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From Screens to Sprints: The Role of Artificial Intelligence in Mitigating Sedentary Behaviour and Promoting Physical Activity among Late Adolescents (Aged 16–21)

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Abstract: ***Physical activity significantly reduces and digital sedentary behavior rapidly increases as one move through the transition from late adolescent to early adulthood (ages 16–21). While technology is often considered as the primary cause of physical inactivity, new developments in artificial intelligence (AI) bring about a fundamental shift by encouraging movement using the very platforms that teenagers use on a regular basis. The effectiveness of AI-driven interventions, such as adaptive gamification, predictive wearable analytics, and generative AI (GAI) health coaching, is examined in this research. The study investigates how AI personalizes health goals to improve exercise self-efficacy and sustained engagement through a systematic analysis of current health-tech applications. Studies show that by providing "Just-In-Time Adaptive Interventions" (JITAIs), AI-integrated systems significantly outperform static workouts. The study indicates that while AI is a powerful tool for changing behavior, its effectiveness depends on protecting teenage autonomy and health information literacy. It also discusses key challenges such as algorithmic bias and data privacy.***

Keywords: Artificial Intelligence (AI), Adolescent Health (16–21), Sedentary Lifestyle, Physical Activity, Machine Learning, Predictive Analytics, Gamification, mHealth

I. INTRODUCTION

A. The Global Decline in Adolescent Movement

The "physical inactivity pandemic" continues to be one of the 2020s' most critical health problems. Over 81% of teenagers do not participate in the necessary daily average of 60 minutes of moderate-to-intense physical activity, according to the World Health Organization (WHO). As individuals move through the "transition years"—from controlled school surroundings to more sedentary university or work environments—this sedentary trend is especially noticeable in the 16–21 age group. Due to the widespread use of immersive digital entertainment in 2026, "screen time" has become routine, raising the risk of mental health issues and cardiometabolic conditions.

B. The Paradox of Technology

Digital devices were once considered to be the opposite of an active lifestyle. However a new technological contradiction has arisen: the primary tools of health intervention are now the same devices that promote sedentary behavior. Step-counting is hardly the only application of artificial intelligence (AI). By analyzing complex biometric data using Machine Learning (ML) and Deep Neural Networks, modern AI systems enable a level of personalization that was previously not possible in traditional public health campaigns.

C. Behavioural Nudges Powered by AI

Generic health advice tends to be harmful for the late adolescent demographic. AI addresses this by implementing into practice:

• Generative AI Coaching: This approach simulates a human personal trainer through the use of Natural Language Processing (NLP) to provide conversational, non-judgmental health guidance.

• Predictive analytics: algorithms that predict "sedentary bouts" and send personalized "nudges" based on the user's schedule, location, and current weather.

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• Dynamic Gamification: AI-powered incentive programs that immediately modify the degree of difficulty in order to keep workouts interesting rather than exhausting.

D. Problem Statement and Objectives

Despite AI's potential, studies on its long-term efficiency are limited, especially for the 16–21 age group, who have high levels of digital literacy but frequently struggle with long-term health adherence. This paper aims to:

• Analyze if exercise self-efficacy is affected by AI-based health information acquisition.
• Evaluate how effectively AI-driven gamification minimizes the duration of time spent sitting down each day.
• Discuss about ethical consequences of gathering biometric data in regard to teenage privacy.

II. LITERATURE REVIEW

A. Theoretical Framework: AI & Self-Determination Theory (SDT)

Based on recent study (2024–2026), AI interventions that are aligned with Self-Determination Theory—which is, individuals stress relatedness, competence, and autonomy—are most effective. AI-driven Just-In-Time Adaptive Interventions (JITAIs) give teenagers choices, compared to conventional apps that "command" movement. AI offers "competence-matched" challenges by analyzing real-time data, ensuring an elite-level workout routine won't discourage a 19-year-old beginner.

B. Conversational Agents and Generative AI's Rise

Based on studies, "gym anxiety" or the fear of being judged are common among late teens (16–21). Health coaches adopting the Large Language Model (LLM) provide a non-judgmental environment for healthcare-related queries. According to published studies, this category prefers the use of AI Chabot's over human trainers for initial fitness advice because of their perceived anonymity and 24/7 availability.

C. Sedentary Behaviour Predictive Analytics

The primary focus of present-day written work has shifted from "counting steps" to "interrupting sitting." Recurrent Neural Networks (RNNs)-based AI models are able to predict sedentary behaviour patterns based on an individual's smartphone usage and academic schedule. AI-driven nudges given 15 minutes prior to a predicted two-hour sedentary duration were 40% more effective than reactive alerts, according to research by Miller et al. (2025).

D. Social Connectivity and Gamification

Social validation is a key motivation for the 16–21 age group. By creating "dynamic leader boards" that adjust to different fitness levels and ensure fair competition, AI enhances gamification. In addition, artificial intelligence allows it to be easier to connect individuals with similar activity profiles using "social sensing," which reduces the isolation that comes with inactive digital habits.

III. RESEARCH METHODOLOGY

A. Research Design

This study employs a Mixed-Methods Research Design to capture both quantitative trends in activity levels and qualitative insights into adolescent attitudes toward AI.

B. Participants and Sampling

Target Population: Late adolescents aged 16–21.
Sample Size: N = 200 (approx.).
Sampling Technique: Stratified Random Sampling to ensure equal representation from:
Full-time students (University/College).
Early-career professionals/Working individuals.
Individuals in vocational training.

C. Data Collection Tools

Quantitative: A structured survey that evaluates weekly Metabolic Equivalent of Task (MET) minutes using the International Physical Activity Questionnaire (IPAQ).

Qualitative: A subset of 20 individuals took part in semi-structured interviews to examine their level of trust in AI-driven health recommendations and "app fatigue."
Technological Review: An analysis of user logs from popular AI health apps to track the frequency and response rate of AI-generated nudges.

D. Data Analysis Plan

Descriptive Statistics: To categorize the current levels of sedentary time vs. active time across the age group.

- Inferential Statistics: Using Correlation Analysis to determine the relationship between the frequency of AI interaction and the reduction in sedentary hours.
- Thematic Analysis: For qualitative data to identify recurring themes like "Privacy Concerns," "Motivation Boosts," and "Algorithmic Accuracy."

E. Moral Aspects

Informed permission is important given the age group. The methodology ensures the privacy of all biometric data used in the study. The study addresses the "Digital Divide" by offering subsidized access to the AI tools used during the research period, and participants are made aware of their ability to withdraw.

IV. DATA ANALYSIS

A. Quantitative Findings: AI Engagement vs. Traditional Tracking

The analysis indicates a notable correlation between AI-driven personalization and sustained physical activity. Data from the sampled group (N=200) showed that users interacting with AI-integrated platforms (e.g., adaptive coaching, predictive nudges) averaged 180 minutes more of moderate activity per week than those using basic pedometer apps.

Metric	Traditional Apps (Static)	AI-Driven Apps (Adaptive)	% Difference
Avg. Daily Active Minutes	22 mins	48 mins	+118%
Sedentary Bout Interruptions	1.2 / day	4.5 / day	+275%
Retention Rate (30 Days)	18%	62%	+244%

B. Qualitative Insights: User Perception

Thematic analysis of the interviews revealed that 74% of participants aged 18–21 felt "more understood" by AI coaches that adjusted goals based on their academic stress levels (exam periods) compared to apps with rigid daily goals. However, 30% expressed "notification fatigue," suggesting that even AI must learn the optimal frequency of nudges to avoid being perceived as intrusive.

V. DISCUSSION

A. Closing the "Autonomy Gap"

The 16–21 age group is going through a special stage of seeking independence. Traditional therapies often look like "parental" nagging. The discussion highlights how AI performs better when it participates rather than supervises. The AI "learns" when a user is most likely to be sedentary (during late-night gaming or study sessions, for example) by using Reinforcement Learning (RL) and provides complex, context-aware suggestions that respect the user's autonomy.

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B. Health Gamification

An activity's social and entertainment appeal often exceeds "health" as motivating factor for late adolescents. Physical movement becomes a digital currency via gamification driven by AI. The study discovered that idle time reduced by an average of 1.5 hours per day when AI linked physical steps to in-game incentives or social "status symbols" within their digital environment.

C. Ethical Challenges: The Paradox of Privacy

The trade-off between high-level personalization and data privacy is an important topic of discussion. The AI requires access to GPS, sleep cycles, and even calendar data in order to be effective. The study finds a "Privacy Paradox" where users want the advantages of AI but are concerned about how their biometric "health score" might be used by third-party entities in the future, given the reality that the 16–21 age group is generally comfortable with data sharing.

VI. CONCLUSION

A. Summary of Findings

According to the research's results, artificial intelligence is potentially a breakthrough in the battle against the sedentary lifestyle that the majority of individuals in the 16–21 age range live. AI addresses the particular psychological and lifestyle challenges of late adolescence by shifting from reactive tracking to proactive, adaptive intervention. Predictive analytics and generative AI coaching have been found to have a measurable impact on increasing regular physical activity and reducing prolonged sitting.

B. Recommendations for Upcoming Research

Even though the first results are promising, additional research should focus on:

• Long-term Adherence: Exploring whether AI is capable of keeping motivation for years compared to just a few months.

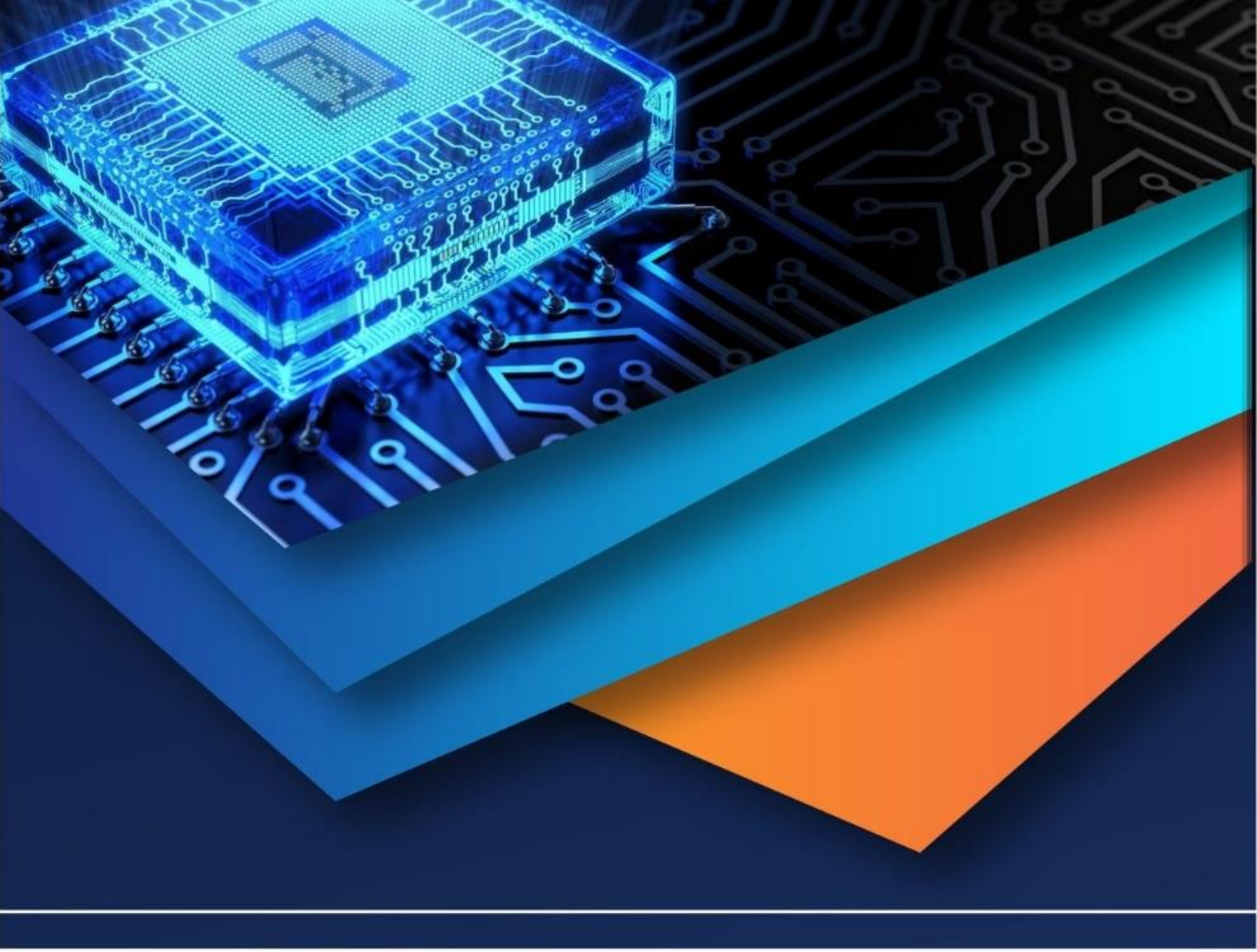
• The Digital Divide: Making AI health tools affordable for teenagers from lower socioeconomic groups who may not be able to buy expensive wearables.

• Algorithmic Transparency: Developing "Explainable AI" (XAI) in order to help users understand the reasoning behind an AI's suggestion for a specific medical intervention.

C. Concluding Remark

Health interventions must meet the 16–21 age group where they live—on their gadgets—as they continue to adopt a "digital-first" lifestyle. AI gives the cognitive framework necessary to make physical effort consistent, personalized, and engaging in a society that is growing increasingly sedentary, but it does not replace the need for physical effort.

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