Review

DOI: 10.5582/bst.2025.01105

Promoting active health with AI technologies: Current status and prospects of high-altitude therapy, simulated hypoxia, and LLM-driven lifestyle rehabilitation approaches

Mingyu Liu[1], Wenli Zhang[2,*], Junyu Wang[3], Kehan Bao[4], Ziyi Fu[5], Boyuan Wang[6,7,8,*]

[1] College of International Tourism and Public Administration, Hainan University, Haikou, China;
[2] School of Information Science and Technology, Beijing University of Technology, Beijing, China;
[3] State Key Laboratory of Integrated Chip and Systems, School of Microelectronics, Fudan University, Shanghai, China;
[4] Business Department, Mediva inc, Tokyo, Japan;
[5] Business Development of Particle Accelerator in China, Hitachi Particle Engineering & Services, Inc. Pleasanton, USA;
[6] Beijing Xiaotangshan Hospital, Beijing, China;
[7] Department of Biomedical Sciences, City University of Hong Kong, Hong Kong;
[8] Zhuhai Fudan Innovation Institute, Fudan University, Zhuhai, China.

SUMMARY: In the context of the rising global prevalence of obesity, traditional intervention measures have proven insufficient to meet the demands of personalized and sustainable health management, necessitating the exploration of innovative solutions through innovative technologies. This study explores how advanced digital technologies, including Internet of Things (IoT) and Artificial Intelligence (AI), can manage weight and enhance full-lifecycle health in individuals with obesity under simulated high-altitude hypoxic conditions (HC). The findings suggest that integrating simulated HC with digital health technologies offers a novel and safe approach to obesity rehabilitation. By leveraging environmental stimuli, real-time monitoring through wearable devices, and intelligent evaluation using large language models (LLMs), this method enables more scientific weight loss, prevents rebound weight gain, and fosters proactive healthy lifestyles, significantly improving weight control outcomes for individuals with obesity. Future research should evaluate the efficacy of simulated HC in weight management and its long-term impact on obesity control. Establishing an integrated framework that combines simulated HC, lifestyle interventions, and smart health ecosystems is crucial for advancing rehabilitative healthcare and addressing the global burden of obesity through digital innovation.

Keywords: personalized weight management, digital health innovation, lifestyle intervention, obesity rehabilitation, sustainable health improvement, public health management, plateau innovation industry

1. Introduction

With societal development, lifestyle changes have led to increased obesity globally. GBD projections warn that without strict interventions, by 2050, 38 billion adults — over half the global adult population — will be overweight or obese. Besides, one-third (746 million) of children and adolescents will be overweight or obese, with about 360 million suffering from obesity (*1*). These trends underscore the urgent need for effective obesity interventions.

Globally, obesity has been identified as the fifth leading risk factor for mortality (*3*). primarily due to complications like type 2 diabetes, cardiovascular diseases, osteoarthritis, sleep apnea, and cancer (*4*). By 2025, over 1.31 billion people are projected to have diabetes due to rising obesity rates (*5*), while cardiovascular events may double in some countries within a decade (*6*). According to a prediction, by 2070, obesity is predicted to cause over 2 million new cancer cases annually, accounting for 7% of all cancers (*7*).

Beyond health risks, obesity strains global public health systems and socioeconomic resources. In high-income countries, it adds pressure to aging populations and healthcare costs, while in low- and middle-income countries, it worsens child malnutrition and overburdens limited resources (*8*). In 2019, obesity-related costs ranged from 3.19 billion in low – income countries to 1.33 trillion in high-income countries (*9*). By 2035, the obesity epidemic could reduce global GDP by 2.9%, equivalent to a $4 trillion loss (*10*), underscoring its critical impact on modern public health.

The evolving understanding of obesity as a complex chronic disease has spurred advancements in its

treatment (*4*), including oral medications to bariatric surgery (BS). Oral medications can cause gastrointestinal side effects despite better weight loss than placebos (*11*) , while BS effectively achieves rapid, sustained weight loss but comes with significant complications (early complications require specialized center care, while later complications are managed locally) (*12,13*) .

Therefore, multiple countries are now prioritizing lifestyle-based interventions such as health management for obesity. For instance, on March 9, 2025, China's National Health Commission promoted a "Weight Management Year" three-year action, declaring "healthy weight as the core indicator of national health," and integrating weight management into chronic disease prevention and treatment strategies. Since 2024, in collaboration with other departments, they've launched campaigns to boost public awareness and skills in weight management, aiming to control overweight, obesity, and prevent chronic diseases. This initiative not only covers all age groups but also emphasizes the family as the smallest unit of health management, which needs to take primary responsibility (*92*).

Current research on weight management utilizing health management approaches includes lifestyle interventions (*14*), commercial weight management programs such as the CSIRO Total Wellbeing Diet Online (*15*), online exercise programs (*16*), and dietary interventions (*17*), all of which have been shown to significantly improve obesity. Recently, hypobaric hypoxia environments have gained attention for their role in weight management. Studies show high altitudes positively correlate with metabolic health and a non-obese phenotype, while negatively associating with unhealthy metabolic states (*18*). Multiple studies confirm altitude's beneficial impact on weight loss (*19-21*), positioning high-altitude environment as a promising intervention. Recently, HC has been applied to both acute (single exposure) and chronic (repeated exposure over several weeks) sessions for overweight and obese individuals. The aim is to enhance cardiac metabolic health and promote weight loss (*2*). Encouraging obese individuals to engage in diet or physical activities in simulated high altitude environment promotes weight management, while combining HC with exercise offers therapeutic potential (*22*). This approach supports weight loss and enhances metabolic health, making simulated high-altitude environment an innovative obesity solution. An integrated scenario for weight intervention is illustrated in Figure 1.

Modern technologies like IoT, AI, and 5G are revolutionizing weight management by effectively intervening in the lifestyles of obese individuals. Johanna *et al*. studied wearable IoT devices for lifestyle changes in obese pregnant women (*23*). Sharareh *et al*. used AI to predict obesity, showing that AI algorithms can accurately forecast obesity (*3*). These digital innovations have proven effective in addressing obesity. However, research on integrating HC with AI, IoT, and 5G for enhanced weight management is scarce.

This study investigates the integration of IoT, AI, and 5G with HC (via simulated high altitude environment in laboratory) for weight management in obese patients. By promoting lifestyle interventions and supporting the entire life cycle, it offers theoretical support for simulated high-altitude environment as a weight management strategy, improving patient quality of life and reducing public health burdens. The contributions of this study:

1). Highlights the effectiveness of combining lifestyle interventions, physical exercise, and hypobaric hypoxic therapy in simulated high-altitude environment as an

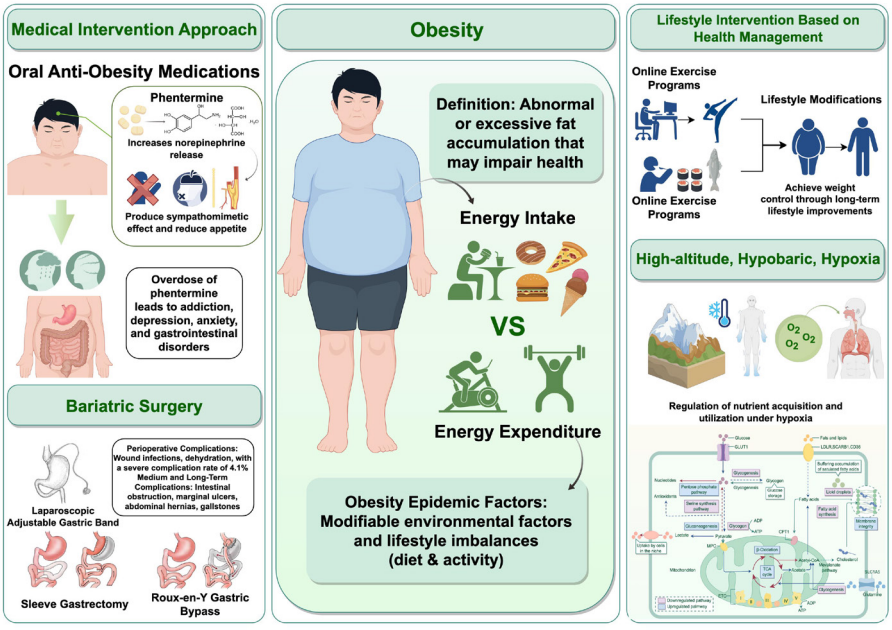

Figure 1. Scenario diagram of four obesity management approaches.

emerging weight management approach.

2). Integrates innovative technologies (IoT, AI, 5G) with traditional methods to offer personalized solutions. Utilizes wearable health monitoring devices and AI-driven predictions for obesity and related diseases.

3). Identifies research gaps in technology integration and hypobaric hypoxic applications, proposing further exploration of simulated high-altitude environment's long-term effects on weight management, offering valuable insights for researchers and global public health innovation.

2. Fundamental theory

2.1. Obesity and weight management

The WHO defines obesity as "an abnormal or excessive fat accumulation that may impair health," pointing out that the fundamental cause of obesity is an energy imbalance between calories consumed and calories expended (*3,24*). Research indicates that genetic factors only account for obesity in a very small segment of the population, with the widespread prevalence of obesity mainly attributed to modifiable environmental factors and individual lifestyle choices (*25*). In other words, overeating and insufficient physical activity are the primary causes of obesity. This is because diet is the form through which humans consume calories, while physical activity is the main pathway through which humans expend calories.

Jeffrey emphasized that obesity should be viewed as a biological disease akin to other chronic conditions like heart disease, hypercholesterolemia, diabetes, or hypertension (*26*). The adverse effects of obesity extend beyond its complications to the challenges in its treatment. Stella highlighted the difficulty overweight or obese individuals face in returning to a normal or healthy weight once classified as such (*27*). Although weight loss can improve complications and quality of life, maintaining that weight loss remains a significant challenge (*4*).

The primary goal of obesity management has shifted from merely achieving weight loss to improving health at a broader level (*28*), encompassing lifestyle changes, weight-loss medications, and bariatric surgery (*16*). Lifestyle interventions, mainly including dietary modifications, tailored exercise plans, and personalized behavioral counseling, have been shown to significantly improve weight outcomes and are now widely used in weight management.

Moreover, comprehensive behavioral weight management programs that combine physical activity with dietary restrictions have proven more effective for both short-term and long-term weight loss compared to interventions based solely on diet or physical activity (*29*). On one hand, creating a calorie deficit through prescribed caloric intake and appropriate physical activity is aimed at sustained weight loss (*16*); on the other hand, personalized weight loss behavioral counseling serves to motivate obese patients by adjusting and optimizing weight loss strategies in real time (*14*). This approach provides a gentle yet effective pathway for weight loss among obese patients, emphasizing gradual and sustainable improvements in lifestyle.

2.2. The efficacy of HC in simulated high-altitude environment

High-altitude environment refers to elevated areas above 2,500 meters (*30,31*). HC is defined as exposure to systemic and/or local hypoxia at rest (passive) or combined with exercise training (active) (*2*). With advancements in technology, the ability to simulate high-altitude environments has become more accessible, leading to a surge in its popularity. This trend has attracted numerous researchers to investigate the effects and applications of simulated HC. Such environments offer promising avenues for studying weight management, cardio-metabolic health, and other physiological impacts on obese populations, spurring innovation and exploration in both research and practical applications.

Simulated high-altitude environments, characterized by low atmospheric pressure, reduced oxygen partial pressure, long daylight hours, and low humidity, create unique physiological effects on the human body. Exposure to hypobaric hypoxia condition often leads to weight loss (*19*), driven by multiple factors: decreased oxygen levels at higher altitudes reduce blood and tissue oxygen partial pressure, triggering compensatory responses such as increased ventilation and sympathetic nervous system activation, which elevate metabolic demands (*32,33*). Additionally, reduced appetite (*20*) or impaired gut function (*34*) decreases energy intake, creating a negative energy balance. Cold environments further increase energy expenditure for thermoregulation, depleting fat stores (*35*), while extra exercises amplify this effect through increased energy expend, altering body composition (*22*). Combining hypobaric hypoxia conditioning with dietary or exercise interventions has been proposed as an effective weight management strategy. Kayser noted that intermittent hypoxic exposure during rest or exercise improves body composition, exercise tolerance, metabolism, and arterial pressure (*36*). Quintero *et al*. highlighted oxygen availability as a key regulator of body weight and energy homeostasis (*37*), showcasing promising potential for obesity treatment. The mechanisms underlying weight reduction in simulated high-altitude hypobaric hypoxia environments are illustrated in Figure 2.

Rapid adaptation training in a simulated hypobaric and hypoxic environment may challenge the body's ability to acclimatize to acute hypoxia, but it offers a unique opportunity for weight management and health improvement. This environment can effectively promote

weight loss, but it is also important to take precautions against acute mountain sickness (AMS), commonly caused by hypoxia. Zhou *et al*. found that weight loss at high altitudes correlates with the severity of AMS, particularly due to fatigue(*38*), while Ge *et al*. noted that higher body weight increases susceptibility to AMS under hypoxic conditions(*21*). Therefore, while simulated HC provide potential for weight management, attention must also be paid to preventing and managing AMS, especially in obese individuals.

2.3. The integrated application of digital innovation technologies such as IoT, 5G, and AI

The Internet of Things (IoT), defined as an open network of intelligent objects capable of self-organizing, sharing data, and reacting to environmental changes, enables previously impossible connectivity and communication (*39*). IoT devices, including sensors and actuators, gather and store data locally or in the cloud, supporting applications like smart homes, smart health, and smart cities (*40,41*). Integrating IoT with machine learning (ML) or deep learning (DL) architectures tailored to specific needs has revolutionized healthcare, enabling innovative solutions for disease detection and health monitoring (*40*).

AI, particularly ML and DL, has proven effective in predicting obesity risks. Faria Ferdowsy achieved 97.09% accuracy in obesity risk prediction using ML techniques (*42*) , while Sharareh Rostam demonstrated AI's potential for early detection, enabling timely interventions to prevent related diseases like type 2 diabetes and cardiovascular conditions (3). Similarly, Mahmood Safaei and Elankovan validated the efficacy of ML methods, such as neural networks, decision trees, random forests, and DL, in managing obesity (*43*).

The advent of 5G, with its high bandwidth, low latency, reliability, and massive connectivity, is a key driver of IoT growth (*44*). In healthcare, 5G-enabled IoT expands device connectivity and enhances wireless services. For instance, Chen *et al*. developed a personalized emotion-aware healthcare system using 5G, targeting emotional care for children, psychiatric patients, and the elderly (*45*). This integration highlights the transformative potential of combining digital innovations, as illustrated in Figure 3.

This study synthesizes a comprehensive strategy through an integrative review of the literature, combining lifestyle interventions with simulated high-altitude hypoxia, enhanced by digital innovations. It supports weight management for obese individuals, monitors hypoxia-related risks, and ensures holistic health protection. The approach benefits personal health and provides solutions to global public health challenges associated with obesity. Additionally, it enhances safety for obese patients in simulated high-altitude environments, ensuring comprehensive health protection.

3. Methodology

This study adheres to the PRISMA framework (*46*), conducting a systematic review of literature on weight management, high-altitude environment (hypobaric hypoxia intervention), AMS, and the application of 5G-IoT and AI (ML/DL) technologies in healthcare. Through four stages—identification, screening, eligibility assessment, and inclusion—a conceptual model was developed to explore the potential of high-altitude environment in improving obesity symptoms and its integration with digital innovations. From January to March 2025, searches were conducted in Web of Science, PubMed, and IEEE databases, targeting high-quality journals. Inclusion criteria focused on English peer-reviewed articles published after 1990 at SJR Q1 level (*47*). The search strategy revolved around several themes:

Related to weight management: "obesity" OR "overweight" OR "obesity management" OR "weight management"

Related to high-altitude environment (hypobaric hypoxia intervention): "high altitude" OR "low pressure" OR "low oxygen" OR "hypobaric" OR "hypoxia"

Related to digital innovation technologies: "5G-IoT" OR "AI" OR "ML" OR "DL"

Related to AMS: "acute mountain sickness" OR "AMS"

The specific classifications and results analysis are as follows:

A systematic search was conducted using the keywords "obesity" OR "overweight" OR "obesity management" OR "weight management," yielding 1,400,452 articles, of which 126,079 met the inclusion criteria. Among these, 88 studies explored the application of AI (ML/DL) in weight management. A combined search using the keywords ("high altitude" OR "low pressure" OR "low oxygen" OR "hypobaric" OR "hypoxia") AND ("obesity" OR "overweight" OR "obesity management" OR "weight management") generated 1,101 publications, with 122 selected to demonstrate the effects of hypobaric hypoxia on body composition. Additionally, a search combining terms ("5G" OR "IoT" OR "AI" OR "ML" OR "DL") with high-altitude-related keywords retrieved 2,658 articles, of which 119 were retained; 15 studies focused on digital interventions for treating respiratory diseases and chronic kidney disease, which are closely associated with obesity. Also, we noted that 13 papers highlighted the significant role of technologies in the early detection and prevention of AMS.

Based on the above literature search and screening results, the study ultimately included 181 articles for in-depth review. Existing research highlights high-altitude environment, simulated or real hypobaric hypoxia, weight management, and digital technologies as key areas. However, interdisciplinary research remains scarce, particularly integrating high-altitude environment

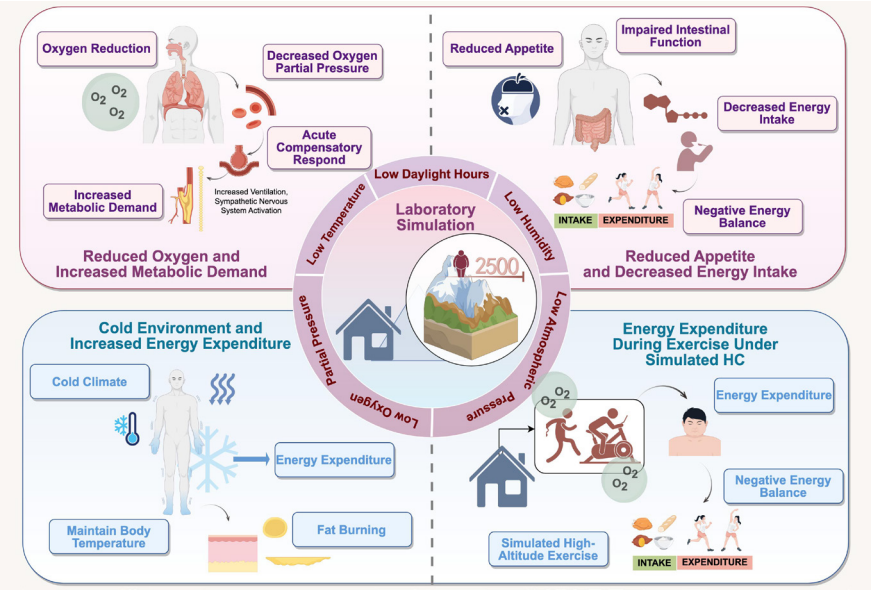

Figure 2. Schematic diagram of weight management in simulated high-altitude hypobaric & hypoxic environments.

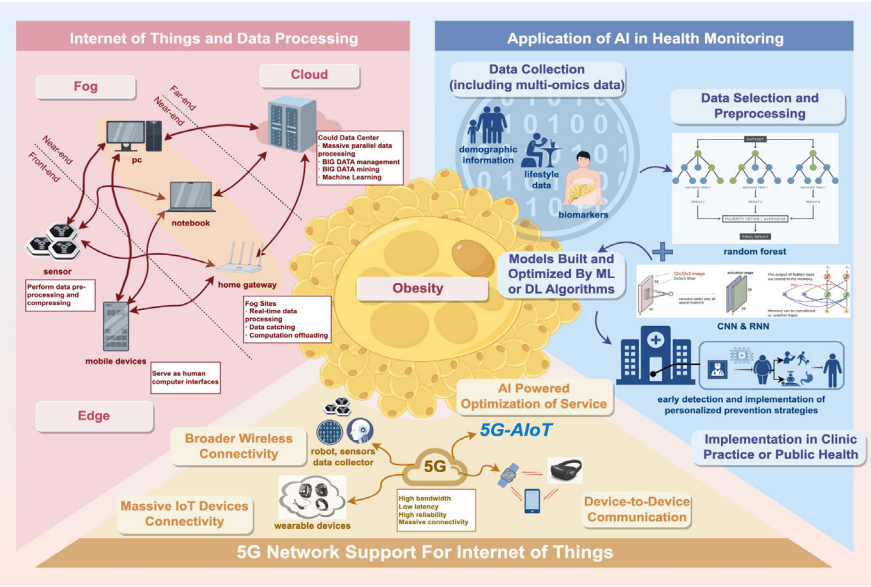

Figure 3. Integrated application scenarios of digital innovation technologies.

with digital innovations.This gap underscores the need for further exploration in this field. The search process and criteria are illustrated in Figure 4.

4. 5G-IoT and AI Synergy for Weight Management and Safety in Hypobaric Conditions

This study reviews an integrated health management strategy, merging simulated high-altitude environment's hypobaric hypoxia (combine with diet and exercise) with digital innovations. This approach supports weight management for obese individuals, relevant health risks, and ensures comprehensive health protection. It benefits personal health and provides innovative solutions and technical support for global public health systems facing rising obesity rates among various age groups.

4.1. Data-driven obesity management and safety rescue

AI (ML, DL) can describe, classify, and predict obesity-related risks and outcomes using data from sensors, smartphone apps, electronic health records, and insurance data. Besides, ML and DL analyze causes and risks of dietary plan failures, such as alcohol consumption and self-efficacy. Additionally, IoT wearable devices monitor physiological indicators in real time for tailored diet and exercise plans. By applying AI, we can comprehensively analyze data from obese patients engaging in simulated high-altitude environment, assessing and predicting their obesity risks and severity. Combining exercise habits, dietary risks, and environmental conditions at laboratory, personalized hypobaric hypoxia weight management plans can be developed for each patient.

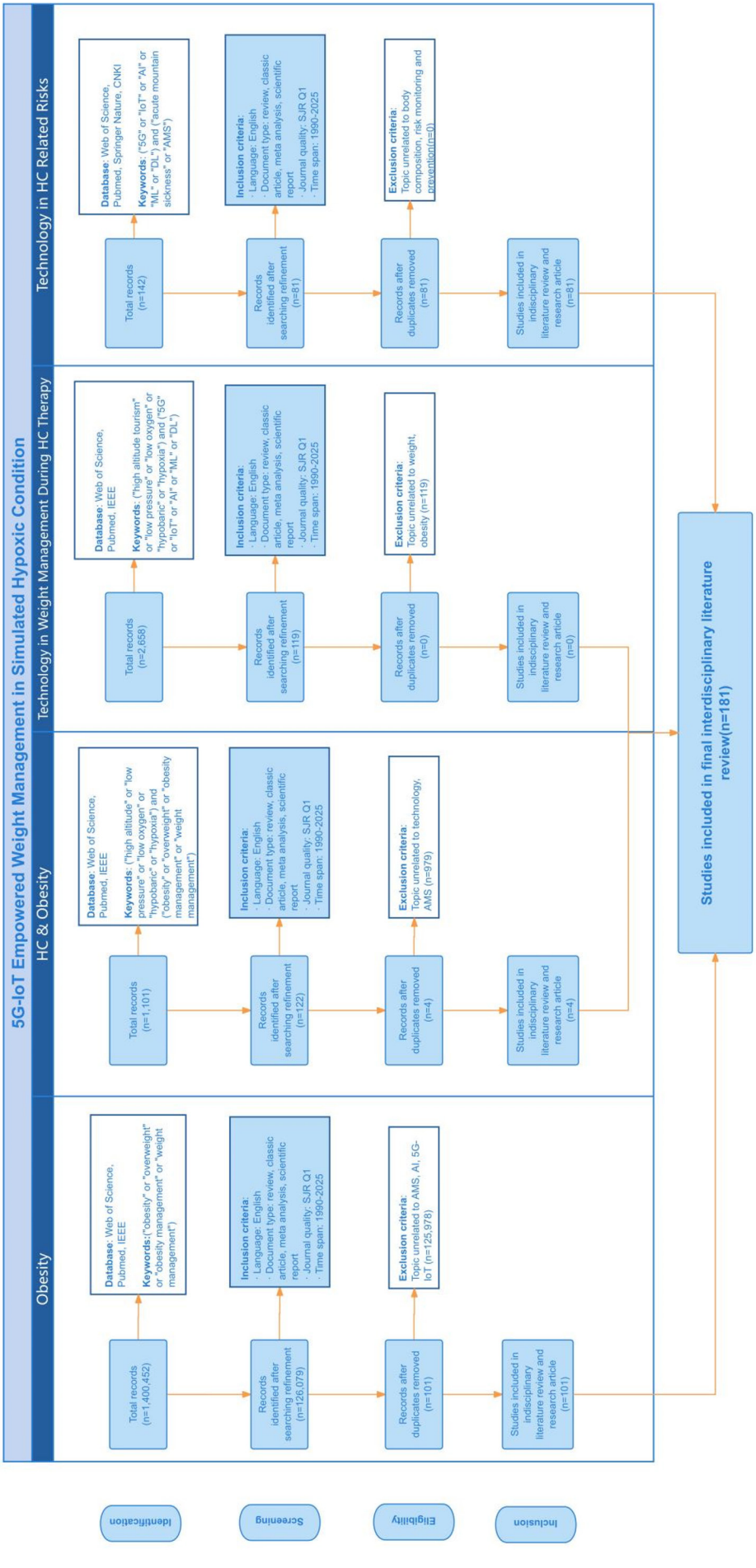

Figure 4. Literature review process and screening criteria.

For example, DeGregory *et al*. reviewed ML methods (*e.g.*, regression, neural networks, decision trees) applied to health survey data, demonstrating their potential for large-scale obesity analysis (*48*). Chatterjee *et al*. developed an intelligent eCoach system using ML to predict risks and provide personalized recommendations for obesity and related conditions (*49*). Sala *et al*. created an ML model predicting dietary lapses, identifying alcohol and low self-efficacy as key risk factors (*50*). Greco *et al*. highlighted AI's role in accurately segmenting adipose tissue in CT/MR images, aiding weight change tracking (*51*). Varun *et al*. assessed wearable-EHR integration for remote obesity monitoring, finding positive patient attitudes toward sharing activity data with healthcare teams (*52*). Please see Table 1 for details of the study and the proof process.

4.2. Real-time health monitoring and adverse health event prevention – Under simulated hypobaric hypoxia conditions

IoT wearables monitor hydration, respiratory conditions, and other physiological indicators in real time. AI algorithms analyze these data to predict relevant risks and recommend preventive measures. Continuous tracking of weight, oxygen levels, exercise, and nutrition enables early health warnings and timely adjustments to weight management plans, enhancing safety and precision in obesity treatment.

Nicholas *et al*. showed obese individuals lost more weight in simulated hypoxia than in normoxic conditions, marking the first trial of hypoxia-induced weight loss and highlighting normobaric hypoxia's potential for non-dietary weight management (*53*). Hobbins *et al*. reviewed passive and active hypoxic conditioning (HC), finding passive HC increased energy expenditure and altered fuel use, while active HC reduced weight and blood pressure, though results were inconsistent for triglycerides, cholesterol, and fitness.

These studies fully confirm the effectiveness and feasibility of weight loss in simulated high-altitude environments. With the widespread adoption of technologies like IoT and AI, wearable devices' health monitoring capabilities and smart healthcare ecosystems based on digital innovation now provide strong support for such weight loss programs. Real-time monitoring of patients' physiological indicators *via* IoT devices, combined with data sharing through 5G cloud platforms, enables healthcare providers to better understand patient conditions, enhance doctor-patient communication, and optimize weight management strategies.

Many studies have indicated that fluid retention, obesity, and obesity-related symptoms (such as respiratory impairments) are major factors contributing to the risk of AMS among obese patients at high altitudes (*54-57*). With the effective promotion of weight management for obese patients in simulated HC, the

Table 1. Analysis of the role of AI and IoT in weight management

Method	Region	Participant	Way	Result	*Ref.*
ML Methods	America	A nationally representative sample of US adults	The study compared logistic regression, decision trees, neural networks, and deep learning for predicting hypertension and body fat percentage	Innovative mathematical methods in ML are needed to analyze new data sources in obesity, meeting the demand for advanced predictions and descriptions.	(*48*)
ML Methods - Digital eCoaching System	Norway	Targeting men and women in age groups >20 and <60,	Statistical analysis was performed on public datasets from "Kaggle" and "UCI" using ML models, evaluating their classification and regression performance	The digital eCoaching system will collect data on obesity/overweight risk factors from male and female trials in southern Norway, using this for regression and prediction to provide automated, personalized advice to participants.	(*49*)
EMA and ML Analysis Methods	America	One sample had 58 overweight/obese individuals; another had 29.	The first group received Weight Watchers (WW) or WW + Just-In-Time Adaptive Interventions (JITAIs). The second group followed the WW Freestyle diet and completed six EMA surveys daily.	Alcohol consumption and self-efficacy influenced dietary lapses, enhancing JITAIs for personalized interventions.	(*50*)
AI Algorithms	Italy	/	Utilizing AI algorithms to extract quantitative data from computed tomography (CT) and magnetic resonance (MR) images.	AI effectively quantifies visceral (VAT) and subcutaneous adipose tissue (SAT) in CT images and shows promise for analyzing abdominal fat in MR images.	(*51*)
RPM plan integrated wearable devices with EHR.	America	Recruited 10 PCPs and 8 obese patients from UMass clinics.	Wearable data were uploaded to EHR, followed by interviews with PCPs and patients.	Patients wanted to share PA data via EHR for more specific consultations. Providers were open to PA-focused RPM solutions that fit their workflow and supported health equity.	(*52*)

application of innovation technologies to help obese patients avoid the risk of AMS under this condition. For instance, Pablo *et al*.'s wearable system monitors vital signs and environmental conditions for workers, providing real-time cardiac and respiratory analysis *via* Bluetooth (*58*). Wei *et al*. used ML algorithms for an AMS risk model, demonstrating higher accuracy with multivariate analysis (*59*).

Table 2 shows details of the main research methods and results.

4.3. Personalized lifestyle support – Prognosis

During and after high-altitude environment therapy, the big data analytics powered by AI and IoT technologies, along with personal health data tracking, can not only provide each participant with customized daily health meal plans and appropriate regular exercise programs but also monitor for post-travel physical discomfort. This helps in the prognosis of obese patients. Such personalized health management strategies contribute to long-term weight management and overall health maintenance, supporting healthy living while preventing weight regain.

Woo *et al*. demonstrated that AI-IoT technology improves elderly healthcare by enhancing medication habits, managing hypertension, frailty, diabetes, and promoting physical activity and nutrition (*60*). Ying *et al*. showcased how AI dietitians improve food recognition, dietary recording, nutritional assessment, and recipe suggestions, significantly boosting efficiency (*61*). Rafael *et al*. highlighted wearable devices for personalized medicine in ketosis and diabetic ketoacidosis (DKA) management, emphasizing their role in early diagnosis and timely interventions (*62*).

Renu *et al*. explored an Ambient Assisted Living (AAL) system using a DNN-based IoMT architecture to accelerate data collection and processing, enabling effective healthcare predictions (*63*). Saeed *et al*. proposed an IoT framework with an ML activity classification system to monitor surgical and overweight patients, facilitating accurate patient profiles and automated data analysis (*64*). Chioma *et al*.'s review underscored the effectiveness of ML and DL algorithms in analyzing sensor data for various health issues, including activity monitoring and sleep disorder detection (*65*). Alireza *et al*. found that integrating IoT and AI in smart fitness equipment enhances user self-awareness and motivation during workouts (*66*). Table 3 shows the specific details of these studies.

4.4. 5G-enabled comprehensive health management services – Empowering VR/AR, IoT, and AI technologies to build a digital healthcare ecosystem

By integrating the advantages of 5G networks (high speed, low latency, and massive connectivity), IoT, AI algorithms,

Table 2. The simulated HC strategy in weight management

Method	Region	Participant	Way	Result	Ref.
Low intense physical exercise in normobaric hypoxia	Germany	32 obese participants (mean age: 47.6 years; mean BMI: 33.1.; 16 males, 4 females)	8-week intervention with low-intensity exercise (3 sessions/week, 90 minutes/session). No dietary interventions applied.	The hypoxia group lost more weight than the placebo. BMI trended down, but HbA1c didn't change. Eight weeks of mild exercise in 15% O_2 led to greater weight loss than the placebo for obese individuals.	(*53*)
Normobaric hypoxic conditioning	Chile	Human participants aged 21 to 51, including those with obesity, overweight, and sedentary lifestyles, as well as animal participants	Animals underwent intermittent hypoxia and continuous hypoxia training, while humans engaged in exercise training under passive hypoxia exposure, active hypoxia exposure, or a combination of both	Passive HC increases energy expenditure and alters fuel utilization, while active HC leads to weight loss and reduced blood pressure. However, the effects on lipid profiles, cholesterol levels, and physical fitness remain inconsistent	(*2*)
Wearable Oximeter - Maxim Oximeter	America	Volunteers provided informed consent for participation.	Data collection involved using Maxim oximeters worn at different positions (wrist, sternum, forehead, ear).	The forehead provided excellent signal quality, while the sternum required more power and motion artifact mitigation. The wearable oximeter monitors hypoxemia at high altitudes and shock during trauma, aiding safety in extreme environments.	(*91*)
25 ML Algorithms	China	32 participants (25 males and 7 females) were involved.	Participants hiked from Cui Fengshan Forest Park (2300m) to Wuling (3275m). ML analyses on physiological, environmental data, and LLS established AMS risk algorithms.	25 ML algorithms analyzed the data, showing improved sensitivity, specificity, and accuracy over previous studies, aiding AMS risk assessment model development.	(*59*)

Table 3. A global analysis of smart health technology applications

Method	Region	Participant	Way	Result	*Ref.*
AI-IoT in Healthcare	Korea	Utilizing this service, 21,966 smartphone users	Provided non-face-to-face health consultations and customized services to health experts, categorized into healthy, formerly weak, and disadvantaged groups.	Over 97% controlled hypertension and diabetes, with improvements up to 50.4% and 34.8%. Physical activity and diet improved by over 50%. Frailty scores decreased by 41% to 65%.	(*60*)
AI Nutritionist	China	177 AI dietitians	AI dietitians use algorithms to assess personalized nutrition at the molecular level, matching genotypes and phenotypes with diets, and provide detailed analyses via self-monitoring.	With a comprehensive understanding of food and habits, they improve dietary assessment accuracy and efficiency for broader populations.	(*61*)
Mobile and Wearable Sensing Devices	America	DKA patients	Wearable sensing technology and alternative body fluids enable quick, non-invasive measurement of beta-hydroxybutyrate, a key ketone for DKA diagnosis.	This platform allows painless home monitoring with faster analysis, lower cost, and higher sensitivity, improving diagnostic reliability without relying on clinics or professionals.	(*62*)
IoMT-AAL Architecture	India	Used for healthcare monitoring in 10 patients	IoMT-AAL collects and analyzes sensor data to identify behavioral patterns, habits, and living difficulties, enabling preventive measures for smarter daily environments.	Compared to PHD-HBD, ERPS-MLT-MA, and DDRU, IoMT-AAL achieves 94.3% transmission speed and 90.1% accuracy, validated through experimental analysis.	(*63*)
IoT Framework Benefiting from ML Activity Classification Systems	Saudi Arabia	Obesity patients	The IoT infrastructure gathers wearables data on vital signs and activities, using machine learning to classify movements. It supports health and nutrition, especially for postoperative patients.	The proposed IoT framework further extends by including a calorie intake analysis system based on ML and activity-based calorie burning, which can help create precise weight prediction factors, having a better impact on patients.	(*64*)
Mobile and Wearable Sensors for Health Monitoring	British	/	Mobile and wearable devices monitor health in areas like contact tracing, activity recognition, fall detection, Parkinson's detection, and disease diagnosis.	These sensor-based systems enable real-time diagnosis, management, and prevention of diseases, along with treatment suggestions.	(*65*)
IoT-Based Smart Fitness	France	Users of fitness trackers, motion analysis, and fitness apps	Users interact with a four-layer system: Observation, Contextualization, Decision, and Action.	Fitness trackers and smartwatches help users gain self-awareness and motivate casual runners to achieve their goals and improve training experiences.	(*66*)

and VR/AR, it is possible to achieve full-process health management supervision and remote hyper-realistic assistance for obese patients. This applies whether patients are undergoing HC in simulated high-altitude environment or managing their health independently at home after completing their treatment programs.

Specifically, 5G will enhance telemedicine by enabling remote precision medicine through seamless connectivity of medical devices to cloud platforms, avoiding network congestion. This supports immersive VR, real-time AR, and latency-free interactions, providing doctors with accurate diagnostic tools and improving training quality (*67*). By integrating 5G with IoT, wearable devices monitor patient health data, analyzed *via* cloud, fog, and edge computing, creating a "smart network" ecosystem that optimizes health plans and visualizes outcomes. Furthermore, 5G-enabled emotion recognition, with up to 99.87% accuracy (*68*), provides real-time emotional feedback for obese patients in HC, facilitating timely treatment adjustments and remote psychological counseling.

It is evident that the application of cutting-edge technologies such as 5G in healthcare not only enhances the quality of health management services but also ensures comprehensive weight management from the short term to the long term, ultimately achieving the goal of full lifecycle health assurance.

Machorro-Cano *et al*.'s PISIoT platform effectively aids weight loss and reduces myocardial infarction risk in elderly obese patients (*69*). Mohanta *et al*. describe Healthcare 5.0, which uses AI, IoT, and 5G for swift transmission of large medical files, enhancing remote monitoring (*70*). Singh highlights gamified 5G wearable interventions for childhood obesity, proving effective through engaging strategies and motivational challenges (*71*). Venkatachalam *et al*. demonstrate diabetes management in obese patients using IoT devices integrated with 5G networks (*72*). Dong *et al*.'s smart physical education system improves college student fitness through 5G and VR technology (*73*). Chen *et al*.'s 5GCS-Health-Sys focuses on emotional interaction, benefiting children, psychiatric patients, and the elderly (*45*). Specific details of the relevant studies can be viewed in Table 4.

These technologies optimize weight management strategies for obese patients in HC, enhance safety during simulated high-altitude therapy, and support full lifecycle health management. They offer new solutions to public health challenges posed by rising global obesity rates, improving service quality and addressing critical health issues (as summarized in Table 4 and illustrated in Figure 5).

5. Limitations and future prospects of current research

Despite the potential of 5G and IoT in healthcare,

Table 4. Next-gen weight care: Harnessing AI and IoT for effective obesity treatment

Method	Region	Participant	Way	Result	*Ref.*
PISIoT	Mexico	40 obese elderly aged 60–80 with myocardial infarction symptoms or history participated in a weight loss study	PISIoT, a user-centric IoT solution, integrates data from various devices, analyzes it using ML, and provides real-time monitoring, alerts, and medical advice.	By phase three, 40% achieved weight loss (1–7 kg) and lower BMI. PISIoT reduced myocardial infarction risk, improved health, and enhanced quality of life.	(*69*)
Healthcare 5.0	India	Open access	Components include IIoT controllers, smart IoT devices, smart blood banks, automated pathology labs, smart waste management, and 5G services covering over 2000 users.	Monitoring sensory data enables early disease prediction, promoting healthier lives.	(*70*)
Gamified 5G Wearable Device Interventions	America	Child obesity patients.	Gamified 5G wearables use engaging games, challenges, and education to help obese children lose weight through exercise, motivating them to take initiative and build daily weight management habits.	These devices make weight loss fun and effective for children.	(*71*)
Diabetes Vehicle System (Involving IoT and 5G)	China	Potential patients with diabetes caused by obesity.	IoT devices monitor health metrics such as blood glucose and blood pressure. The data is processed and analyzed at 5G edge nodes, and diagnostic results are shared with patients.	The system supports self-care, lifestyle analysis, and real-time monitoring to prevent and manage diabetes caused by obesity.	(*72*)
Smart Physical Education Program System Platform	China	8352 university graduates from 2020 and 2021	Students use tablets and VR glasses to access 3D videos for learning in class and during leisure time, fostering exercise awareness. Peer discussions and extracurricular talks improve fitness and health.	This 5G and VR-enhanced PE led to better physical performance and greater interest in sports compared to traditional methods.	(*73*)
A New Healthcare System Based on 5G Cognitive Systems (5G-Csys)—5GCS-Health-Sys	China	24 participants recorded in the dataset; 13 males and 11 females aged 20 to 30.	5GCS-Health-Sys recognizes voice emotions, categorizes them into six types, and sends results to smart terminals via the cloud. These terminals generate commands for EPIC-Robot to execute.	5GCS-Health-Sys accurately identifies user emotions and responds accordingly to improve negative emotions, enhancing healthcare outcomes.	(*45*)

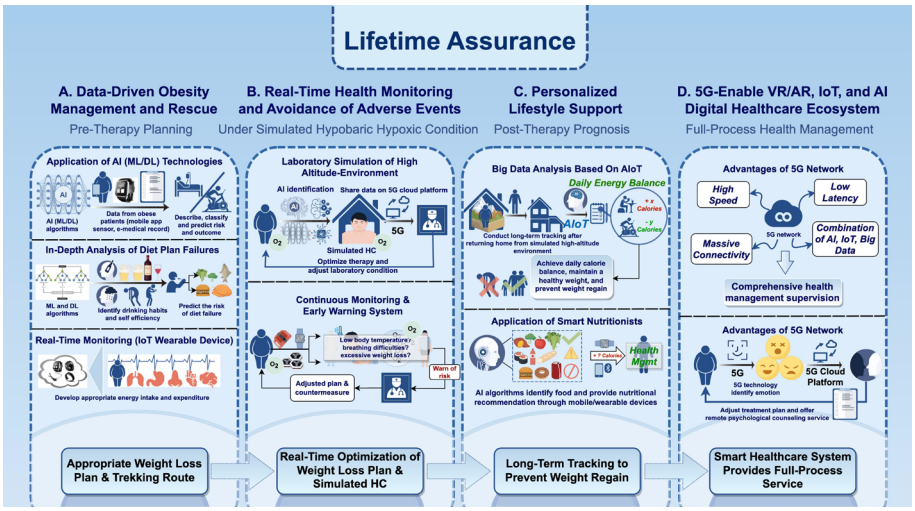

Figure 5. Schematic diagram of 5G-IoT-driven full-lifecycle weight management in HC.

their application in weight management for obese patients in simulated high-altitude (hypobaric hypoxia) environments remains limited. Most studies focus on isolated domains rather than integrating these technologies for comprehensive HC interventions. While 5G offers superior security, reliability, and mobility compared to Wi-Fi, making it ideal for monitoring patients and providing real-time feedback during simulated hypoxia, empirical research is scarce (*74-78*). Peralta *et al.*'s review reveals that only 15.91% of studied cases involve operational 5G-based smart healthcare systems, indicating a lack of large-scale implementation (*79-82*). This gap extends to obesity management in HC, where cross-domain technological integration is crucial. Managing sensitive health data in 5G-IoT systems is challenging, especially for resource-constrained devices (*83*). AI-driven authentication mechanisms, such as radio frequency fingerprinting, are essential to protect privacy and build trust (*84*,*85*).

Empirical evidence on hypoxia's impact in simulated high-altitude environments is also limited, with only 0.87% of studies addressing this topic, notably Gutwenger *et al.*'s low-altitude control study (*86*). Findings suggest improvements in BMI, cardiovascular health, and metabolism in HC and the integration of digital innovations like 5G-IoT remain understudied. Lippl *et al*. demonstrated weight loss driven by increased metabolic rates and reduced food intake, though their study relied on traditional methods (*87*). Similarly, Marlatt *et al*. and Mackenzie *et al*. confirmed metabolic benefits but did not incorporate modern technologies (*88,89*). Kayser *et al*. noted that systematic implementation of hypoxia-induced weight loss is premature due to insufficient evidence (*90*). Current efforts focus on theoretical frameworks and short-term outcomes, emphasizing the need for empirical validation of 5G-IoT applications to ensure safe deployment. These advancements aim to improve health outcomes and foster inclusive healthcare solutions.

6. Conclusion

This study addresses the gap in systematically reviewing IoT and AI technologies for laboratory-simulated high-altitude (hypobaric hypoxia) weight management. It highlights their potential in personalized weight management, real-time health monitoring, mitigating risks, and supporting long-term health. Integrating IoT and AI with laboratory-simulated hypobaric hypoxia weight management leverages synergies in HC, reducing chronic disease risks and global health burdens. This approach opens new frontiers in weight management and builds comprehensive health systems, improving global health outcomes.

Acknowledgements

We thank Hainan University faculty for their instruction in public administration, which enhanced my expertise in public health management. We also acknowledge using Figdraw for Figures 1, 2, 3, and 5.

Funding: This research was funded by the National Key R&D Program 'Prevention and Treatment Research for Cancer, Cardiovascular, Respiratory, and Metabolic Diseases' under the Science and Technology Innovation 2030 initiative, Project 'Key Technology and Intervention Strategy Research for Plateau Holistic Health Security Based on Multi-center Population Cohorts', grant number 2023ZD0505300/2023ZD0505303 and Medical Scientific Research Foundation of Guangdong Province of China, grant number A2023159.

Conflict of Interest: The authors have no conflicts of interest to disclose.

References

1. GBD 2021 Adolescent BMI Collaborators. Global,

regional, and national prevalence of child and adolescent overweight and obesity, 1990–2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. Lancet. 2025; 405:785-812.
2. Hobbins L, Hunter S, Gaoua N, Girard O. Normobaric hypoxic conditioning to maximize weight loss and ameliorate cardio-metabolic health in obese populations: A systematic review. Am J Physiol Regul Integr Comp Physiol. 2017; 313:R251-R264.
3. Rostam S, Najafi F, Hasannejadasl H, Soroush H. Artificial intelligence-enabled obesity prediction: a systematic review of cohort data analysis. Int J Med Inform. 2025; 196:105804.
4. Perdomo CM, Cohen RV, Sumithran P, Clément K, Frühbeck G. Contemporary medical, device, and surgical therapies for obesity in adults. Lancet. 2023; 401:1116-1130.
5. Ong KL, Lauryn K. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2023; 402:203-234.
6. Mohebi R, Chen C, Nasrien E. Cardiovascular disease projections in the United States based on the 2020 census estimates. J Am Coll Cardiol. 2022; 80:565-578.
7. Soerjomataram I, Bray F. Planning for tomorrow: global cancer incidence and the role of prevention 2020-2070. Nat Rev Clin Oncol. 2021; 18:663-672
8. GBD 2021 Adult BMI Collaborators. Global, regional, and national prevalence of adult overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. Lancet. 2025; 405:813-838.
9. Adeyemi O, Rachel N, Garrison S, Jaynaide P, Johanna R, John W. Economic impacts of overweight and obesity: current and future estimates for 161 countries. BMJ Glob Health. 2022; 7:e009773.
10. World Obesity Federation. World Obesity Atlas 2023. *https://data.worldobesity.org/publications/?cat=19* (accessed March 31, 2025).
11. Benedictus B, Pratama VK, Purnomo CW, Tan K, Puspita RF. Efficacy of oral medication in weight loss management: A systematic review and network meta-analysis. Clin Ther. 2025; 47:316-329.
12. Healy P, Clarke C, Reynolds I, Arumugasamy M, Deborah M. Complications of bariatric surgery: What the general surgeon needs to know. Surgeon. 2016; 14:91-98.
13. Agarwal N, Kavita S. Optimizing micro and macro nutrients: Navigating weight loss success and health risks in bariatric surgery for obesity management. Endocrinol Metab Clin North Am. 2025; 54:135-147.
14. Kumari A, Kaur D, Ranjan P, Malhotra A, Pandey S, Kumar A, Kaloiya G, Mohanty A, Ahuja N, Vikram NK. Efficacy of a lifestyle intervention for weight management in postpartum women: A randomised controlled trial at a tertiary care centre in India. Midwifery. 2025;143:104312.
15. Hendrie G, Baird D, James-Martin G, Brindal E, Brooker P. Weight loss patterns and outcomes over 12 months on a commercial weight management program (CSIRO Total Wellbeing Diet Online): large-community cohort evaluation study. J Med Internet Res. 2025; 27:e65122.
16. Wichansawakun S, Srikhajonjit W, Srichan C, Jutamat T. Efficacy of an online exercise program to improve weight management outcomes in individuals with obesity: A randomised trial. Clin Nutr ESPEN. 2025; 66:202-207.
17. Tan LJ, Sangah S. Impact of eating duration on weight management, sleeping quality, and psychological stress: A pilot study. J Nutr Biochem. 2025; 137:109835.
18. Peng W, Shi L, Huang Q, Li T, Jian W, Zhao L, Xu R, Liu T, Zhang B, Wang H, Tong L, Tang H, Wang Y. Metabolite profiles of distinct obesity phenotypes integrating impacts of altitude and their association with diet and metabolic disorders in Tibetans. Sci Total Environ. 2024; 949:174754.
19. Tschöp M, Morrison KM. Weight loss at high altitude. In: Hypoxia: from genes to the bedside (Roach RC, Wagner PD, Hackett PH, eds.). Springer US, Boston, MA, USA, 2001; pp. 237-247.
20. Westerterp-Plantenga MS, Westerterp KR, Rubbens M, Verwegen CR, Richelet JP, Gardette B. Appetite at "high altitude" [Operation Everest III (Comex-'97)]: a simulated ascent of Mount Everest. J Appl Physiol. 1999; 87:391-399.
21. Ge RL, Wood H, Yang HH, Liu YN, Wang XJ, Babb T. The body weight loss during acute exposure to high-altitude hypoxia in sea level residents. Acta Physiol Sin. 2010; 62:541-546.
22. Dünnwald T, Gatterer H, Faulhaber M, Arvandi M, Schobersberger W. Body composition and body weight changes at different altitude levels: a systematic review and meta-analysis. Front Physiol. 2019; 10:430.
23. Saarikko J, Axelin A, Huvinen E, Rahmani AM, Kolari T, Niela-Vilén H. Effectiveness of supporting lifestyle change in pregnant mothers with obesity through the wearable internet-of-things (SLIM)-intervention on self-efficacy in weight management in pregnant women: a quasi-experimental trial. Midwifery. 2025; 140:104235.
24. Camacho S, Ruppel A. Is the calorie concept a real solution to the obesity epidemic? Glob Health Action. 2017; 10:1289650.
25. Karaoglan M, Karaoglan M. The evolution of obesity and the origin of adipose tissue. Obes Med. 2024; 52:100561.
26. Jeffrey MF. On the causes of obesity and its treatment: The end of the beginning. Cell Metab. 2025; 37:570-577.
27. Lartey ST, Si L, Otahal P, de Graaff B, Boateng GO, Biritwum RB, Minicuci N, Kowal P, Magnussen CG, Palmer AJ. Annual transition probabilities of overweight and obesity in older adults: evidence from World Health Organization Study on global AGEing and adult health. Soc Sci Med. 2020; 247:112821.
28. Piccinini-Vallis H, Evdaev V, Asaminew J, McCurdy T, Rogers M, Vallis M. Obesity management in primary care: are we adequately preparing the next generation of Canadian family physicians? Obes Pillars. 2024; 12:100151.
29. Chieh C, Stojic S, Boehl G, Wong S, Lüscher J, Bertolo A, Itodo OA, Mueller G, Stoyanov J, Gemperli A, Perret C, Eriks-Hoogland I, Glisic M. Can lifestyle and behavioral interventions improve weight management in individuals with spinal cord injury? A systematic review and meta-analysis. Arch Phys Med Rehabil. 2025; 106:580-589.
30. Grannemann JJ, Roper A. Travelling to high altitude destinations after recovery from COVID-19-infection: new aspects of medical advice in altitude medicine. Pneumologie. 2021; 75:214-220.
31. Tsao TM, Hwang JS, Tsai MJ, Lin ST, Wu C, Su TC. Seasonal effects of high-altitude forest travel on cardiovascular function: an overlooked cardiovascular risk of forest activity. Int J Environ Res Public Health. 2021;

18:9472.
32. Kara T, Narkiewicz K, Somers VK. Chemoreflexes — physiology and clinical implications. Acta Physiol Scand. 2003; 177:377-384.
33. Baggish AL, Wolfel EE, Levine BD. Cardiovascular system. In: High altitude: human adaptation to hypoxia (Swenson ER, Bärtsch P, eds.). Springer New York, New York, US, 2014; pp. 103-139.
34. Hamad N, Travis SP. Weight loss at high altitude: pathophysiology and practical implications. Eur J Gastroenterol Hepatol. 2006; 18:5-10.
35. Burtscher M, Gatterer H, Burtscher J, Mairbäurl H. Extreme terrestrial environments: life in thermal stress and hypoxia. A narrative review. Front Physiol. 2018; 9:572.
36. Kayser B, Verges S. Hypoxia, energy balance and obesity: from pathophysiological mechanisms to new treatment strategies. Obes Rev. 2013; 14:579-592.
37. Quintero P, Milagro FI, Campión J, Martínez JA. Impact of oxygen availability on body weight management. Med Hypotheses. 2010; 74:901-907.
38. Zhou S, Dong H, Huang P, Li Y, Zhong Z, Xiao H, Xie J, Wu Y, Li P. Changes in body composition during acute exposure to high altitude is related to acute mountain sickness. Travel Med Infect Dis. 2025; 64:102815.
39. Madakam S, Ramaswamy R, Tripathi S. Internet of Things (IoT): a literature review. J Comput Commun. 2015; 3:164-173.
40. Rhmann W, Khan J, Khan GA, Ashraf Z, Pandey B, Khan MA, Ali A, Ishrat A, Alghamdi AA, Ahamad B, Shaik MK. Comparative study of IoT- and AI-based computing disease detection approaches. Data Sci Manag. 2025; 8:94-106.
41. Shafique K, Bilal KA, Sabir F, Qazi S, Mustaqim M. Internet of Things (IoT) for next-generation smart systems: a review of current challenges, future trends and prospects for emerging 5G-IoT scenarios. IEEE Access. 2020; 8:23022-23040.
42. Ferdowsy F, Rahi KSA, Jabiullah MI, Tarek HM. A machine learning approach for obesity risk prediction. Curr Res Behav Sci. 2021; 2:100053.
43. Safaei M, Sundararajan EA, Driss M, Boulila W, Shapi'i A. A systematic literature review on obesity: understanding the causes & consequences of obesity and reviewing various machine learning approaches used to predict obesity. Comput Biol Med. 2021; 136:104754.
44. Kar S, Mishra P, Wang KC. 5G-IoT architecture for next generation smart systems. IEEE 5G World Forum. 2021; 2021:241-246.
45. Chen M, Yang J, Hao Y, Mao S, Hwang K. A 5G cognitive system for healthcare. Big Data Cogn Comput. 2017; 1:2.
46. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J Clin Epidemiol. 2009; 62:e1-34.
47. Ritchie BW, Jiang Y. Risk, crisis and disaster management in hospitality and tourism: a comparative review. Int J Contemp Hosp Manag. 2021; 33:3465-3493.
48. DeGregory KW, Kuiper P, DeSilvio T, Pleuss JD, Miller R, Roginski JW, Fisher CB, Harness D, Viswanath S, Heymsfield SB, Dungan I, Thomas DM. A review of machine learning in obesity. Obes Rev. 2018; 19:668-685.
49. Chatterjee A, Gerdes MW, Martinez SG. Identification of risk factors associated with obesity and overweight: a machine learning overview. Sensors (Basel). 2020; 20:2734.
50. Sala M, Taylor A, Crochiere RJ, Zhang F, Forman EM. Application of machine learning to discover interactions predictive of dietary lapses. Appl Psychol Health Well Being. 2023; 15:1166-1181.
51. Greco F, Mallio CA. Artificial intelligence and abdominal adipose tissue analysis: a literature review. Quant Imaging Med Surg. 2021; 11:4461-4474.
52. Ayyaswami V, Subramanian J, Nickerson J, Erban S, Rosano N, McManus DD, Gerber BS, Faro JM. A clinician and electronic health record wearable device intervention to increase physical activity in patients with obesity: formative qualitative study. JMIR Form Res. 2024; 8:e56962.
53. Netzer NC, Chytra R, Küpper T. Low intense physical exercise in normobaric hypoxia leads to more weight loss in obese people than low intense physical exercise in normobaric sham hypoxia. Sleep Breath. 2008; 12:129-134.
54. Hackett PH, Rennie D, Grover RF, Reeves JT. Acute mountain sickness and the edemas of high altitude: a common pathogenesis? Respir Physiol. 1981; 46:383-390.
55. Ge RL, Chase PJ, Witkowski S, Wyrick BL, Stone JA, Levine BD, Babb TG. Obesity: associations with acute mountain sickness. Ann Intern Med. 2003; 139:253-257.
56. Caravedo MA, Mozo K, Morales ML, Smiley H, Stuart J, Tilley DH, Cabada MM. Risk factors for acute mountain sickness in travellers to Cusco, Peru: coca leaves, obesity and sex. J Travel Med. 2022; 29:taab102.
57. Gatterer H, Wille M, Faulhaber M, Lukaski H, Melmer A, Ebenbichler C, Burtscher M. Association between body water status and acute mountain sickness. PLoS One. 2013; 8:e73185.
58. Aqueveque P, Gutiérrez C, Rodríguez FS, Pino EJ, Morales AS, Wiechmann EP. Monitoring physiological variables of mining workers at high altitude. IEEE Trans Ind Appl. 2017; 53:2628-2634.
59. Wei CY, Chen PN, Lin SS, Huang TW, Sun LC, Tseng CW, Lin KF. Using machine learning to determine the correlation between physiological and environmental parameters and the induction of acute mountain sickness. BMC Bioinformatics. 2022; 22:628.
60. Woo Y, Choi J, Kim D. Effectiveness analysis of AI-IoT based public health care service for elderly in Korea. Arch Phys Med Rehabil. 2024; 105:e14.
61. Liang Y, Xiao R, Huang F, Lin Q, Guo J, Zeng W, Dong J. AI nutritionist: intelligent software as the next generation pioneer of precision nutrition. Comput Biol Med. 2024; 178:108711.
62. Rafael, Saha T, Moonla C, Ernesto, Joseph W. Ketone bodies detection: wearable and mobile sensors for personalized medicine and nutrition. Trends Analyt Chem. 2023; 159:116938.
63. Yadav R, Pradeepa P, Srinivasan S, Rajora CS, Rajalakshmi R. A novel healthcare framework for ambient assisted living using the internet of medical things (IOMT) and deep neural network. Meas Sens. 2024; 33:101111.
64. Alsareii SA, Raza M, Alamri AM, AlAsmari MY, Irfan M, Raza H, Awais M. Artificial intelligence and Internet of Things enabled intelligent framework for active and healthy living. Comput Mater Contin. 2023; 75:3833-3848.
65. Anikwe CV, Nweke HF, Ikegwu AC, Egwuonwu CA, Onu FU, Alo UR, Teh YW. Mobile and wearable sensors

for data-driven health monitoring system: state-of-the-art and future prospect. Expert Syst Appl. 2022; 202:117362.
66. Farrokhi A, Farahbakhsh R, Rezazadeh J, Minerva R. Application of Internet of Things and artificial intelligence for smart fitness: a survey. Comput Netw. 2021; 189:107859.
67. Li D. 5G and intelligence medicine: How the next generation of wireless technology will reconstruct healthcare? Precis Clin Med. 2019; 2:205-208.
68. Hossain MS, Muhammad G. Emotion-aware connected healthcare big data towards 5G. IEEE Internet Things J. 2018; 5:2399-2406.
69. Machorro-Cano I, Alor-Hernández G, Paredes-Valverde MA, Ramos-Deonati U, Sánchez-Cervantes JL, Rodríguez-Mazahua L. PISIoT: A machine learning and IoT-based smart health platform for overweight and obesity control. Appl Sci. 2019; 9:3037.
70. Mohanta B, Das P, Patnaik S. Healthcare 5.0: A paradigm shift in digital healthcare system using artificial intelligence, IoT 5G Comm. 2019; 2019:191-196.
71. Singh P. Gamified wearables in childhood obesity therapy driven by 5G wireless communication system with special emphasis on Pacific Island countries. In: 5G Wireless Communication Systems in Healthcare Informatics. CRC Press; 2023:113-132.
72. Venkatachalam K, Prabu P, Alluhaidan AS, Hubálovský S, Trojovský P. Deep belief neural network for 5G diabetes monitoring in big data on edge IoT. Mob Netw Appl. 2022; 27:106
73. Dong Y. Analysis of intelligent physical education teaching scheme based on 5G communication and VR technology. Mob Inf Syst. 2022; 2022:8598077.
74. Ahad A, Tahir M, Yau K-LA. 5G-based smart healthcare network: Architecture, taxonomy, challenges and future research directions. IEEE Access. 2019; 7:100747-100762.
75. Ahad A, Tahir M, Sheikh MA, Ahmed KI, Mughees A. An intelligent clustering-based routing protocol (CRP-GR) for 5G-based smart healthcare using game theory and reinforcement learning. Appl Sci. 2021; 11:9993.
76. Pradhan B, Das S, Roy DS, Routray S, Benedetto F, Jhaveri RH. An AI-assisted smart healthcare system using 5G communication. IEEE Access. 2023; 11:108339-108355.
77. Gupta N, Juneja PK, Sharma S, Garg U. Future aspect of 5G-IoT architecture in smart healthcare system. Int Conf Intell Comput Control Syst. 2021; 2021:406-411.
78. Devi DH, Duraisamy K, Armghan A, Alsharari M, Aliqab K, Sorathiya V, Das S, Rashid N. 5G technology in healthcare and wearable devices: A review. Sensors. 2023; 23:2519.
79. Rocha NP, Dias A, Santinha G, Rodrigues M, Queirós A, Rodrigues C. Smart cities and public health: A systematic review. Procedia Comput Sci. 2019; 164:516-523.
80. Rocha NP, Bastardo R, Pavao J, Santinha G, Rodrigues M, Rodrigues C, Queiros A, Dias A. Smart cities' applications to facilitate the mobility of older adults: A systematic review of the literature. Appl Sci. 2021; 11:6395.
81. Pacheco Rocha N, Dias A, Santinha G, Rodrigues M, Queirós A, Rodrigues C. Smart cities and healthcare: A systematic review. Technologies. 2019; 7:58.
82. Peralta-Ochoa AM, Chaca-Asmal PA, Guerrero-Vásquez LF, Ordoñez-Ordoñez JO, Coronel-González EJ. Smart healthcare applications over 5G networks: A systematic review. Appl Sci. 2023; 13:1469.
83. Ghavimi F, Chen HH. M2M communications in 3GPP LTE/LTE-A networks: Architectures, service requirements, challenges, and applications. IEEE Commun Surv Tutorials. 2014; 17:525-549.
84. Sodhro AH, Awad AI, Beek JV, Nikolakopoulos G. Intelligent authentication of 5G healthcare devices: A survey. Internet of Things. 2022; 20:100610.
85. Ahmed S, Subah Z, Ali MZA. Cryptographic data security for IoT healthcare in 5G and beyond networks. IEEE Sensor. 2022; 2022:1-4.
86. Gutwenger I, Hofer G, Gutwenger AK, Sandri M, Wiedermann CJ. Pilot study on the effects of a 2-week hiking vacation at moderate versus low altitude on plasma parameters of carbohydrate and lipid metabolism in patients with metabolic syndrome. BMC Res Notes. 2015; 8:103.
87. Lippl FJ, Neubauer S, Schipfer S, Lichter N, Tufman A, Otto B, Fischer R. Hypobaric hypoxia causes body weight reduction in obese subjects. Obesity. 2010; 18:675-681.
88. Marlatt KL, Greenway FL, Schwab JK, Ravussin E. Two weeks of moderate hypoxia improves glucose tolerance in individuals with type 2 diabetes. Int J Obes. 2020; 44:744-747.
89. Mackenzie R, Maxwell N, Castle P, Brickley G, Watt P. Acute hypoxia and exercise improve insulin sensitivity (S_I^{2*}) in individuals with type 2 diabetes. Diabetes Metab Res Rev. 2011; 27:94-101.
90. Kayser B, Verges S. Hypoxia, energy balance, and obesity: An update. Obes Rev. 2021; 22:e13192.
91. Telfer B, Reed H, Lacirignola J, Patel T, Siegel A, Swiston A, Singh N, Trebicka R, Weston C, Williamson J. Wearable Oxim for Harsh Env. 2017; 2017: 107-110.
92. Xinhuanet. Press conference on the theme of people's livelihood at the Third Session of the 14th National People's Congress. *https://www.cche.org.cn/portal/gzdt/xwtt/2025/3/97ab62ad2b18441fae9317fc6a58e9e8.htm* (accessed March 11, 2025).

Received April 7, 2025; Revised April 23, 2025; Accepted April 26, 2025.

Address correspondence to:
Wenli Zhang, School of Information Science and Technology, Beijing University of Technology, No. 100 Pingleyuan, Chaoyang District, Beijing, 100124, China.
E-mail: zhangwenli@bjut.edu.cn

Boyuan Wang, Beijing Xiaotangshan Hospital, No. 390, Yinjie North Road, Xiaotangshan Town, Changping District, Beijing, 102211, China.
E-mail: boyuanwang@fudan-zhuhai.org.cn

Released online in J-STAGE as advance publication April 29, 2025.