ARTIFICIAL INTELLIGENCE IN OBESITY AND MENTAL HEALTH CARE: APPLICATIONS, EFFECTIVENESS, AND FUTURE DIRECTIONS

Dr. P. B. Ingle
Assist. Professor, Dept. of Psychology, Indira Mahavidyalaya Kalamb, Dist. Yavatmal
drpbingle21@gmail.com

Abstract
The integration of artificial intelligence (AI) and machine learning (ML) into healthcare has created novel opportunities to address complex public health challenges, particularly obesity and mental health disorders. These circumstances are multifactorial and require individualized, comprehensive management strategies. This paper synthesizes current evidence on AI applications across obesity and mental health domains, highlighting their roles in early detection, predictive modeling, personalized treatment, and continuous monitoring. AI-powered interventions, including digital therapeutics, mobile health applications, wearable devices, and conversational agents, have demonstrated strong potential for enhancing engagement, precision, and scalability of care. Clinical trial data and systematic reviews provide evidence of effectiveness, with AI models often outperforming traditional approaches in predictive accuracy. Nonetheless, significant limitations persist, including data heterogeneity, limited long-term evidence, algorithmic bias, and challenges in clinical integration. Ethical concerns around privacy, equity, and transparency remain critical considerations. Emerging trends such as explainable AI, multimodal models, and precision healthcare signal important directions for future development. This review emphasizes the transformative potential of AI in obesity and mental health management while underscoring the need for longitudinal studies, robust ethical frameworks, and equitable implementation strategies to realize its full promise.
Keywords: *Artificial Intelligence, Machine learning, Obesity, Mental Health, Digital Health, Personalized care, Predictive modeling*

Introduction

The integration of artificial intelligence (AI) and machine learning (ML) technologies into healthcare has emerged as a promising approach to address two of the most pressing public health challenges: obesity and mental health disorders. Both conditions represent complex, multifactorial health issues that require personalized, comprehensive management strategies (Hinchliffe et al., 2022). AI applications in these domains range from early detection and risk prediction to personalized treatment recommendations and continuous monitoring systems(Kiruthika et al., 2024; Veneziani et al., 2024).

The convergence of digital health technologies with AI has created unprecedented opportunities to enhance the quality, efficiency, and accessibility of care for both obesity and mental health conditions(Hinchliffe et al., 2022). This comprehensive analysis examines the current state of AI applications across these interconnected health domains, evaluating their effectiveness, limitations, and future potential.

Evidence Synthesis

AI Applications in Obesity Management and Prevention

Predictive Modeling and Risk Assessment

AI technologies have demonstrated significant potential in obesity prediction and risk stratification. Machine learning models utilizing diverse data sources including genetic, epigenetic, and clinical data have been developed to identify individuals at risk for obesity (Azmi et al., 2025). These predictive models have shown high accuracy in identifying obesity-related risk factors, enabling earlier and more targeted interventions (Welchen et al., 2024).

Research has shown that AI presents high precision in identifying risk factors for obesity, allowing for more precocious and personalized interventions (Welchen et al., 2024). The application of machine learning and deep learning techniques in obesity research includes risk prediction, early detection, and individualization of treatment plans (Azmi et al., 2025).

Digital Behavioral Phenotyping

A groundbreaking study demonstrated the use of machine learning to identify digital behavioral phenotypes that predict engagement and health outcomes in obesity interventions. The research found that 16 types of digital phenotypes, including lower intake of high-calorie food and evening snacks and higher interaction frequency with mentors, predicted engagement rates with a mean R^2 of 0.416. For weight change prediction, 13 different digital phenotypes were associated with short-term outcomes (mean R^2 0.382), while 8 measures predicted long-term weight change (mean R^2 0.590) (Kim et al., 2021).

Personalized Treatment Approaches

AI has facilitated the development of personalized obesity management strategies. Machine learning techniques have shown considerable efficacy in

augmenting current therapeutic and preventive approaches for childhood obesity. The intersection of AI with conventional obesity management practices presents a novel approach to fortify interventions targeting pediatric obesity (Alghalyini, 2023).

Digital therapeutics (DTx) powered by AI technologies offer dynamic visual representations of weight loss journeys and provide platforms for real-time progress monitoring. These interventions have received high scores in terms of usability, effectiveness, predictiveness, personalization, user satisfaction, and continuous usage adherence (Kim et al., 2021).

AI Applications in Mental Health Diagnosis and Treatment

Early Detection and Screening

AI technologies have revolutionized mental health screening and early detection capabilities. Machine learning algorithms can evaluate extensive volumes of data, including social media posts and voice patterns, to detect patterns and symptoms associated with mental illness. This facilitates the implementation of more focused interventions and individualized treatment strategies (Shimada, 2023).

Sophisticated AI systems can analyze behavioral or mental health insights extracted from an individual's "digital exhaust" - data obtained from personal digital devices and social media activities. Natural language processing techniques enable the statistical use of language as data to infer mental health status (Kiruthika et al., 2024).

Diagnostic Support Systems

AI has shown significant promise in mental health diagnosis through machine learning algorithms trained with extensive datasets that enable accurate and efficient classification and diagnosis of different mental health conditions. These systems can analyze patient information, past medical results, and evidence-based guidelines to recommend personalized treatments. Recent developments include AI-powered conversational agents and chatbots designed to provide initial assessment, psychoeducation, and treatment, thereby expanding access to mental health services(Mittal et al., 2023). These tools offer round-the-clock assistance to individuals experiencing acute distress or provide access to therapy when waiting lists are extensive (Shimada, 2023).

Predictive Analytics for Mental Health

AI applications have demonstrated utility in assessing risk and predicting cognitive decline in patients with comorbid conditions. Research has shown that AI and ML techniques can identify key risk factors and predictive biomarkers, paving the way for tailored prevention strategies and treatment plans(Veneziani et al., 2024). Machine learning approaches have been successfully applied to predict various mental health outcomes, including depression risk in specific populations (Zhang et al., 2025).

Integration of AI in Digital Health Interventions

Mobile Health Applications

AI-enhanced mobile health applications have become increasingly sophisticated in delivering personalized interventions. These applications leverage machine learning algorithms to deliver customized content and adapt to user behavior patterns. The integration of behavioral economics principles, such as nudges and prompts, with AI systems has shown promise in enhancing user engagement with digital mental health interventions (Van Mierlo et al., 2025).

Wearable Technology Integration

AI programs continue to advance care and management through integration with wearable devices equipped with sensors that collect physical and behavioral data in real-time. Intelligent algorithms analyze this data to detect early signs of relapse or deterioration, allowing for timely intervention and personalized care that ultimately improves patient outcomes (Mittal et al., 2023).

Virtual Reality and Augmented Reality

Technologies such as virtual reality (VR) and augmented reality (AR) combined with artificial intelligence are collaborating to provide innovative treatment approaches and improve patient experience (Mittal et al., 2023). These immersive technologies offer new possibilities for therapeutic interventions in both obesity and mental health contexts.

Current Challenges and Limitations

Data Quality and Technical Issues

Despite the promising potential of AI in healthcare, several challenges persist. Data quality remains a significant concern, as AI models vary in effectiveness based on dataset type, research goals, and model interpretability. Technical requirements and the need for high-quality, representative datasets pose ongoing challenges for implementation (Azmi et al., 2025).

Ethical Considerations

Ethical issues are of utmost importance in the application of AI in healthcare. Key concerns include privacy, bias, and accurate diagnosis. The incorporation of ethical considerations throughout the use of AI in mental healthcare is essential for

successful integration (Shimada, 2023). Issues such as data privacy and equitable access for all populations require careful attention (Veneziani et al., 2024).

Clinical Integration Challenges

The translation of AI research into clinical practice faces several barriers. Healthcare professionals need training and support to effectively integrate AI tools into their workflows. Additionally, regulatory frameworks and validation processes for AI-based healthcare interventions require further development (Welchen et al., 2024).

Future Directions and Emerging Trends

Explainable AI

The development of explainable AI is crucial for facilitating acceptance by healthcare professionals(Welchen et al., 2024). Future research should focus on creating AI systems that provide transparent, interpretable results that clinicians can understand and trust.

Multimodal AI Systems

Emerging trends include the development of multimodal AI models that can integrate multiple types of data sources simultaneously (Azmi et al., 2025). These systems show promise for providing more comprehensive and accurate assessments of both obesity and mental health conditions.

Precision Healthcare

AI offers promising advancements in obesity and mental health management, enabling more personalized and efficient care (Azmi et al., 2025). The shift toward precision healthcare, supported by AI technologies, represents a significant opportunity to improve outcomes for individuals with these complex conditions.

Evidence of Effectiveness from Clinical Studies

Clinical Trial Results

Several clinical studies have demonstrated the effectiveness of AI-driven interventions. A randomized controlled trial examining digital cognitive behavioral therapy for obesity found that higher engagement rates were associated with greater weight loss at both 8 weeks ($r=-0.59$; $P<.001$) and 24 weeks ($r=-0.52$; $P=.001$) (Kim et al., 2021).

Machine learning analysis successfully identified important characteristics that predicted both engagement and health outcomes, with lower self-esteem on conventional phenotypes and higher in-app motivational measures on digital phenotypes commonly accounting for both engagement and health outcomes (Kim et al., 2021).

Systematic Review Evidence

Systematic reviews have provided evidence supporting the utility of AI and ML in assessing risk and predicting outcomes in various health conditions. The findings underscore the potential for early detection, prevention, and personalized interventions facilitated by these technologies to significantly reduce costs and time (Veneziani et al., 2024).

Research comparing AI models with conventional statistical approaches found that the majority (82%) of studies showed that AI models achieved higher prediction accuracy on test data. However, some studies revealed mixed results, indicating the high contingency of model performance on the specific dataset and task (Alghalyini, 2023).

Conclusion

The evidence demonstrates several key strengths of AI applications in obesity and mental health. Multiple studies show AI models consistently outperforming traditional approaches in prediction tasks. AI enables highly individualized interventions based on digital behavioral phenotypes. Digital AI-powered interventions can reach large populations with minimal human resources. Continuous data collection and analysis enable proactive intervention strategies.

Limitations

Several limitations must be acknowledged. Noteworthy variation in methodologies, populations, and outcome measures across studies. Most studies focus on short-term outcomes with limited follow-up periods. There are limited evidences available on actual implementation and sustainability of AI interventions. Concerns about algorithmic bias and generalizability across diverse populations.

Implications

Practical Applications

Current AI applications demonstrate practical utility across multiple domains: AI systems assist healthcare providers in identifying high-risk patients and recommending personalized treatment approaches. Mobile applications with AI capabilities help individuals monitor their progress and receive personalized feedback. AI enables large-scale screening and risk stratification for public health interventions.

Theoretical Implications

The integration of AI in obesity and mental health care represents a paradigm shift toward moving from intuition-based to evidence-based, algorithmically-informed clinical decisions. Emphasis on early detection and prevention rather

than reactive treatment. Highly personalized interventions tailored to individual characteristics and preferences.

Future Research Directions

Priority areas for future research include Long-term effectiveness and sustainability of AI interventions. Strategies for successful integration into healthcare systems. Development of comprehensive ethical guidelines for AI in healthcare. Ensuring AI benefits reach underserved and marginalized populations. The convergence of AI with obesity and mental health care offers unprecedented opportunities to transform healthcare delivery, but realizing this potential requires continued research, careful implementation, and ongoing attention to ethical considerations.

References

1. Alghalyini, B. (2023). Applications of artificial intelligence in the management of childhood obesity. *Journal of Family Medicine and Primary Care*, *12*(11), 2558–2564. https://doi.org/10.4103/jfmpc.jfmpc_469_23
2. Azmi, S., Kunnathodi, F., Alotaibi, H. F., Alhazzani, W., Mustafa, M., Ahmad, I., Anvarbatcha, R., Lytras, M. D., & Arafat, A. A. (2025). Harnessing Artificial Intelligence in Obesity Research and Management: A Comprehensive Review. *Diagnostics*, *15*(3), 396. https://doi.org/10.3390/diagnostics15030396
3. Hinchliffe, N., Capehorn, M. S., Bewick, M., & Feenie, J. (2022). The Potential Role of Digital Health in Obesity Care. *Advances in Therapy*, *39*(10), 4397–4412. https://doi.org/10.1007/s12325-022-02265-4
4. Kim, M., Yang, J., Ahn, W.-Y., & Choi, H. J. (2021). Machine Learning Analysis to Identify Digital Behavioral Phenotypes for Engagement and Health Outcome Efficacy of an mHealth Intervention for Obesity: Randomized Controlled Trial. *Journal of Medical Internet Research*, *23*(6), e27218. https://doi.org/10.2196/27218
5. Kiruthika, R., Ajay, R., Balakrishnan, P., & Giridharan, S. (2024). AI CHATBOT FOR MENTAL HEALTH. *ShodhKosh: Journal of Visual and Performing Arts*, *5*(5). https://doi.org/10.29121/shodhkosh.v5.i5.2024.2853
6. Mittal, A., Dumka, L., & Mohan, L. (2023). A Comprehensive Review on the Use of Artificial Intelligence in Mental Health Care. *2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, 1–5. https://doi.org/10.1109/ICCCNT56998.2023.10308255
7. Shimada, K. (2023). The Role of Artificial Intelligence in Mental Health: A Review. *Science Insights*, *43*(5), 1119–1127. https://doi.org/10.15354/si.23.re820
8. Van Mierlo, T., Fournier, R., Kit Yeung, S., & Lahutina, S. (2025). Developing a Behavioral Phenotyping Layer for Artificial Intelligence–Driven Predictive Analytics in a Digital Resiliency Course: Protocol for a Randomized Controlled Trial. *JMIR Research Protocols*, *14*, e73773. https://doi.org/10.2196/73773
9. Veneziani, I., Grimaldi, A., Marra, A., Morini, E., Culicetto, L., Marino, S., Quartarone, A., & Maresca, G. (2024). Towards a Deeper Understanding: Utilizing Machine Learning to Investigate the Association between Obesity and Cognitive Decline—A Systematic Review. *Journal of Clinical Medicine*, *13*(8), 2307. https://doi.org/10.3390/jcm13082307
10. Welchen, V., Fachinelli, A. C., & De Avila E Silva, S. (2024). Aplicação de Inteligência Artificial na Predição da Obesidade Adulta: Inovações e Desafios no Setor de Saúde. *Navus - Revista de Gestão e Tecnologia*, 1–14. https://doi.org/10.22279/navus.v15.2019
11. Zhang, Z., Chen, H., Ye, Y., Chen, H., Guo, H., & Zhou, J. (2025). Entropy-based risk network identification in adolescent self-injurious behavior using machine learning and network analysis. *Translational Psychiatry*, *15*(1), 299. https://doi.org/10.1038/s41398-025-03511-3