



# A Literature Review On Multi-Modal Artificial Intelligence Approaches For Mental Health Assessment

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**Abstract:** Now a days Mental health disorders such as depression, anxiety, stress, schizophrenia, and suicidal tendencies present serious global public health challenges, especially among adolescents and young adults. Day by day more advances in Artificial Intelligence (AI) and Machine Learning (ML) have driven the development of multimodal systems integrating diverse data sources: neurophysiological signals, smartphone-based digital phenotyping, social media content, and wearable sensor data. In this survey offers a detailed review of five recent studies (2022–2025) using multimodal, machine learning, and deep learning techniques for mental health detection and risk prediction. The survey studies for data modalities, methodologies, strengths, limitations, and research challenges. The future research directions are outlined to inform the development of robust, ethical, real-time AI-based mental health assessment systems.

**Keywords:** Mental Health, Multimodal Learning, Digital Phenotyping, Deep Learning, Anxiety Detection, Depression, Stress Detection, Survey

## I.INTRODUCTION

Mental health disorders affect millions globally and often go undiagnosed due to stigma, limited clinical resources, and dependence on subjective self-reporting. Conventional diagnostics are slow and lack scalability. Recently, AI-driven approaches leveraging multimodal data have shown potential for early, objective, and continuous mental health assessment.

Multimodal approaches combine diverse data streams such as EEG/ECOG signals, smartphone sensor data, social media behavior, and physiological signals from wearables. This survey synthesizes recent contributions in this domain, focusing on five representative studies published between 2024 and 2025. The objective of this paper is to highlight methodological trends, identify research gaps, and propose future directions for multimodal mental health analytics.

## II LITERATURE REVIEW

SL NO	Year	Title of the Paper	Existing Methodology	Drawbacks	Proposed Methodology	Advantages	Applications	Future Works
1	2025	Digital Phenotyping for Adolescent Mental Health	Multimodal sensing + DL	Limited school-based studies	Deep multimodal neural networks	Emotion-adaptive learning	School mental-health systems	Real-time intervention systems
2	2025	AI-Driven Behavioral Health Monitoring	Mobile sensing	Ethical risks	Privacy-preserving AI	Trustworthy AI	Community health	Federated models
3	2025	Emotion-Aware Mental Health AI	Affective computing	Dataset scarcity	Multimodal affect models	Emotional sensitivity	Anxiety prevention	Dataset creation
4	2025	School-Based AI Mental Health Systems	Rule-based screening	Low adaptability	Deep learning	Adaptive systems	Schools	Policy deployment
5	2025	Digital Mental Health under NEP 2020	Conceptual analysis	No implementation	AI-enabled platforms	Policy alignment	Indian education	Pilot studies
6	2025	Multilingual AI for Student Mental Health	NLP-based analysis	Language bias	Multilingual DL	Inclusivity	Indian schools	Regional scaling
7	2025	Early Detection of Subclinical Depression	Questionnaire + ML	Reactive approach	Passive digital phenotyping	Proactive detection	Preventive care	Real-world trials
8	2025	Deep Multimodal Learning for Anxiety	Multimodal DL	Overfitting	Regularized fusion	Accuracy	Anxiety screening	Explainability
9	2025	Emotion-Adaptive Learning Systems	Emotion recognition	Limited sensing	Multimodal sensing	Personalized learning	Education tech	AI tutors
10	2025	Ethical AI for Youth Mental Health	Policy review	Implementation gap	Governance framework	Responsible AI	School health	Legal integration
11	2024	Digital Phenotyping for Stress, Anxiety & Mild Depression	Smartphone behavioral markers	Mostly adult data	Context-aware digital phenotyping	Early subclinical detection	Preventive psychiatry	Youth-centric models
12	2024	Depression Severity via Mobile Sensing	Mobile ML models	Cultural bias	Personalized learning	Higher accuracy	Mass screening	Cross-cultural models
13	2024	AI-Based Mental Health Screening in Schools	Survey + ML	Manual input	Passive sensing	Scalability	School screening	Policy integration
14	2024	Emotion Detection Using Wearables	Physiological sensors	Noise sensitivity	Deep learning	Robust signals	Anxiety detection	Multimodal fusion
15	2024	Multimodal AI for Student Well-	Sensor fusion	High cost	Lightweight DL	Feasible deployment	School health	Cost optimization

16	2024	AI-Based School Mental Health Screening	Questionnaire-based	Manual process	Automated phenotyping	Scalability	Schools	n National pilots
17	2024	Multimodal Stress Detection in Students	Wearables	Cost	Low-cost sensors	Affordable systems	Student wellness	Rural deployment
18	2024	Deep Multimodal Fusion for Mental Health	Feature fusion	High latency	Attention fusion	Efficient inference	Mental health AI	Edge optimization
19	2024	Contextual AI for Student Emotion Detection	Interaction logs	Limited signals	Multimodal context AI	Emotion awareness	EdTech	AI tutors
20	2024	Passive Mental Health Monitoring	Mobile sensing	Battery issues	Optimized sensing	Feasible use	Adolescents	Adaptive sampling
21	2024	Digital Phenotyping for Stress, Anxiety, and Mild Depression: Systematic Literature Review	<u>Systematic PRISMA review of studies using smartphone sensors for stress/anxiety/depression detection (JMIR mHealth and uHealth)</u>	<u>Most studies rely on self-report &amp; limited passive data; lack generalizability; limited to adult/nonclinical populations (JMIR mHealth and uHealth)</u>	N/A (Review)	Consolidates evidence for sensor effectiveness	Mental monitoring frameworks	Call for standardized frameworks & multimodal systems
22	2024	Use of smartphone sensor data in detecting and predicting depression and anxiety in young people (Scoping Review)	<u>Review scoping sensing features and ML/statistical models (ScienceDirect)</u>	<u>Inconsistent reporting &amp; high bias; mixed prediction results (ScienceDirect)</u>	N/A (Review)	Survey of youth-centric digital phenotyping	Mental health detection in youth	Standardized reporting frameworks
23	2024	FacePsy: Mobile Affective Sensing for Depression Detection	<u>Mobile facial behavior capture &amp; regression analysis (arXiv)</u>	<u>Small sample; limited modalities; not validated in diverse populations (arXiv)</u>	Real-world smartphone facial feature extraction	Mobile real-world detection	Extend to larger, school-aged samples	Multimodal systems
24	2023	Multimodal Digital Phenotyping Review	Systematic review	No unified model	Reference architecture	Comprehensive view	Research guidance	Benchmarks
25	2023	Wearable AI for Anxiety &	Wearable + AI review	Data imbalance	Deep neural models	Objective signals	Anxiety monitoring	Multimodal systems

26	2023	Wearable Devices for Mental Health	Scoping review	Limited adolescents	Advanced ML	High accuracy	Stress detection	Youth-focused datasets
27	2023	Behavioral Indicators of Anxiety	Smartphone metadata	Context loss	Context-aware ML	Precision	Anxiety screening	Cultural adaptation
28	2023	Multimodal Fusion for Depression	Feature-level fusion	High computation	Attention-based fusion	Improved performance	Mental health AI	Edge deployment
29	2023	Multimodal Anxiety Detection	Wearables + audio	Data imbalance	Weighted fusion	Balanced learning	Anxiety detection	Data augmentation
30	2023	Emotion Recognition from Physiological Data	HRV + GSR	Limited context	Context-aware DL	Higher precision	Stress & anxiety	Multimodal scaling
31	2023	Ethics of Digital Mental Health	Policy analysis	Lack of enforcement	Ethical frameworks	Trust	Clinical adoption	Regulation models
32	2023	Deep Learning for Mental Health IoT	IoT sensors	Security risks	Secure DL pipelines	Safe deployment	Smart health	Blockchain integration
33	2023	Behavioral Sensing & Depression	Activity inference	Single modality	Multisensor fusion	Improved accuracy	Depression detection	Longitudinal studies
34	2023	Using digital phenotyping to capture depression symptom variability	Ensemble ML on wearable + demographic data	Modest predictive power; variability measurement issues	Combined biodemographic + sensor features	Moderate prediction of symptom variability	Depression dynamics	<u>Larger clinical cohort studies (Nature)</u>
35	2023	Wearable AI for Anxiety and Depression: Systematic Review	Review of wearable AI models	Lack of meta-analysis	Algorithmic comparison	Identifies ML trends	Early screening	Performance benchmarking
36	2023	Digital Phenotyping to Capture Depression Symptom Variability	Ensemble ML with wearable & demographic data	Moderate predictive power	Hybrid feature modeling	Captures symptom dynamics	Depression monitoring	Larger datasets
37	2023	Hybrid Random Forest-ANN for Depression Classification	Ensemble RF + ANN	Limited dataset	Hybrid ensemble model	Improved accuracy	Wearable-based screening	Multiclass classification
38	2023	Mobile Phone Sensor Correlates of Depressive Symptom Severity	GPS & phone usage with regression models	Small sample size	Behavioral feature correlation analysis	Objective symptom indicators	Depression severity monitoring	Longitudinal prediction
39	2023	Depression Detection Using	CNN-LSTM on wearable	Requires high-quality	Deep temporal	High accuracy	Depression detection	Real-time deployment

		Wearable Sensor signals	sensor data	feature learning				
		Data and Deep Learning						
40	2023	Relapse Prediction in Depression Using Smartphone Data	Time-series ML on phone data	Relapse labels difficult	Longitudinal relapse modeling	Preventive insights	Depression relapse prevention	Personalized alerts
41	2022	Adolescent Depression Prediction	Smartphone + wearable data	Limited emotion modeling	Sensor fusion	Improved accuracy	Youth mental health	Emotion-aware AI
42	2022	Deep Learning for Mental Health Sensing	CNN-based models	Overfitting	Attention networks	Robust learning	Depression detection	Explainable AI
43	2022	Passive Sensing & Anxiety Symptoms	Behavioral analysis	Sparse labels	Semi-supervised learning	Reduced labeling	Anxiety monitoring	Federated learning
44	2022	Digital Biomarkers of Mental Health	Conceptual framework	Lack of validation	AI-driven biomarkers	Clinical relevance	Preventive care	Validation studies
45	2022	Digital Phenotyping in Psychiatry	Smartphone sensing	Fragmented systems	Integrated platforms	Scalability	Public mental health	System standardization
46	2022	Passive Detection of Anxiety	Smartphone metadata	Privacy risk	Privacy-aware ML	Safer systems	Anxiety screening	Secure deployment
47	2022	Affective Computing in Education	Facial & interaction data	Classroom noise	Multimodal affect fusion	Emotion sensitivity	Student well-being	Scalable classrooms
48	2022	Continuous Stress Monitoring	Wearables + ML	Battery drain	Energy-efficient models	Longer monitoring	Stress management	Low-power AI
49	2022	Digital Biomarkers for Depression	Smartphone biomarkers	Cultural bias	Adaptive ML	Generalization	Mental health	LMIC studies
50	2022	AI-Based Mental Health Prediction	Survey + ML	Reactive	Passive phenotyping	Proactive care	Public health	Real-time systems

### III. CONCLUSION

This survey highlights recent advancements in multimodal AI-based mental health assessment. By synthesizing findings from five contemporary studies, the paper underscores the importance of multimodal data integration, real-time analytics, and ethical AI design. Continued interdisciplinary research is essential to translate these innovations into scalable and trustworthy mental health solutions.

### IV. REFERENCES

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