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THE ROLE OF SMART FITNESS DEVICES WITH AI IN OBESITY PREVENTION AND HEALTH MONITORING

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Abstract

Modern lifestyle, the abundance of high-calorie food, and the lack of physical activity have led to a global increase in obesity rates. In this context, the development of smart fitness equipment powered by artificial intelligence (AI) represents significant potential for enhancing physical activity, monitoring health parameters, and providing personalized guidance for weight loss and fitness improvement. This paper explores the functionalities and advantages of AI-equipped fitness devices, including physiological parameter monitoring, motion analysis through computer vision, detection of improper exercise execution, and automated adjustment of training plans. Special attention is given to the role of these technologies in obesity prevention among adults, as well as their potential for early detection of health risks. In addition to the literature review, the paper incorporates a practical case study conducted in Bijeljina, Bosnia and Herzegovina, where AI-integrated smart fitness equipment is already in use. This example illustrates the real-world implementation of such technologies and highlights their relevance for improving public health outcomes. Through a combined methodological approach, the paper examines actual and practical examples of successful applications of AI-powered fitness systems and discusses the challenges of their broader implementation within the context of public health.

Key words: *obesity, artificial intelligence, smart fitness equipment, personalized training, health monitoring.*

Introduction

This paper examines the broader context of obesity in modern society, highlighting the factors that contribute to its spread and negative impact on public health—a topic that has remained relevant in scientific research for several centuries. Special attention is given to lifestyle changes that reduce physical activity, as well as to the potential of modern technologies particularly AI-powered smart fitness equipment to provide innovative solutions for the prevention and control of obesity. Through the analysis of global trends, lifestyle habits, and technological opportunities, a foundation is established for further discussion on the role of AI in improving health. Additionally, the paper incorporates a real-world case study that illustrates the practical implementation of AI-powered fitness equipment in Bosnia and Herzegovina.

In line with the above, the aim of this paper is to examine how AI-powered smart fitness equipment can contribute to the prevention and control of obesity, particularly through personalized physical activity monitoring, automated workout adjustment, and motivational support. The focus is on analyzing how modern technologies can be integrated into everyday

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life to promote healthy habits and ensure the long-term sustainability of physical activity. Based on this, the paper poses the following research question: *How does AI-powered smart fitness equipment influence the improvement of physical activity, and can it serve as an effective tool in the prevention and control of obesity?* In addition to highlighting the benefits of AI-powered fitness technologies, this paper also provides a critical examination of their limitations, potential risks, and conflicting findings from existing research to ensure a balanced and scientifically grounded perspective.

The global problem of obesity

Obesity has become one of the most widespread health problems worldwide, with a continuous increase in prevalence across all age groups. Adolescent obesity, in particular, is recognized as a global problem, requiring urgent preventive strategies (Güzeloğlu et al., 2025). According to the World Health Organization (WHO) (Obesity and Overweight, 2025), the number of obese individuals has more than tripled since 1975, and obesity is increasingly present among children and adolescents. This issue carries not only physical consequences but also psychological and social ones, including stigmatization, depression, and reduced quality of life (Xinyue et al., 2024). Obesity is directly associated with a higher risk of chronic diseases such as type 2 diabetes, hypertension, cardiovascular diseases, and certain types of cancer (Putra et al., 2023). Recent studies also show a growing incidence of early-onset obesity-related cancers worldwide, including colorectal and kidney cancer (Terashima et al., 2025).

In Bosnia and Herzegovina, the situation mirrors global trends. According to public health reports, approximately 63% of the adult population is overweight, and 22% are classified as obese. Alarmingly, over 17.5% of children are affected by overweight or obesity, which significantly increases their risk of chronic diseases later in life. In the Federation of BiH, obesity is more prevalent among women (23.3%) than men (19.1%), while in Republika Srpska, the average BMI among adults is 26.2 kg/m², with a growing trend of childhood obesity. These statistics highlight the urgent need for effective prevention strategies tailored to the local context, including the integration of smart technologies and AI-driven health monitoring systems (Smjernice za prevenciju i tretman gojaznosti kod odraslih timova obiteljske/porodične medicine, 2025). Figure 1 illustrates the prevalence of overweight and obesity among adults, as well as combined overweight/obesity rates among children in Bosnia and Herzegovina.

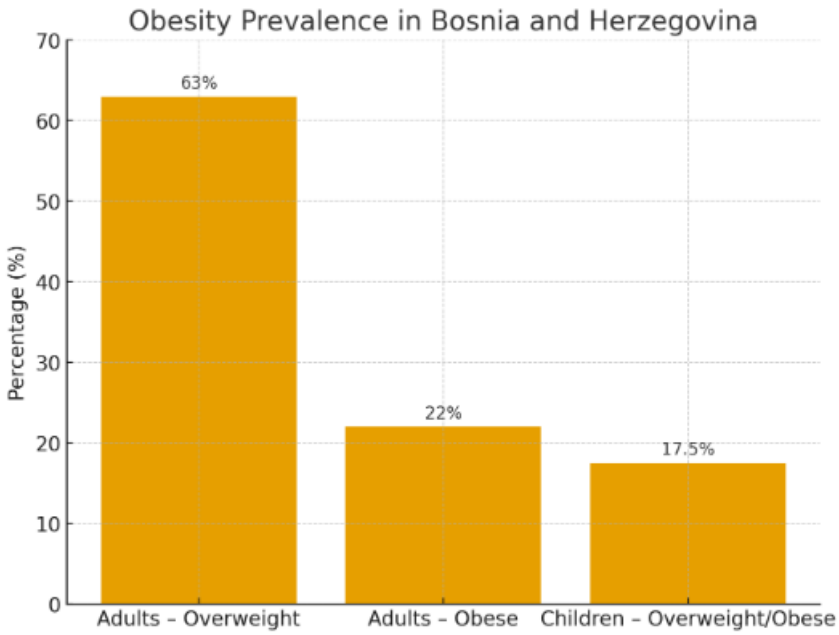

Figure 1. Obesity Prevalence in Bosnia and Herzegovina

The Impact of Modern Lifestyle

The modern lifestyle is characterized by a fast pace, prolonged sitting, reduced physical activity, and increased consumption of high-calorie, processed foods (Sirwan & Ribwar, 2025). Although technological advancements bring numerous benefits, they also often contribute to sedentary behavior remote work, digital entertainment, and the automation of daily tasks reduce the need for physical movement. In addition to physical activity, dietary habits play a significant role in obesity prevention, with research indicating potential risks associated with the use of dietary supplements (Svetlana, Nina, Nataša, and Jelena, 2024). At the same time, stress, lack of sleep, and irregular eating habits further deteriorate metabolic health. In such an environment, obesity prevention requires innovative approaches that can be seamlessly integrated into an individual's daily routine.

The Role of Technology in Health

Over the past decade, technology has become increasingly present in the field of health and wellness. Smartphones, wearable devices, and applications enable users to monitor their health parameters in real time. Of particular note are smart fitness devices that utilize artificial intelligence (AI) for data analysis, personalized training, and user motivation. AI allows for a deeper understanding of an individual's physical condition, automatic adjustment of exercises, detection of improper movement execution, and prediction of health risks. These technologies have the potential to become key tools in combating obesity, offering accessible, effective, and long-term solutions for improving health. Studies have shown that the use of wearable devices and AI applications can significantly contribute to increased physical activity and weight reduction (Han et al., 2021). Moreover, recent research emphasizes that AI-driven solutions are not only improving individual fitness but also transforming public health systems through predictive analytics, telemedicine, and personalized care strategies (Panahi, 2025).

Methodology of Literature Review

The literature review was conducted using a systematic approach that included multiple scientific databases and credible online sources. Searches were performed in Scopus, Web of Science, IEEE Xplore, PubMed, and Google Scholar, while additional relevant insights were obtained from reputable organizations and industry reports such as WHO, Fitt/Insider, GarageGymReviews, and government/public-health guidelines. The search covered the period 2018–2025, aligning with the publication years of the included studies. Key search terms were derived from the main concepts present in the collected literature, including: "AI-powered fitness equipment," "smart fitness devices," "computer vision exercise monitoring," "wearable technology," "obesity prevention," "AI in healthcare," "virtual fitness coach," "AI-driven obesity risk prediction," and "personalized training systems."

Smart Fitness Devices and AI: A Technological Overview

The development of smart fitness devices that integrate artificial intelligence (AI) represents a significant step toward the digitalization of health and the personalization of physical activity. These technologies enable users to monitor their health parameters in real time, receive feedback on exercise performance quality, and adjust workouts according to individual needs. The following section examines three key categories of smart devices and their role in obesity prevention.

Wearable Devices

Wearable devices, such as smartwatches, fitness bands, and biosensors, enable continuous monitoring of physiological parameters, including heart rate, oxygen levels, sleep quality, and calorie expenditure. By integrating AI algorithms, these devices not only collect data but also analyze it in real time, providing users with personalized recommendations for physical activity and nutrition (Alzghaibi, 2025). Studies indicate that AI enables early detection of health anomalies, such as arrhythmias, sleep disorders, and changes in blood glucose levels, thereby enhancing the effectiveness of chronic disease prevention (Dominic et al., 2024). Recent research also emphasizes the role of intelligent wearable devices combined with AI algorithms in optimizing fitness training, improving data collection, and enabling adaptive exercise programs (Wang et al., 2025). Wearable devices are particularly valuable in the context of obesity, as they motivate users to move more, track progress, and maintain consistency in healthy habits.

Smart Fitness Equipment

Smart fitness equipment, including exercise bikes, treadmills, rowing machines, and interactive mirrors, increasingly comes with built-in AI systems that analyze user movements, detect exercise errors, and automatically adjust workout intensity. This category of smart fitness equipment includes devices from brands such as Technogym, which offer AI-driven performance tracking and adaptive training. Similarly, smart bikes like Peloton provide virtual training sessions with instructors, while interactive mirrors like Tonal and Mirror use cameras and AI to correct form (O'Reilly, 2025). Such smart fitness equipment allows users to train at home with professional guidance, which is particularly valuable for individuals who avoid gyms due to embarrassment, time constraints, or health reasons. AI in these devices enables adaptive learning the system recognizes user progress and adjusts workouts according to their abilities and goals.

Integration with Mobile Applications and Cloud Services

Smart fitness devices and wearable gadgets increasingly operate in synergy with mobile applications and cloud services. This integration enables data storage, analysis through AI models, and synchronization with electronic health records. Through these applications, users receive personalized plans, reminders, progress notifications, and health improvement advice (Zachary, 2024). Cloud platforms allow healthcare professionals to monitor patient status in real time, which is particularly valuable in the context of chronic diseases and obesity prevention. Integration with applications such as Apple Health, Samsung Health, and Google Fit enables users to consolidate data from multiple devices, providing a comprehensive overview of their health.

AI Functionalities in Fitness Devices

Smart fitness devices with integrated artificial intelligence (AI) enable users to enhance physical activity through precise monitoring, analysis, and personalized training. AI technologies in these devices encompass sensor data processing, computer vision, machine learning, and adaptive algorithms that adjust according to the user's progress and individual needs. Contemporary approaches to analyzing data from smart fitness devices include fractal analysis and machine learning algorithms (XGBoost, SVM), which enable the detection of complex patterns in user behavior (Wang et al., 2024). These patterns are used not only for workout personalization but also for predicting long-term device usage and optimizing retail strategies. Recent studies highlight that AI-powered smart clothing extends these capabilities by embedding sensors into textiles, enabling continuous health monitoring and personalized fitness interventions beyond traditional wearable devices (Anurag and Kusum, 2025).

Monitoring of Physiological Parameters

Wearable devices, such as smartwatches and fitness bands, use sensors to continuously monitor physiological parameters including heart rate, calorie expenditure, blood oxygen levels, and sleep quality. AI enables real-time processing of this data, pattern recognition, and prediction of potential health risks (Chidambaram et al., 2022). For example, devices like the Apple Watch and the Oura Ring utilize AI to analyze sleep and physical activity data, providing users with personalized recommendations to improve health and prevent obesity. Recent advancements in flexible sensor technology further enhance the accuracy and comfort of physiological monitoring, enabling long-term, non-invasive health tracking (Pillalamarri et al., 2024).

Computer Vision and Movement Analysis

Computer vision enables AI systems to analyze user movements through video footage or sensor data. This technology is used for biomechanical analysis, form correction, and exercise performance optimization. Markerless systems, which do not require physical sensors on the body, are increasingly applied in rehabilitation and sports training. Modern algorithms can accurately track body position, calculate joint angles, and identify movement irregularities, thereby reducing injury risk and improving training efficiency (Colyer et al., 2018). In addition to wearable sensors, computer vision-based approaches using non-contact technologies have emerged as effective alternatives for monitoring vital signs during exercise, leveraging deep learning and image processing techniques (Khanal et al., 2022).

Detection of Improper Exercise Execution

AI systems use a combination of computer vision and machine learning to detect improper exercise execution. For example, applications utilizing OpenCV and MediaPipe can analyze body posture during exercise and provide real-time feedback on form errors (Ayush et al., 2025). This functionality is particularly useful for home workouts, where users do not have access to professional trainers. AI trainers can automatically count repetitions, monitor movement accuracy, and provide feedback that helps prevent injuries. Recent implementations, such as FitFusion, demonstrate how OpenCV-based pose estimation can effectively identify incorrect posture and deliver instant corrections, making AI-driven fitness assistants a cost-effective alternative to personal trainers (Pimenta et al., 2025).

Personalized Training and Adaptive Plans

One of the most important AI functionalities in fitness devices is the ability to create personalized and adaptive training plans. AI algorithms analyze data on the user's health, goals, progress, and preferences, adjusting exercise intensity, duration, and type accordingly. For instance, AI can detect when a user enters a plateau phase and automatically increase workout intensity or suggest alternative exercises. It can also analyze sleep and fatigue data to optimize training timing and prevent overtraining (Amarel, 2025). Recent implementations, such as AI-based fitness systems, demonstrate how machine learning models can dynamically generate individualized workout plans and adapt them in real time based on user performance and physiological feedback (Vishwajeet et al., 2025).

Role in Obesity Prevention

Smart fitness devices with artificial intelligence (AI) not only facilitate physical activity but also play a key role in obesity prevention through early risk detection, user motivation, and continuous progress monitoring. Their ability to analyze complex health data and provide personalized recommendations makes them a powerful tool in combating obesity.

Early Risk Warning

AI algorithms in wearable devices and smart fitness equipment can analyze physiological data such as heart rate, blood pressure, glucose levels, and waist circumference to identify early signs of metabolic syndrome. These systems use machine learning to detect patterns indicating an increased risk of type 2 diabetes, cardiovascular diseases, and obesity. For example, devices like Fibion Vitals combine sensors for respiration, temperature, and movement with AI analysis to provide users and healthcare professionals with early warnings about potential health issues before symptoms manifest (Tikkanen, 2025). Furthermore, recent research highlights that AI-driven models can predict obesity risk with high accuracy by integrating data from wearables, electronic health records, and lifestyle factors, enabling timely interventions and personalized management strategies (Huang et al., 2025).

Motivation through Gamification and AI Support

Gamification, supported by AI, represents an effective method for increasing user engagement. Through elements such as points, challenges, virtual rewards, and personalized goals, users are encouraged to exercise regularly and monitor their health. AI systems analyze user behavior and adapt motivational strategies according to emotional and physical states. Projects like the STOP Obesity Platform employ AI chatbots that offer nutrition and exercise advice, monitor users' emotional states, and provide support through interactive

communication, thereby increasing the likelihood of long-term lifestyle changes (AI-based platform offers personalised support to people with obesity, 2023). Gamification strategies have proven effective in increasing intrinsic motivation and reducing amotivation among university students engaged in physical activity, making them a valuable tool for promoting adherence to exercise programs (Sotos-Martinez et al., 2024).

Progress Tracking and Feedback

One of the most important AI functionalities in fitness devices is the ability to track user progress and provide real-time feedback. AI analyzes data on physical activity, sleep, recovery, and nutrition, offering recommendations for further training, form correction, and result optimization. For example, platforms like MyFitnessPal and Technogym, along with devices such as the Apple Watch and WHOOP, leverage AI to design personalized fitness plans, monitor progress, and adapt workouts according to user performance. This functionality helps users stay motivated, to control the state of fatigue of the body through the quality of sleep, avoid plateaus, and achieve better outcomes in weight management.

Case Study: Practical Application of AI Fitness Equipment in Bijeljina, Bosnia and Herzegovina

As part of this research, a visit was conducted to GS Premium Gym in Bijeljina, one of the most advanced fitness centers in Bosnia and Herzegovina, equipped with modern smart machines powered by artificial intelligence. In addition to Technogym equipment featuring motion-tracking sensors, automatic form correction, and adaptive load adjustment, the gym offers a fully integrated digital ecosystem. Members utilize smart wristbands for locker access and activity tracking, while a dedicated mobile application enables membership management, workout scheduling, and real-time progress monitoring. The application also provides personalized meal plans tailored to individual goals and health data.

As illustrated in Figure 2, AI-integrated machines allow detailed analysis of exercise execution, detect movement irregularities, and generate personalized training parameters. Figure 3 presents the Technogym app interface for monitoring heart rate zones and workout intensity. Figure 4 shows a smart check-up station that measures body composition (fat percentage, muscle mass, water content), joint mobility, balance, and cognitive abilities.

This practical example demonstrates that AI-driven fitness systems, combined with wearable technology and mobile applications, create a comprehensive health-monitoring ecosystem, offering a promising solution for obesity prevention and the improvement of public health.

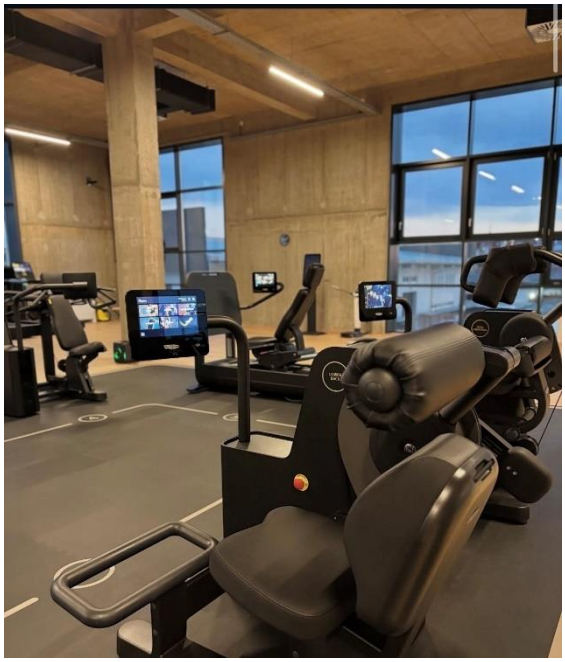

Figure 2. AI-Integrated Smart Fitness Equipment – Technogym, Bijeljina

Figure 3. Technogym app interface for monitoring heart rate zones and workout intensity

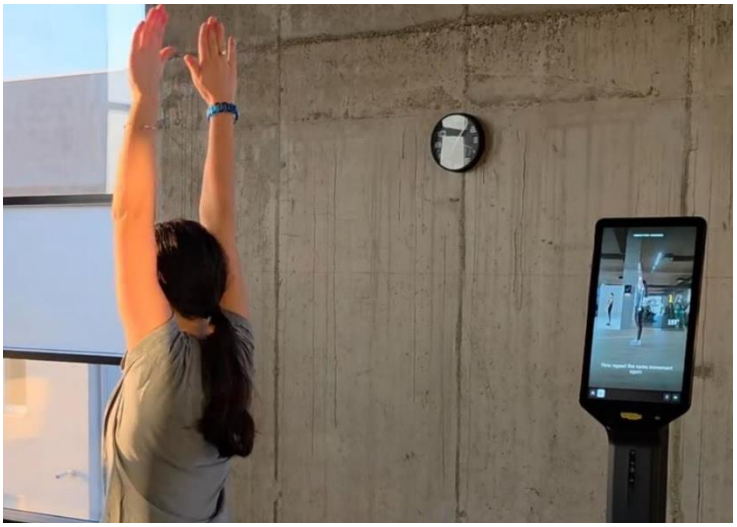

Figure 4. Smart check-up station measuring body composition (fat percentage, muscle mass, water content), joint mobility, balance, and cognitive abilities.

Challenges and Limitations

Although smart fitness devices with AI provide significant advantages in obesity prevention and health monitoring, their broader adoption is accompanied by several challenges. Key concerns include data privacy, technology accessibility, and the ethical reliability of AI-driven recommendations. Addressing these issues is essential to ensure both user safety and effective implementation.

Data Privacy

One of the most pressing challenges is the protection of personal data. Smart devices gather highly sensitive information including physiological parameters, location, habits, and even emotional states. Without adequate safeguards, this data is vulnerable to misuse, breaches, or unauthorized access (John et al., 2016). Research published in the Journal of Medical Internet Research indicates that users are often unaware of the scope of information they share with applications or how it is processed. Stronger transparency measures and stricter regulatory frameworks are therefore required to protect user privacy.

Technology Accessibility

Despite their advanced functionalities, AI fitness devices remain inaccessible to many. High purchase costs, reliance on stable internet connections, and limited digital literacy represent significant barriers, particularly in rural and socioeconomically disadvantaged communities (Mazur, 2025). Studies highlight a widening digital divide between populations with access to smart technologies and those without. This disparity risks reinforcing health inequalities, underscoring the need for more affordable solutions and educational initiatives to support broader adoption.

Ethics and Reliability of AI Recommendations

AI-based fitness systems generate recommendations through algorithms that are not always transparent. This raises critical questions of accountability who is responsible if an AI-generated recommendation results in injury, health deterioration, or incorrect advice?

Moreover, algorithmic bias may occur if models are trained on incomplete or unrepresentative datasets (Stojanovic et al., 2024).

Conclusion

Smart fitness devices integrated with artificial intelligence (AI) represent an important advancement in modern strategies for improving physical activity and preventing obesity. Their ability to monitor physiological parameters, analyze movements, personalize training, control the sleep quality, monitor eating habits, and motivate users makes them a powerful tool in modern approaches to a healthy lifestyle. However, the broader adoption of these technologies demands careful consideration of key challenges, including data privacy, accessibility, ethical responsibility, and the reliability of AI-generated recommendations. By combining wearable sensors, smart fitness equipment, and mobile applications, users can obtain a comprehensive overview of their health and receive tailored support in achieving long-term goals. Nevertheless, to ensure equitable access and sustainable impact, further development in this field requires more affordable devices, stronger data protection frameworks, AI models trained on diverse populations, and robust regulatory standards. Integrating AI-powered fitness systems into public health strategies has the potential to significantly increase physical activity at the population level, reduce healthcare costs, and improve overall quality of life. Educational initiatives and subsidized programs could help bridge the digital divide and enable wider adoption of these technologies. This paper contributes to both academic and practical understanding by providing a balanced evaluation of the benefits, risks, and real-world applications of AI in fitness and obesity prevention. Practical implications of this research highlight that AI-driven fitness systems can enhance public health programs, support personalized obesity management, and improve early risk detection through continuous monitoring. However, the study faces limitations related to the high cost of devices, uneven digital literacy, and the lack of long-term empirical evidence regarding the actual effectiveness of these technologies. Future research should therefore include randomized clinical trials, long-term user adherence studies, and analyses of effectiveness across different age groups and socio-economic categories. Additional attention should be given to developing accessible, ethical, and medically reliable AI models that can be systematically integrated into national health systems. Strengthening interdisciplinary collaboration between healthcare professionals, technology developers, and policymakers will be essential for ensuring that AI-powered fitness technologies achieve their full public health potential.

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ULOGA PAMETNIH FITNESS UREĐAJA SA VJEŠTAČKOM INTELIGENCIJOM U PREVENCIJI GOJAZNOSTI I PRAĆENJU ZDRAVLJA

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Apstrakt

Savremeni stil života, obilje visokokaloričnе hrane i nedostatak fizičke aktivnosti doveli su do globalnog porasta stope gojaznosti. U tom kontekstu, razvoj pametne fitness opreme zasnovane na vještačkoj inteligenciji (AI) predstavlja značajan potencijal za unapređenje fizičke aktivnosti, praćenje zdravstvenih parametara i pružanje personalizovanih smjernica za mršavljenje i poboljšanje fizičke kondicije. Ovaj rad istražuje funkcionalnosti i prednosti fitness uređaja opremljenih AI tehnologijama, uključujući praćenje fizioloških parametara, analizu pokreta putem računarskog vida, detekciju nepravilnog izvođenja vježbi i automatsko prilagođavanje trening planova. Posebna pažnja posvećena je ulozi ovih tehnologija u prevenciji gojaznosti kod odraslih, kao i njihovom potencijalu za rano otkrivanje zdravstvenih rizika. Pored pregleda literature, rad uključuje i praktičnu studiju slučaja sprovedenu u Bijeljini, Bosna i Hercegovina, gdje se već koristi pametna fitness oprema integrirana s AI tehnologijama. Ovaj primjer ilustruje stvarnu primjenu takvih rješenja i naglašava njihov značaj za unapređenje javnog zdravlja. Kombinovanom metodološkom analizom, rad razmatra stvarne i praktične primjere uspješne primjene AI zasnovanih fitness sistema te diskutuje izazove njihove šire implementacije u kontekstu javnog zdravlja.

Ključne riječi: *gojaznost, vještačka inteligencija, pametni fitness uređaji, personalizovani trening, praćenje zdravlja.*

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