



Article Type: Review Article

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN CHILDHOOD OBESITY PREVENTION: A REVIEW

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ABSTRACT

Childhood obesity is a major global public health concern, with serious short- and long-term health repercussions. Conventional obesity prevention programs may have limited ability to identify children at risk and provide ongoing, personalised care. Artificial intelligence (AI), particularly machine learning (ML), provides new prospects to improve obesity prevention through risk prediction, personalised lifestyle treatments, continuous monitoring, and population-wide health surveillance. AI-based models can use demographic, anthropometric, behavioural, nutritional, clinical, and environmental data to identify children who are more likely to become obese. AI-enabled mobile health applications, chatbots, wearable devices, and digital coaching platforms may help with dietary tracking, physical activity, goal setting, and behaviour change. At the population level, AI can help analyse massive health databases to detect risk patterns and influence prevention programs in schools and communities. However, the evidence is still mixed, and various barriers to widespread implementation exist, including data quality, algorithmic bias, privacy and security issues, little external validation, digital disparities, and uncertainty about long-term effectiveness and sustainability. As a result, AI is a prospective complement to existing paediatric obesity prevention efforts rather than a replacement for established public health and clinical practices. Future research should focus on strong external validation, diverse paediatric demographics, long-term evaluation, and equitable implementation to evaluate whether AI-enabled interventions can provide long-term gains in paediatric obesity prevention.

Keywords - Artificial intelligence; Machine learning; Childhood obesity; Obesity prevention; Digital health; Personalised intervention; Wearable technology

INTRODUCTION

Childhood obesity has reached epidemic proportions worldwide, leading to significant health and economic burdens. Despite extensive efforts to curb this issue, conventional methods often lack precision and sustainability.

Artificial intelligence (AI) is a discipline within computer science that employs algorithms to develop systems capable of carrying out tasks that typically require human intelligence, such as decision-making, visual recognition, and language processing ^[1-2] and presents a promising avenue to enhance obesity prevention through real-time monitoring, personalized recommendations, and behavior modification strategies.

AI has become increasingly valuable in healthcare, particularly in managing chronic conditions and preventing diseases. It enhances patient satisfaction by making care more efficient, informative, and accessible, as well as streamlining follow-ups. Since the COVID-19 pandemic, the adoption of AI-driven technologies like telemedicine and chatbots has grown rapidly ^[3].

Machine learning (ML), a subset of AI, enables computational systems to identify patterns and relationships within data and use these patterns to generate predictions or classifications. ML approaches may be particularly useful in childhood obesity prevention because obesity risk is influenced by multiple interacting factors, including anthropometric characteristics, dietary behaviours, physical activity, sleep, family history and environmental factors. Depending on the available data and research objective, supervised and unsupervised learning approaches can be used for risk prediction, classification and identification of patterns associated with obesity development ^[4,5].

Deep learning is a further subset of ML that uses multilayered neural networks to learn complex patterns from large and often high-dimensional datasets. Different deep-learning architectures, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have potential applications in obesity-related research. CNN-based approaches may support image-based dietary assessment and recognition of food-related information, while RNN-based approaches can analyse longitudinal or sequential data such as physical activity, dietary behaviour and other health-related measurements ^[6,7,10,11].

The increasing availability of electronic health records, wearable devices, mobile health applications and other digital data sources has created new opportunities for applying AI to childhood obesity prevention. These technologies may facilitate early identification of children at increased risk, personalised lifestyle recommendations, monitoring of physical activity and dietary behaviours, and behavioural support. ^[7,8,11] However, the effectiveness and generalisability of these applications depend on the quality and representativeness of the underlying data, appropriate model validation, privacy protection and equitable access to digital technologies. ^[11,12] Figure 1 provides a conceptual overview of the potential role of AI in childhood obesity prevention, illustrating the relationship between available data sources, AI/ML approaches, potential applications, implementation settings, expected outcomes, and ethical safeguards. Hence, this review examines the current applications of AI in childhood obesity prevention, with particular emphasis on risk prediction, personalized interventions, behavioral modification, monitoring and emerging public-health applications.

Applications of AI in Childhood Obesity Prevention

Artificial intelligence (AI) has emerging applications in childhood obesity prevention, particularly in early risk identification, personalised interventions, behavioural support, and continuous monitoring. AI-driven models can integrate multiple factors, including anthropometric, behavioural, dietary, family, and environmental characteristics, to identify children who may be at increased risk of obesity. Machine learning (ML) algorithms have been explored for predicting obesity risk using variables such as body mass index (BMI), physical activity, dietary patterns, and family history. Such approaches may support earlier identification

of high-risk children and facilitate targeted preventive strategies. ^[6-8] The major applications of AI in childhood obesity prevention, together with their potential uses and key considerations, are summarised in Table 1.

One potential application of AI is personalised nutrition and dietary support. AI-based systems can analyse information related to dietary intake, nutritional requirements, individual preferences, and lifestyle patterns to generate personalised recommendations. Image-based dietary assessment may also assist in estimating food intake and identifying dietary patterns. ^[9,10] AI-enabled chatbots and virtual assistants may provide automated feedback and reminders, although their effectiveness in producing sustained behavioural change among children requires further evaluation. ^[7,11]

AI can also support the monitoring of physical activity and lifestyle behaviours through mobile health applications and wearable technologies. These technologies can collect information on parameters such as physical activity, movement patterns, heart rate, sleep, and other behavioural indicators. AI algorithms may subsequently analyse these data to provide feedback, identify behavioral patterns, and support personalised goal setting. Gamification and interactive features may further encourage engagement with physical activity interventions, although sustained adherence and the accuracy of device-derived measurements remain important considerations. ^[11,12]

At the population and public-health level, AI can analyse large datasets to identify patterns and population groups at increased risk of obesity. Such analyses may support the planning and targeting of school- and community-based prevention programmes. AI may also contribute to dietary surveillance and the analysis of population-level behavioural and health data, potentially supporting more targeted public-health decision-making. However, the usefulness of these applications depends on the quality, completeness, representativeness, and governance of the underlying data. ^[7,11,12]

Another emerging application is synthetic data generation; whereby artificial datasets are generated to reproduce selected characteristics of real-world health data. Synthetic data may facilitate the development and testing of AI models while potentially reducing some privacy concerns associated with the use of identifiable health information. However, synthetic datasets may not fully reproduce the complexity, and biases present in real-world populations and therefore require appropriate validation before being used for clinical or public-health decision-making.

AI-based approaches have also been investigated for risk prediction among children and adolescents using combinations of anthropometric and behavioural variables. Such models may offer opportunities for early risk stratification and targeted prevention. ^[6,8] Nevertheless, high predictive performance within a particular study population does not necessarily indicate that a model will perform similarly in other populations. External validation, assessment of algorithmic bias, and evaluation across diverse socioeconomic, cultural, and geographic settings are therefore important before widespread implementation. ^[6,8,11]

Overall, AI may complement existing approaches to childhood obesity prevention by supporting risk stratification, personalised lifestyle guidance, behavioural monitoring, and population-level planning. However, current applications should be interpreted considering limitations related to data quality, privacy, algorithmic bias, digital accessibility, user engagement, and limited evidence regarding long-term effectiveness. Further research is required to determine how AI can be integrated effectively and equitably into established family-, school-, community-, and healthcare-based obesity prevention strategies. ^[11,12]

Table 1. Applications of artificial intelligence in childhood obesity prevention: potential uses and key limitations.

AI application	Data sources	Potential application	Potential benefit	Key limitations
Risk prediction	BMI, anthropometry, EHR, family history, behavioural data	Identify children at increased risk	Earlier targeted prevention	Limited external validation
Personalised nutrition	Dietary records, food images, preferences	Tailored dietary recommendations	Individualised guidance	Portion/food recognition errors
Physical activity monitoring	Wearables, smartphones	Monitor activity and sedentary behaviour	Continuous feedback	Device accuracy/adherence
Behavioural support	Lifestyle and engagement data	Coaching, reminders, goal setting	Ongoing support	Long-term engagement uncertain
Digital dietary assessment	Meal photographs	Food recognition/nutrient estimation	Reduced reporting burden	Variable accuracy
Population surveillance	EHR/epidemiological data	Identify population-level risk	Targeted public-health planning	Data representativeness
Synthetic data	Health datasets	Model development/testing	Potential privacy protection	May not reproduce real-world complexity

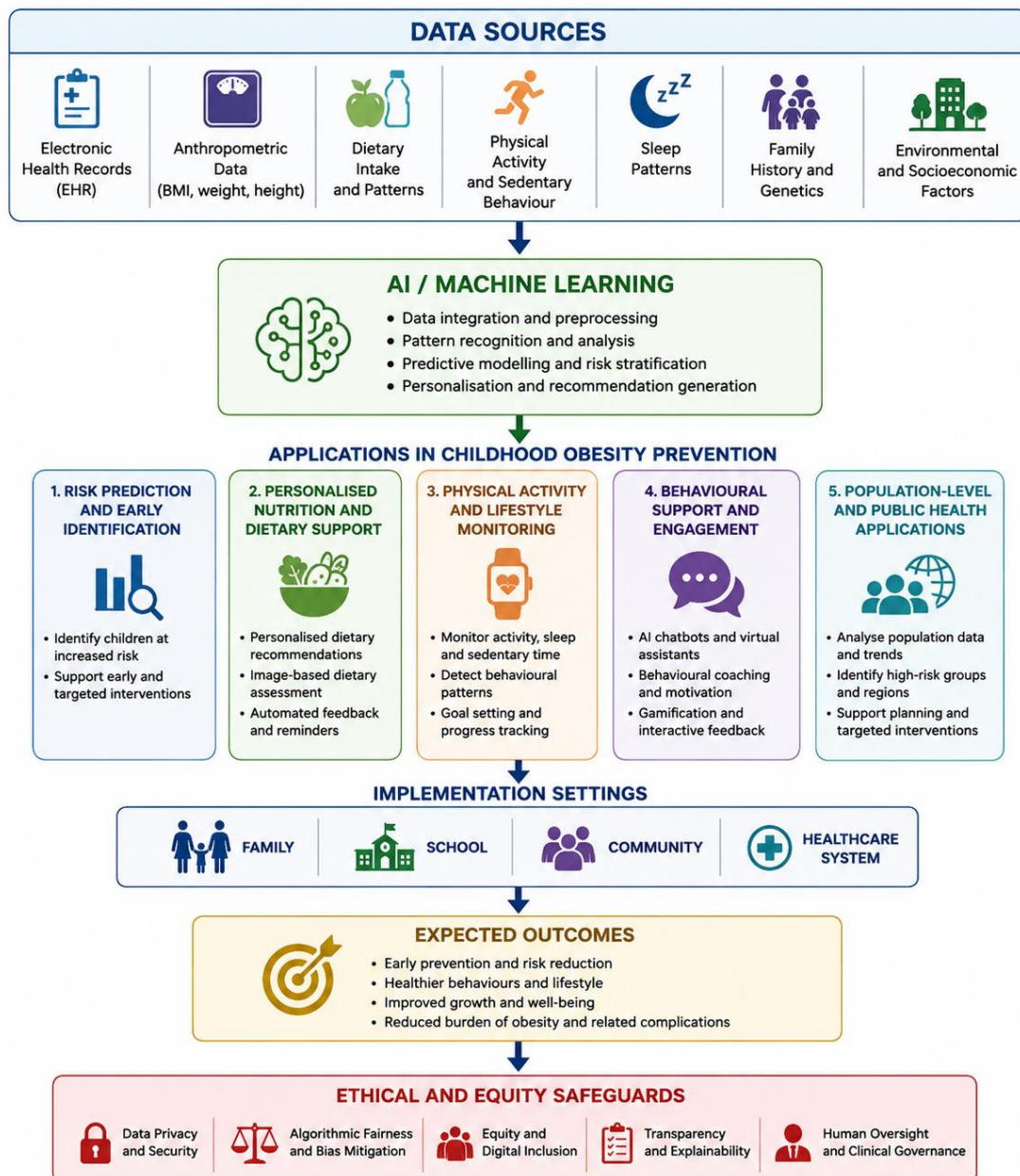


Figure 1: Conceptual framework illustrating the potential role of artificial intelligence in childhood obesity prevention.

AI-Enabled Digital Health Technologies in Childhood Obesity Prevention

AI-enabled mobile health (mHealth) applications and wearable technologies provide opportunities for continuous monitoring and personalised support in childhood obesity prevention. These technologies can collect information on physical activity, sleep, dietary behaviours, body weight and other health-related indicators, which can subsequently be analysed using AI or machine-learning approaches. Such information may support personalised feedback, goal setting, activity reminders and behavioural coaching. However, the effectiveness of these technologies depends on sustained user engagement, the quality of the collected data and the accuracy of the algorithms used to generate recommendations.^[11-12] mHealth applications can support monitoring of dietary and physical activity behaviours and may provide personalised recommendations based on individual characteristics and behavioural patterns.^[7,11] AI-enabled chatbots and virtual assistants can additionally provide automated feedback and reminders and may facilitate ongoing engagement outside conventional healthcare settings. Image-recognition approaches have also been explored for dietary assessment, potentially allowing users to document meals through photographs and

facilitating estimation of food composition or dietary patterns.[9,10] Nevertheless, automated dietary assessment may be affected by difficulties in accurately identifying foods, portion sizes and preparation methods, and therefore should not be assumed to provide completely accurate nutritional estimates. [9,10]

Wearable devices, including activity trackers and smartwatches, can provide continuous or repeated measurements of physical activity, sleep and other physiological parameters. In the context of obesity prevention, these data may be used to identify patterns of sedentary behaviour, monitor activity levels and provide feedback to encourage healthier behaviours. Gamification, including activity challenges, goal-based rewards and interactive feedback, may further support engagement among children and adolescents. However, evidence regarding sustained behavioural change from wearable-based interventions remains variable, and device-derived measurements may differ from directly measured clinical or physiological parameters. [11,12]

At the population level, aggregated information from digital health technologies may potentially contribute to the identification of behavioural patterns and population groups at increased risk of obesity. AI-based analysis of epidemiological and health datasets may support the planning of targeted school- and community-based interventions and assist policymakers in identifying areas requiring additional preventive resources. However, the representativeness of digitally generated data is an important consideration because populations with limited access to smartphones, wearable devices or reliable internet connectivity may be underrepresented. [7,11,12]

AI may also contribute to the assessment of psychosocial and behavioural factors associated with obesity. Digital systems can potentially identify patterns in eating behaviour, physical activity, sleep and engagement with health interventions and use these patterns to provide tailored behavioural support. Such approaches may complement, rather than replace, established family-, school- and community-based interventions.

Another emerging application is synthetic data generation, which involves creating artificial datasets that reproduce selected characteristics of real-world health data. Synthetic datasets may facilitate the development and testing of AI models while reducing the direct use of identifiable health information. However, synthetic data may not completely reproduce the complexity, variability or biases present in real-world populations and therefore require careful validation before being used for clinical or public-health decision-making. [11,12]

Despite their potential, AI-enabled mHealth and wearable technologies present several challenges. These include data privacy and security, algorithmic bias, measurement accuracy, digital inequity, limited interoperability, user engagement and uncertainty regarding long-term effectiveness. These concerns are particularly important in children because health-related data may involve sensitive information and require appropriate parental consent and safeguards. Therefore, the integration of AI-enabled digital technologies into childhood obesity prevention should be accompanied by appropriate clinical oversight, transparent data governance and evaluation of effectiveness across diverse populations.

Use of AI in Obesity Prevention in India

AI-enabled technologies are increasingly being explored in India for health monitoring, lifestyle modification and personalised health support. Mobile health applications, wearable devices and digital healthcare platforms provide opportunities to collect and analyse information related to physical activity, dietary behaviours, body weight and other health-related characteristics. In the context of obesity prevention, these technologies may support early identification of individuals at increased risk, personalised lifestyle recommendations and behavioural monitoring. However, evidence specifically evaluating the effectiveness of AI-based interventions for childhood obesity prevention in India remains limited, and further research is required to establish their effectiveness and feasibility across diverse populations.

AI-Driven Public Health Initiatives and Policy Support

India's expanding digital health infrastructure provides opportunities for incorporating AI into preventive healthcare and population-level health programmes. Initiatives such as the Ayushman Bharat Digital Mission (ABDM) are developing interoperable digital health infrastructure that may facilitate the use of data-driven technologies in healthcare. However, the existence of digital health infrastructure should not be interpreted as evidence that AI-based childhood obesity prevention programmes have already been widely implemented through these initiatives.

AI may potentially support school- and community-based obesity prevention by analysing anthropometric, behavioural and lifestyle information to identify children who may benefit from early preventive interventions. Similarly, digital platforms and telehealth services may provide opportunities to extend lifestyle counselling and health education to populations with limited access to conventional healthcare services. Nevertheless, the effectiveness, accessibility and acceptability of such approaches require evaluation in real-world Indian settings.

Social Robotics and AI-Assisted Behavior Change

Social robotics represents an emerging area of AI-assisted health promotion. Interactive AI-enabled systems have been explored in healthcare and education to provide information, encouragement and behavioural support. In childhood obesity prevention, such technologies could potentially be used to deliver interactive health education, encourage physical activity and support engagement through gamification. However, evidence regarding the effectiveness and feasibility of social robotics specifically for childhood obesity prevention in India remains limited. Therefore, these approaches should currently be regarded as emerging possibilities rather than established public-health interventions.

Challenges and Future Prospects

The application of AI to obesity prevention in India presents several challenges, including data privacy and security, affordability, digital accessibility, digital literacy, algorithmic bias and unequal access to digital technologies. These challenges are particularly relevant in childhood obesity prevention because Indian children and families differ substantially in socioeconomic circumstances, dietary practices, physical activity patterns, cultural contexts and access to healthcare and digital infrastructure. AI models developed using limited or non-representative datasets may therefore have reduced applicability to different population groups.

Future AI-based obesity prevention strategies in India should prioritise locally relevant and representative datasets, external validation, transparent algorithms, appropriate data governance and equitable access. Collaboration among public health professionals, healthcare providers, researchers, technology developers and policymakers will be necessary to ensure that AI complements established family-, school- and community-based approaches. Rather than replacing conventional prevention strategies, AI should be evaluated as a tool that may enhance risk identification, personalisation, monitoring and delivery of preventive interventions.

CONCLUSION

Artificial intelligence represents a promising adjunct to existing childhood obesity prevention strategies, particularly for risk stratification, personalised lifestyle support, behavioural monitoring and population-level health planning. AI-enabled dietary assessment, physical activity monitoring, predictive models and digital interventions may complement established family-, school-, community- and healthcare-based approaches. However, the available

evidence remains heterogeneous, and important challenges related to data quality, algorithmic bias, privacy, digital inequity, external validation and long-term effectiveness remain. Future research should focus on validating AI models across diverse paediatric populations, evaluating their long-term effectiveness and sustainability, and ensuring that AI-enabled interventions are implemented equitably and with appropriate clinical and ethical oversight.

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