Summaries of Migraine Research Documents

Petrušić (2025): Digital Phenotyping for Migraine—A Game-Changer for Research and Management

Summary:
This review highlights digital phenotyping (DP) as a transformative approach for migraine research and management. DP involves real-time collection of behavioral and physiological data via smartphones, wearables, and biosensors, enabling identification of individual migraine phenotypes and triggers. The approach promises more personalized diagnostics, tailored treatments, and the discovery of digital biomarkers. DP can also facilitate predictive modeling for migraine attacks, empower patients in self-management, and support the development of digital twin models for precision medicine. The review emphasizes the need for multidisciplinary collaboration and addresses technological, ethical, and educational challenges for integrating DP into clinical practice.

Stubberud et al. (2023): Forecasting Migraine with Machine Learning Based on Mobile Phone Diary and Wearable Data

Summary:
This study explores the use of machine learning to forecast migraine attacks using data from mobile headache diaries and wearable biosensors. Eighteen patients provided daily entries and physiological measurements (heart rate, skin temperature, muscle tension). Several machine learning models were tested, with the best (random forest classifier) achieving moderate predictive accuracy (AUC = 0.62). Both self-reported symptoms and physiological data contributed to predictions. The study demonstrates proof-of-concept for using high-dimensional modeling and mHealth data in migraine forecasting but notes limitations due to small sample size and lack of headache type differentiation. Future research should include larger datasets and more diverse predictors for improved accuracy.

Buse et al. (2020): Predicting the Future of Migraine Attack Prediction

Summary:
This editorial discusses the challenges and opportunities in predicting migraine attacks. It reviews forecasting models based on triggers, premonitory symptoms, and patient diaries. While some individuals can predict attacks based on premonitory symptoms (e.g., fatigue, concentration difficulties), most models—including a recent multivariable model—only slightly outperform chance. The editorial suggests that prediction may be possible for some patients, especially with personalized models and improved data collection (e.g., wearables, ecological momentary assessment). The authors advocate for long-term, individualized observation and integration of physiological and behavioral data to enhance prediction and management of migraine.

Holsteen et al. (2020): Development and Internal Validation of a Multivariable Prediction Model for Individual Episodic Migraine Attacks Based on Daily Trigger Exposures

Summary:
This study developed and validated a multivariable model to predict daily migraine risk using self-reported exposures to common triggers (stress, sleep, caffeine, alcohol, menstruation) and self-prediction. Data from 178 adults over 90 days revealed that decreased caffeine, higher stress, and proximity to menstruation were associated with increased risk. However, the model's predictive accuracy was only slightly better than chance (C-statistic: 0.56). The findings suggest that episodic migraine attacks are not reliably predictable using current self-reported triggers and highlight the need for broader and more accurate data collection to build clinically useful models.

Katsuki et al. (2023): Investigating the Effects of Weather on Headache Occurrence Using a Smartphone Application and Artificial Intelligence

Summary:
This large-scale retrospective study analyzed data from 4,375 users (336,951 headache events) of a headache diary smartphone app, combined with weather data. Using statistical and deep learning models, the study found that low barometric pressure, rapid pressure changes, higher humidity, and rainfall were significantly associated with increased headache occurrences. The findings were validated with temporal data and support previous research linking weather factors to headache risk. The study demonstrates the utility of big data and AI for understanding headache triggers and suggests that weather-based alerts could help patients manage their condition proactively.

References

1. Petrušić I. (2025). Digital phenotyping for migraine: A game-changer for research and management. Cephalalgia, 45(7), 1–13.
2. Stubberud A. et al. (2023). Forecasting migraine with machine learning based on mobile phone diary and wearable data. Cephalalgia, 43(5), 1–10.
3. Buse D.C. et al. (2020). Predicting the future of migraine attack prediction. Headache, 60(10), 2125–2128.
4. Holsteen K.K. et al. (2020). Development and internal validation of a multivariable prediction model for individual episodic migraine attacks based on daily trigger exposures. Headache, 60(10), 2364–2379.
5. Katsuki M. et al. (2023). Investigating the effects of weather on headache occurrence using a smartphone application and artificial intelligence. Headache, 63, 585–600.