) in which the pair of linear terms was jointly statistically significant. For the predictors modeled linearly, odds ratios compare the risk associated with a 2-SD difference in the (continuous) predictor value, or with a change from 0 to 1 in a dichotomous predictor.

Section S8. Estimated Odds Ratios from Primary Model.

The purpose of this section is to publish the full estimated odds ratios and 95% confidence intervals from the primary predictive model (**Table S4**), to supplement the estimates plotted in Error! Reference source not found.. As discussed in the methods section, this model was composed of the best models from each category selected based on AIC, and in total it included 34 predictors including the intercept.

Table S4: Estimated Odds Ratios from Primary Model.

Category	Variable	Person-Level?	Estimated OR (95% CI)
Baseline	Headaches per Month (Logit) (logit ha/mo/30) (2-SD increase)	1	1.29 (1.10, 1.53)
Baseline	Headache Days per Month (Logit) (logit d/mo/30) (2-SD increase)	1	1.24 (1.06, 1.45)
Baseline	Headaches Changed in Past 3 Months (0/1)	1	0.77 (0.62, 0.96)
Caffeine/Alcohol	Caffeinated Bev (cups) (Mean) (2-SD increase)	1	1.28 (0.98, 1.67)
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 2 (2-SD increase)	0	1.53 (1.26, 1.87)
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 1 (2-SD increase)	0	0.54 (0.44, 0.67)
Caffeine/Alcohol	Alcohol (drinks) (Mean) (2-SD increase)	1	0.95 (0.80, 1.14)
Caffeine/Alcohol	Alcohol (drinks), Lag 2 (2-SD increase)	0	0.90 (0.79, 1.03)
Caffeine/Alcohol	Alcohol (drinks), Lag 1 (2-SD increase)	0	1.13 (0.99, 1.29)
Prespecified	Headache Self-Prediction (0-4 scale) (Mean) (2-SD increase)	1	1.00 (0.83, 1.20)
Prespecified	Headache Self-Prediction (0-4 scale), Lag 1 (2-SD increase)	0	1.27 (1.09, 1.48)
Prespecified	Has Menstrual Cycles (0/1)	1	0.84 (0.73, 0.97)
Prespecified	Menstruation (Day 1 +/- 2) (0/1), Lag 0	0	1.38 (1.16, 1.63)
Prespecified	Workday (0/1) (Mean)	1	0.93 (0.56, 1.54)
Prespecified	Workday (0/1), Lag 1	0	1.12 (0.98, 1.27)
Prespecified	Workday (0/1), Lag 0	0	1.01 (0.90, 1.14)
Sleep	Bedtime, Diff from 12am (hours) (Mean) (2-SD increase)	1	0.92 (0.74, 1.13)
Sleep	Bedtime, Diff from 12am (hours), Lag 1 (2-SD increase)	0	0.93 (0.77, 1.12)
Sleep	Sleep Quality (PC1) (unitless) (Mean) (2-SD increase)	1	0.95 (0.80, 1.13)
Sleep	Sleep Quality (PC1) (unitless), Lag 1 (2-SD increase)	0	0.88 (0.76, 1.02)
Sleep	Sleep Duration (hours) (Mean) (2-SD increase)	1	1.07 (0.89, 1.28)
Sleep	Sleep Duration (hours), Lag 1 (2-SD increase)	0	0.90 (0.77, 1.06)
Stress	Stress Rating (0-10 scale) (Mean) (2-SD increase)	1	1.15 (0.97, 1.37)
Stress	Stress Rating (0-10 scale), Lag 1 (p10 v. p50)	0	1.10 (0.94, 1.28)
Stress	Stress Rating (0-10 scale), Lag 1 (p90 v. p50)	0	1.21 (1.07, 1.37)
Weather	Wind Gust, Mean of Lags 1-3 (miles per hr) (Mean) (2-SD increase)	1	1.15 (0.95, 1.39)
Weather	Wind Gust, Mean of Lags 1-3 (miles per hr) (2-SD increase)	0	1.07 (0.92, 1.24)
Weather	Precipitation/Humidity (PC1), Mean of Lags 1-3 (unitless) (Mean) (2-SD increase)	1	1.01 (0.87, 1.18)
Weather	Precipitation/Humidity (PC1), Mean of Lags 1-3 (unitless) (2-SD increase)	0	0.89 (0.78, 1.02)
Weather	Temp. Max, Mean of Lags 1-3 (degrees F) (Mean) (2-SD increase)	1	1.00 (0.80, 1.25)
Weather	Temp. Max, Mean of Lags 1-3 (degrees F) (2-SD increase)	0	0.87 (0.71, 1.06)
Weather	Pressure Min, Mean of Lags 1-3 (millibars) (Mean) (2-SD increase)	1	0.99 (0.82, 1.18)
Weather	Pressure Min, Mean of Lags 1-3 (millibars) (2-SD increase)	0	1.01 (0.88, 1.17)
	Intercept		0.19 (0.15, 0.26)

Predictors were measured at the day level (varying across persons and across days within persons) or the person level (varying across persons, but constant across days within persons). Lag 0 denotes the day for which migraine risk is predicted; lag 1 denotes the day before, and lag 2 denotes two days prior. Predictors modeled by 3-knot natural cubic splines were represented in the model by two separate linear terms and are shown in this plot by two separate estimates to summarize the nonlinear relationship: odds ratios for the 90th vs. 50th, and 50th vs. 10th percentiles of the overall distribution of the predictor. These estimates and confidence intervals are plotted in Error! Reference source not found..

Section S9. Estimated Odds Ratios from Penalized Model.

The purpose of this section is to display the results of the grouped-lasso penalized logistic regression model (**Table S5**). This table gives the full list of candidate predictors included in the grouped-lasso procedure, ranked by their absolute mean estimated log-OR. The means are taken over all five imputations, whether or not the predictor was selected for a nonzero effect. The number of imputations in which each predictor was assigned a positive, negative, or zero coefficient are shown in the corresponding columns. The grouped lasso procedure does not produce standard errors for the estimates, so this table does not include confidence intervals.

Table S5: Estimated Odds Ratios from Penalized Model.

Category	Variable	Person Level?	N Positive	N Zero	N Negative	Estimated OR
	Intercept		0	0	5	0.19
Prespecified	Menstruation (Day 1 +/- 2) (0/1), Lag 0	0	5	0	0	1.28
Baseline	Headaches per Month (Logit) (logit ha/mo/30) (2-SD increase)	1	5	0	0	1.25
Prespecified	Headache Self-Prediction (0-4 scale), Lag 1 (2-SD increase)	0	5	0	0	1.22
Caffeine/Alcohol	Change in Caffeinated Bev (cups), Lag 1 (p10 v. p50)	0	5	0	0	1.21
Baseline	Headache Days per Month (Logit) (logit d/mo/30) (2-SD increase)	1	5	0	0	1.17
Sleep	Change in Sleep Quality (PC1) (unitless) (Mean) (2-SD increase)	1	0	0	5	0.86
Weather	Wind Gust Speed (miles per hr) (Mean) (2-SD increase)	1	5	0	0	1.16
Baseline	Headaches Changed in Past 3 Months (0/1)	1	0	0	5	0.87
Stress	Stress Rating (0-10 scale), Lag 1 (p90 v. p50)	0	5	0	0	1.15
Prespecified	Has Menstrual Cycles (0/1)	1	0	0	5	0.89
Prespecified	Workday (0/1), Lag 1	0	5	0	0	1.10
Caffeine/Alcohol	Change in Caffeinated Bev (cups), Lag 1 (p90 v. p50)	0	0	0	5	0.92
Caffeine/Alcohol	Change in Alcohol (drinks), Lag 1 (2-SD increase)	0	5	0	0	1.08
Sleep	Bedtime, Diff from 12am (hours) (Mean) (2-SD increase)	1	0	0	5	0.93
Caffeine/Alcohol	Caffeinated Bev (cups) (Mean) (2-SD increase)	1	5	0	0	1.06
Stress	Stress Rating (0-10 scale) (Mean) (2-SD increase)	1	5	0	0	1.06
Weather	Temp. Max (degrees F), Lag 2 (2-SD increase)	0	0	0	5	0.94
Weather	Precipitation/Humidity (PC1) (unitless), Lag 2 (2-SD increase)	0	0	0	5	0.94
Sleep	Bedtime, Diff from 12am (hours), Lag 2 (2-SD increase)	0	0	0	5	0.96
Stress	Stress Rating (0-10 scale), Lag 1 (p10 v. p50)	0	5	0	0	1.04
Weather	Change in Pressure Min (millibars), Lag 1 (p90 v. p50)	0	5	0	0	1.04
Weather	Wind Gust Speed (miles per hr), Lag 3 (2-SD increase)	0	5	0	0	1.03
Sleep	Change in Sleep Quality (PC1) (unitless), Lag 1 (p90 v. p50)	0	0	0	5	0.98
Caffeine/Alcohol	Alcohol (drinks), Lag 3 (2-SD increase)	0	0	0	5	0.98
Stress	Change in Stress Rating (from -10 to 10), Lag 1 (p90 v. p50)	0	5	0	0	1.02
Sleep	Sleep Quality (PC1) (unitless), Lag 1 (p90 v. p50)	0	0	0	5	0.98
Sleep	Change in Sleep Quality (PC1) (unitless), Lag 1 (p10 v. p50)	0	0	0	5	0.99
Sleep	Sleep Quality (PC1) (unitless) (Mean) (2-SD increase)	1	0	0	5	0.99
Weather	Pressure Min (millibars), Lag 1 (p90 v. p50)	0	5	0	0	1.01
Weather	Change in Temp. Max (degrees F), Lag 1 (p90 v. p50)	0	0	0	5	0.99
Sleep	Sleep Quality (PC1) (unitless), Lag 1 (p10 v. p50)	0	0	0	5	0.99
Weather	Change in Wind Gust Speed (miles per hr) (Mean) (2-SD increase)	1	0	0	5	0.99
Weather	Precipitation/Humidity (PC1) (unitless), Lag 1 (p90 v. p50)	0	0	0	5	0.99
Weather	Change in Temp. Max (degrees F), Lag 1 (p10 v. p50)	0	0	0	5	0.99

Weather	Change in Pressure Min (millibars), Lag 1 (p10 v. p50)	0	1	0	4	1.00
Weather	Precipitation/Humidity (PC1) (unitless), Lag 1 (p10 v. p50)	0	5	0	0	1.00
Stress	Change in Stress Rating (from -10 to 10), Lag 1 (p10 v. p50)	0	5	0	0	1.00
Weather	Pressure Min (millibars), Lag 1 (p10 v. p50)	0	0	0	5	1.00
Caffeine/Alcohol	Alcohol (drinks), Lag 2 (2-SD increase)	0	0	4	1	1.00
Weather	Change in Wind Gust Speed (miles per hr), Lag 1 (p10 v. p50)	0	2	3	0	1.00
Stress	Change in Stress Rating (from -10 to 10) (Mean) (2-SD increase)	1	0	4	1	1.00
Weather	Wind Gust Speed (miles per hr), Lag 2 (2-SD increase)	0	1	4	0	1.00
Weather	Change in Wind Gust Speed (miles per hr), Lag 1 (p90 v. p50)	0	2	3	0	1.00
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 1 (p10 v. p50)	0	1	4	0	1.00
Sleep	Sleep Quality (PC1) (unitless), Lag 3 (2-SD increase)	0	0	4	1	1.00
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 1 (p90 v. p50)	0	1	4	0	1.00
Caffeine/Alcohol	Change in Caffeinated Bev (cups) (Mean) (2-SD increase)	1	0	5	0	1.00
Caffeine/Alcohol	Change in Caffeinated Bev (cups), Lag 2 (2-SD increase)	0	0	5	0	1.00
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 3 (2-SD increase)	0	0	5	0	1.00
Caffeine/Alcohol	Caffeinated Bev (cups), Lag 2 (2-SD increase)	0	0	5	0	1.00
Caffeine/Alcohol	Change in Alcohol (drinks) (Mean) (2-SD increase)	1	0	5	0	1.00
Caffeine/Alcohol	Change in Alcohol (drinks), Lag 2 (2-SD increase)	0	0	5	0	1.00
Caffeine/Alcohol	Alcohol (drinks) (Mean) (2-SD increase)	1	0	5	0	1.00
Caffeine/Alcohol	Alcohol (drinks), Lag 1 (2-SD increase)	0	0	5	0	1.00
Prespecified	Headache Self-Prediction (0-4 scale) (Mean) (2-SD increase)	1	0	5	0	1.00
Prespecified	Workday (0/1) (Mean)	1	0	5	0	1.00
Prespecified	Workday (0/1), Lag 2	0	0	5	0	1.00
Prespecified	Workday (0/1), Lag 0	0	0	5	0	1.00
Sleep	Change in Bed Time (hours) (Mean) (2-SD increase)	1	0	5	0	1.00
Sleep	Change in Bed Time (hours), Lag 2 (2-SD increase)	0	0	5	0	1.00
Sleep	Change in Bed Time (hours), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Sleep	Change in Bed Time (hours), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Sleep	Bedtime, Diff from 12am (hours), Lag 3 (2-SD increase)	0	0	5	0	1.00
Sleep	Bedtime, Diff from 12am (hours), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Sleep	Bedtime, Diff from 12am (hours), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Sleep	Change in Sleep Quality (PC1) (unitless), Lag 2 (2-SD increase)	0	0	5	0	1.00
Sleep	Sleep Quality (PC1) (unitless), Lag 2 (2-SD increase)	0	0	5	0	1.00
Sleep	Change in Sleep Hours (hours) (Mean) (2-SD increase)	1	0	5	0	1.00
Sleep	Change in Sleep Hours (hours), Lag 2 (2-SD increase)	0	0	5	0	1.00
Sleep	Change in Sleep Hours (hours), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Sleep	Change in Sleep Hours (hours), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Sleep	Sleep Duration (hours) (Mean) (2-SD increase)	1	0	5	0	1.00
Sleep	Sleep Duration (hours), Lag 3 (2-SD increase)	0	0	5	0	1.00
Sleep	Sleep Duration (hours), Lag 2 (2-SD increase)	0	0	5	0	1.00

Sleep	Sleep Duration (hours), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Sleep	Sleep Duration (hours), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Stress	Change in Stress Rating (from -10 to 10), Lag 2 (2-SD increase)	0	0	5	0	1.00
Stress	Stress Rating (0-10 scale), Lag 3 (2-SD increase)	0	0	5	0	1.00
Stress	Stress Rating (0-10 scale), Lag 2 (2-SD increase)	0	0	5	0	1.00
Weather	Change in Wind Gust Speed (miles per hr), Lag 2 (2-SD increase)	0	0	5	0	1.00
Weather	Wind Gust Speed (miles per hr), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Weather	Wind Gust Speed (miles per hr), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Weather	Precipitation/Humidity (PC1) (unitless) (Mean) (2-SD increase)	1	0	5	0	1.00
Weather	Precipitation/Humidity (PC1) (unitless), Lag 3 (2-SD increase)	0	0	5	0	1.00
Weather	Change in Temp. Max (degrees F) (Mean) (2-SD increase)	1	0	5	0	1.00
Weather	Change in Temp. Max (degrees F), Lag 2 (2-SD increase)	0	0	5	0	1.00
Weather	Temp. Max (degrees F) (Mean) (2-SD increase)	1	0	5	0	1.00
Weather	Temp. Max (degrees F), Lag 3 (2-SD increase)	0	0	5	0	1.00
Weather	Temp. Max (degrees F), Lag 1 (p10 v. p50)	0	0	5	0	1.00
Weather	Temp. Max (degrees F), Lag 1 (p90 v. p50)	0	0	5	0	1.00
Weather	Change in Pressure Min (millibars) (Mean) (2-SD increase)	1	0	5	0	1.00
Weather	Change in Pressure Min (millibars), Lag 2 (2-SD increase)	0	0	5	0	1.00
Weather	Pressure Min (millibars) (Mean) (2-SD increase)	1	0	5	0	1.00
Weather	Pressure Min (millibars), Lag 3 (2-SD increase)	0	0	5	0	1.00
Weather	Pressure Min (millibars), Lag 2 (2-SD increase)	0	0	5	0	1.00
Prespecified	Menstruation (Day 1 +/- 2) (0/1), Lag 0	0	5	0	0	1.28
Baseline	Headaches per Month (Logit) (logit ha/mo/30) (2-SD increase)	1	5	0	0	1.25
Prespecified	Headache Self-Prediction (0-4 scale), Lag 1 (2-SD increase)	0	5	0	0	1.22
Caffeine/Alcohol	Change in Caffeinated Bev (cups), Lag 1 (p10 v. p50)	0	5	0	0	1.21
Baseline	Headache Days per Month (Logit) (logit d/mo/30) (2-SD increase)	1	5	0	0	1.17

The estimated ORs were calculated by exponentiating the mean estimated coefficient over all of the imputations including zero and non-zero estimates. The number of imputations in which each predictor was assigned a positive, negative, or zero coefficient are shown in the corresponding columns. Lag 0 denotes the day for which migraine risk is predicted; lag 1 denotes the day before, and lag 2 denotes two days prior. Predictors modeled by 3-knot natural cubic splines were represented in the model by two separate linear terms and are shown in this plot by two separate estimates to summarize the nonlinear relationship: odds ratios for the 90th vs. 50th, and 10th vs. 50th percentiles of the overall distribution of the predictor.