INTEGRATING ARTIFICIAL INTELLIGENCE IN COMBATING CHILDHOOD OBESITY FROM POLICY IMPLEMENTATION TO PRACTICE

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Abstract
Childhood obesity is an escalating global health crisis that affects the physical, emotional, and economic well-being of individuals and societies. This paper explores the journey from policy development to effective implementation in combating childhood obesity, with a critical focus on the emerging role of Artificial Intelligence (AI) in enhancing strategic interventions. By analyzing existing research, the paper examines the root causes of obesity in children, evaluates key policies and implementation strategies, and identifies persistent gaps in translating policy into practice. The integration of AI tools, such as predictive analytics, personalized health monitoring, and data-driven school nutrition planning, is presented as a promising innovation to strengthen prevention and intervention efforts. The paper concludes with actionable recommendations to improve policy effectiveness through cross-sector collaboration among policymakers, schools, healthcare providers, technology developers, and families. The goal is to foster a digitally informed, supportive environment that enables sustainable, evidence-based solutions for childhood obesity prevention.

Keywords: Childhood obesity, Policy implementation, Artificial intelligence, Publichealth, Preventive strategies

Introduction

Childhood obesity has emerged as a critical global health issue, affecting over 340 million children and adolescents as of 2022 (World Health Organization [WHO], 2023). It represents one of the most complex and urgent public health challenges of our time (Makinde & Waziri, 2025) and contributes to a cascade of negative health outcomes, including type 2 diabetes, cardiovascular diseases, orthopaedic complications, and mental health disorders such as anxiety and depression. The consequences are not only clinical but also economic, as obesity in early life significantly increases long-term healthcare costs and reduces productivity into adulthood (Swinburn et al., 2023).

In Nigeria and other low- and middle-income countries, the rise in childhood obesity is particularly concerning, given the coexistence of undernutrition and rapid urbanization, which have contributed to a shift toward high-calorie, low-nutrient diets and sedentary behaviours (Abubakar et al., 2022). The obesity epidemic is intensifying alongside urbanization, dietary transition, and reduced physical activity, particularly in cities like Lagos and Abuja. Multiple studies show that children are increasingly exposed to high-calorie, low-nutrient foods due to aggressive food marketing, absence of nutrition education, and declining family-based meal structures (Ajayi et al., 2023; Boyland,

McGale &Maden 2022; Dunford, Popkin & Ng, 2023). Despite several policy responses, including the National School Health Policy and the National Strategic Plan of Action on Nutrition, implementation remains weak due to funding constraints, poor coordination, and lack of real-time data (Bello & Akinyemi, 2022).

Against this backdrop, Artificial Intelligence (AI) offers a potentially transformative pathway to strengthen the planning, monitoring, and delivery of obesity prevention programmes. AI technologies, ranging from machine learning to predictive analytics, can enable more responsive and targeted interventions. This review synthesizes available evidence on the causes of childhood obesity, analyses policy efforts in Nigeria, and explores how AI can be integrated to bridge the implementation gap and deliver sustainable, equitable health outcomes.

Despite the growing awareness and formulation of public health policies targeting childhood obesity, the global prevalence continues to rise at an alarming rate, particularly in low- and middle-income countries like Nigeria. Childhood obesity not only threatens the immediate health and psychosocial well-being of children but also increases the risk of chronic diseases such as diabetes, cardiovascular disorders, and certain cancers later in life (WHO, 2023). Nigeria, in particular, is experiencing a nutritional shift where high-calorie, low-nutrient foods have become common, especially in urban areas, compounding the burden on a public health system already strained by undernutrition and infectious diseases (Abubakar et al., 2022).

Although policies addressing childhood obesity exist, ranging from national school feeding programmes and physical education mandates to nutrition labelling regulations, their implementation has been inconsistent and poorly monitored. Factors such as weak institutional capacity, inadequate funding, and lack of data driven accountability, have led to a significant gap between policy intent and practical outcomes (Adewale & Ugochukwu, 2021). Many schools and health centres lack the infrastructure to track obesity risk factors or measure the effectiveness of interventions over time.

In light of these challenges, Artificial Intelligence (AI) presents a promising yet underutilized solution. AI can be applied to monitor children's dietary patterns, predict obesity risk based on health and lifestyle data, and support targeted, real-time interventions. Globally, AI has been successfully used in various health domains to improve early detection, personalize care, and optimize resource allocation (Patel et al., 2023; Rajpurkar, Chen, Banerjee & Topol, 2023). However, its integration into obesity policy implementation frameworks in Nigeria remains minimal, largely due to limited technical capacity, policy inertia, and lack of awareness among stakeholders.

The failure to incorporate innovative, data-driven tools such as AI in the execution of obesity policies hinders the realization of long-term public health goals. Therefore, there is an urgent need to explore how AI technologies can bridge the gap between childhood obesity policy and practice, enabling more sustainable, scalable, and effective interventions tailored to Nigeria's unique context.

This paper is anchored on the Social Ecological Model (SEM) and the Diffusion of Innovations Theory (DOI). The Social Ecological Model recognizes that childhood obesity

is influenced by multiple interacting factors at the individual, family, school, community, and policy levels. Effective interventions therefore require coordinated actions across these levels. The Diffusion of Innovations Theory explains how new technologies, including artificial intelligence applications, are adopted and integrated into health systems. Together, these frameworks provide a foundation for understanding how AI-enabled interventions can support policy implementation, improve early detection of obesity risk, facilitate personalized health education, and strengthen behavioural change strategies among children and their families.

Childhood obesity is defined by excessive fat accumulation that impairs a child's physical and psychological well-being. It results from complex interactions among genetic, behavioural, environmental, and socio-economic factors. Globally, childhood obesity is a grave public health concern which often leads to life threatening health disorders such as increase risk of hypertension, high serum cholesterol level, cardiac issues, fatty liver disorders, breathing difficulty, sleep apnea and bronchial asthma (Umekar& Joshi, 2024; WHO, 2023; Makinde, 2013). Umekar& Joshi (2024) described childhood obesity as being caused by a complex combination of environmental, genetic, and behavioural variables which leads to extensive repercussions, elevating the risk of chronic conditions, such as diabetes, cardiovascular diseases and mental health challenges. WHO (2023) identified poor diet, insufficient physical activity, and sedentary behaviour often exacerbated by digital screen time as major contributors.Adeomi et al. (2022) in their study titled "Double burden of malnutrition among school-aged children and adolescents: evidence from a community-based cross-sectional survey in two Nigerian States" found out that a double burden exists. Urban children had significantly higher odds of overweight/obesity, $p<0.001$. The study points to nutrition factors: urbanization, higher SES, and changing food environments driving overweight/obesity, while poverty and food insecurity are responsible for undernutrition in the same communities.

In Nigeria, childhood obesity rates have doubled in the last decade, particularly in private school settings where Western-style diets dominate (Oluwayemi et al. 2024; Adeomi et al. 2022). The National Demographic and Health Survey (NDHS, 2021) highlights that children from wealthier households are disproportionately affected, suggesting a strong socioeconomic gradient. Cultural perceptions that associate larger body sizes with wealth and health also hinder early intervention (Okeke & Olanrewaju, 2023).

Policy Interventions for Childhood Obesity

Several policy instruments have been introduced to address the obesity crisis. These include:

i. National School Health Policy (2006)
ii. National Strategic Plan of Action for Nutrition (2014–2019)
iii. The 2021 National Food and Nutrition Policy

However, studies indicate a lack of implementation fidelity. For example, only 38% of public schools have functional health units, and less than 25% of school administrators

are trained on nutritional monitoring (Bello & Akinyemi, 2022). Also, the 2006 National School Health Policy established a framework for health promotion, stakeholders have since noted gaps in addressing emerging health challenges, including those related to nutrition and physical activity among school children (FME, 2006). Furthermore, implementation gaps remain regarding non – communicable disease prevention, including childhood obesity. The 2014 – 2019 National Strategic Plan of Action for Nutrition formally recognized the double burden of malnutrition in Nigeria and set a lifespan approach to improving nutritional status, providing the policy basis for interventions targeting childhood overweight and obesity through school health, behaviour change and multisectoral action (FMH, 2014). The 2021 National Food and Nutrition Policy mark a shift from earlier policies by explicitly targeting the double burden of malnutrition. It commits to 'preventing and mitigating the rise of overweight, obesity, and diet-related NCDs' and lists childhood overweight as a global nutrition target, providing a clear policy mandate for school and community interventions' (FMBNP, 2021).

By 2026, the Nigerian Government pledges comprehensive alignment across all sectors to synergistically address both ends of the spectrum: combating undernutrition (wasting, stunting, micronutrient deficiencies) as well as simultaneously preventing and mitigating the rise of overweight, obesity, and diet-related non-communicable diseases (FMBNP, 2021). Globally, successful obesity policies involve multi-sector collaboration, taxation on sugary beverages, and mandatory physical education, as seen in countries like Chile and the UK (Swinburn et al., 2023; UNICEF, 2022).

Artificial Intelligence is increasingly transforming health systems by improving disease surveillance, personalizing interventions, and automating diagnostics. In childhood obesity, AI can:

i. Monitor weight and behaviour patterns through wearable sensors
ii. Analyze electronic health records to identify risk early
iii. Use data and statistical algorithms to make predictions about future outcomes
iv. Deliver customized health tips via mobile apps
v. Support policymakers with real-time dashboards on programme performance

For instance, AI-powered platforms like *Kurbo* (used in the U.S.) track children's food intake and activity to provide live coaching (Chowdhury et al., 2022). In India, the *Arogya Setu* platform integrates AI to identify areas with poor nutrition metrics. These examples demonstrate the feasibility of adopting AI-driven health technologies in low-resource settings.

Despite AI's potential, adoption in Nigeria's public health system remains limited due to:

i. Poor digital infrastructure, especially in rural areas
ii. Fragmented health data systems with limited interoperability
iii. Lack of AI literacy among health and education professionals
iv. Absence of policies mandating tech integration in school health

Moreover, ethical concerns about privacy, data ownership, and child protection are often neglected in public discourse (Adeleke et al., 2022). Without addressing these issues, AI interventions risk excluding the most vulnerable populations and reinforcing existing inequities.

Integrating AI into Nigeria's childhood obesity policies requires:

i. Developing a national digital health strategy that includes child nutrition
ii. Partnering with EdTech and HealthTech firms to design school-based tools
iii. Training teachers and community health workers on digital surveillance and intervention platforms
iv. Ensuring equity by designing low-bandwidth, mobile-based solutions suitable for underserved communities

Government leadership, supported by NGOs and international agencies, is critical to scale and sustain these efforts. AI integration should complement, not replace, traditional nutrition programmes, with a strong emphasis on transparency, ethics, and local relevance.

The study answered the following questions:

1. What factors contribute to the growing prevalence of childhood obesity?
2. How effective are existing policies and interventions in addressing childhood obesity?
3. What role can artificial intelligence play in the prevention and management of childhood obesity?
4. What challenges hinder the integration of artificial intelligence into childhood obesity interventions?
5. What strategies can enhance the implementation of AI-driven obesity prevention programmes?

Methodology

This study adopted a narrative literature review approach. Relevant literature was sourced from peer-reviewed journals, books, conference proceedings, policy reports, and publications from international organizations like:

i. Peer-reviewed studies (2020-2024)
ii. National policy frameworks on nutrition and child health
iii. Global reports from WHO, UNICEF, and the World Bank
iv. Case studies from countries using AI in public health.

Electronic databases including PubMed, Scopus, Web of Science, Google Scholar, and institutional repositories were searched using keywords such as "childhood obesity,""artificial intelligence,""machine learning,""digital health,""health policy," and "obesity prevention." Priority was given to studies published between 2020 and 2025 to ensure currency of evidence, although seminal studies published earlier were also

included where relevant. Literature was reviewed, synthesized, and analysed thematically to identify emerging trends, opportunities, challenges, and policy implications relating to AI integration in combating childhood obesity.

Discussion of findings

The evidence reviewed indicates that childhood obesity remains a growing global public health challenge driven by unhealthy dietary habits, physical inactivity, socioeconomic factors, urbanization, and increasing exposure to digital lifestyles. Although several national and international policies have been developed to address childhood obesity, implementation gaps continue to limit their effectiveness.

The findings from the literature indicated that childhood obesity had evolved into a complex public health challenge requiring innovative, multi-sectoral, and technology-driven interventions. Existing evidence demonstrated that childhood obesity was influenced by an interplay of behavioural, environmental, socioeconomic, cultural, and policy-related factors (WHO, 2023; UNICEF, 2022). While governments and international organizations have implemented various nutrition and physical activity policies aimed at reducing obesity prevalence, the effectiveness of these policies were often been constrained by weak implementation mechanisms, inadequate monitoring systems, limited resources, and poor stakeholder coordination (Adewale & Ugochukwu, 2021; Bello & Akinyemi, 2022). Consequently, there is growing recognition that traditional approaches alone may be insufficient to address the increasing burden of childhood obesity.

The reviewed literature suggested that artificial intelligence (AI) can provide an opportunity to bridge the gap between policy formulation and practical implementation. AI technologies can strengthen obesity prevention efforts through predictive analytics, machine learning algorithms, intelligent surveillance systems, and personalized intervention strategies (Patel et al., 2023). Unlike conventional public health programmes that often rely on generalized interventions, AI-driven systems enable the analysis of large datasets to identify at-risk populations, predict obesity trends, and facilitate early intervention. This capability aligns with global public health priorities emphasizing prevention rather than treatment and supports the objectives of national nutrition and child health policies (WHO, 2023).

Evidence from recent studies demonstrates that AI-powered applications can improve the identification of behavioural and environmental risk factors associated with childhood obesity. Machine learning models have shown high accuracy in predicting obesity risk by analysing dietary habits, physical activity levels, family health history, socioeconomic characteristics, and biometric indicators (Liu et al., 2024). Similarly, AI-enabled mobile health applications and wearable technologies provide real-time monitoring of children's physical activity, dietary patterns, and sleep behaviours, thereby supporting personalized health promotion and behaviour modification programmes (Patel et al., 2023; Chowdhury et al., 2022). Such innovations can significantly enhance the implementation of school health programmes and community-based obesity prevention initiatives by providing continuous feedback and data-driven decision-making tools.

AI-powered surveillance systems can automate data collection, detect emerging trends, and provide predictive insights that support evidence-based policymaking (Topol, 2024). In school settings, for example, AI systems can assist policymakers and educators in monitoring compliance with nutrition standards, evaluating the effectiveness of physical activity programmes, and identifying schools or communities requiring targeted interventions. Such capabilities improve accountability and enhance the likelihood of achieving policy objectives.

Despite these opportunities, significant implementation challenges remain. The literature consistently identifies inadequate digital infrastructure, limited technical expertise, data privacy concerns, funding constraints, and regulatory deficiencies as major barriers to AI adoption in healthcare and public health systems (Adeleke et al., 2022; Okeke & Olanrewaju, 2023). In many low- and middle-income countries, including Nigeria, disparities in internet access, electricity supply, and technological resources may limit the effectiveness of AI-driven interventions. Additionally, concerns regarding data security and the ethical use of children's health information necessitate robust governance frameworks to ensure responsible AI deployment.

These findings highlight the need for policymakers to develop child-centred regulatory guidelines that balance innovation with ethical considerations.

The successful integration of AI into childhood obesity prevention also depends on stakeholder collaboration. Governments, healthcare providers, schools, technology developers, parents, and community organizations must work together to ensure that AI solutions are contextually appropriate, culturally sensitive, and accessible to diverse populations. Recent evidence suggests that collaborative approaches involving public-private partnerships can facilitate resource mobilization, improve technological capacity, and enhance programme sustainability (World Economic Forum, 2024). Such partnerships can support the development of affordable digital health tools while promoting equitable access among vulnerable populations.

The findings further support the Social Ecological Model, which emphasizes that health behaviours are shaped by multiple levels of influence, including individual, interpersonal, organizational, community, and policy factors. AI has the potential to strengthen interventions across all these levels by facilitating personalized behaviour change, improving family and school engagement, supporting community health programmes, and enhancing policy implementation and evaluation. Similarly, the Diffusion of Innovations Theory explains how successful adoption of AI technologies depends on perceived usefulness, ease of use, institutional support, and stakeholder acceptance. Policymakers must therefore create enabling environments that encourage innovation while addressing barriers to adoption.

Overall, the literature suggests that artificial intelligence should not be viewed merely as a technological innovation but as a strategic public health tool capable of transforming childhood obesity prevention and management. By improving surveillance, enabling personalized interventions, strengthening policy implementation, and supporting evidence-based decision-making, AI can significantly contribute to reducing childhood

obesity rates and improving child health outcomes. However, achieving these benefits requires sustained investment in digital infrastructure, workforce development, ethical governance, and cross-sector collaboration. Integrating AI into existing obesity prevention policies and programmes therefore represents a practical pathway for translating policy intentions into measurable public health outcomes.

Artificial intelligence presents significant opportunities for bridging these gaps through early risk detection, predictive analytics, personalized nutrition guidance, behavioural monitoring, and real-time intervention delivery. AI-powered systems can facilitate more efficient identification of at-risk children, support individualized treatment plans, and improve programme monitoring and evaluation. These capabilities align with contemporary public health goals that emphasize prevention, personalization, and data-driven decision-making.

However, successful implementation requires addressing barriers such as inadequate digital infrastructure, limited technical expertise, data privacy concerns, ethical considerations, and funding constraints. In many low- and middle-income countries, including Nigeria, these challenges may hinder large-scale deployment of AI-based health interventions. Consequently, policy frameworks should prioritize digital capacity building, stakeholder engagement, and equitable access to technological innovations.

Conclusion

Childhood obesity remains a significant public health challenge with profound implications for children's physical, psychological, and social well-being. While existing policies provide important frameworks for intervention, implementation challenges continue to limit their impact. Artificial intelligence offers innovative opportunities for enhancing obesity prevention, early detection, monitoring, and management through data-driven and personalized approaches. However, realizing these benefits requires supportive policies, adequate infrastructure, ethical safeguards, technical capacity, and sustained investment. Integrating artificial intelligence into childhood obesity interventions therefore represents a promising pathway for translating policy into practice and improving health outcomes among children.

Recommendations

The following recommendations were made:

i. Future studies should focus on empirical evaluations of AI-driven obesity interventions among school-aged children, particularly in low- and middle-income countries. Research is also needed to examine the cost-effectiveness, ethical implications, and long-term sustainability of AI-assisted obesity prevention programmes. Additionally, investigations into the use of wearable technologies, machine learning algorithms, and predictive analytics for early obesity detection may provide valuable insights for strengthening public health interventions.
ii. There must be improvepolicy effectiveness on mandate digital integration in school health policies to include AI-based monitoring and reporting tools, establishing accountability frameworks using real-time dashboards to track policy

implementation and outcomes, allocating dedicated funding for digital health infrastructure in schools and community health centres, and updating existing policies to reflect technological advancements and include AI as a strategic tool.

iii. Cross-sector collaboration in ensuring sustainable and inclusive solutions, collaboration across sectors is essential (stakeholder, policymaker, schools, healthcare providers, and tech providers)

iv. Capacity building and equity through training of educators and health workers on AI tools and digital literacy, designing inclusive technologies that work in low-resource settings and protect vulnerable populations, and promote public awareness about AI's role in health to build trust and encourage adoption.

v. Ethical and legal safeguards must be in place to develop child-centred data protection laws, ensure transparent data ownership and consent protocols, and involve ethics committees in the design and deployment of AI tools.

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